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Global Property Rights in Genetic Resources:
Do They Involve Sound Economics?
Will They Conserve Nature and Biodiversity?

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Clem Tisdell[2]

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ABSTRACT

In recent years, growing economic globalisation has been accompanied by rising social support for market systems as a means of managing resource-use. In turn, the free market movement considers definite and secure property rights (especially private rights and, sometimes, communal rights) in resources to be the necessary basis for a desirable market system. Global policies for managing the Earth's genetic resources have been influenced by this approach. As outlined in this article, there has been a global expansion of property rights in genetic resources, and further extensions have been advocated. In order to assess the possible social benefits and costs of granting property rights in genetic resources, these are classified. This classification is shown to be useful in discussing economic and legal reasons for granting or denying property rights in genetic resources. Furthermore, this classification is demonstrated to be pertinent to the consideration of market failures that may accompany the granting of property rights in genetic resources and which limit the potential social economic benefits from establishing property rights in these resources. It is concluded that many of those who advocate the management of genetic resources by means of secure property rights and market systems have been overly optimistic about the economic potential of this policy, its social benefits, its impact on the conservation of biodiversity, and its workability. There is a need for more informed debate on these matters before concluding that wholesale global extension of property rights in genetic material is desirable. In addition to the above, this paper compares and assesses the approach on property rights in wildlife and nature adopted in the Convention on International Trade in Endangered Species (CITES) with that advocated in the international Convention on Biological Diversity.

Global Property Rights in Genetic Resources: Do They Involve Sound Economics? Will They Conserve Nature and Biodiversity?

1. Introduction

Liberal economic philosophy, involving the use of market systems and private property rights, has come to dominate thinking about economic policy globally. As a result, there has been growing support for the global creation of (or recognition of) private property rights and communal property rights in genetic resources (Bhat, 1999; Swanson, 1997) and for these resources to be managed by market operations rather than by government regulation, or for this policy to be adopted in some cases as an alternative to global open-access to genetic resources. Advocates of this policy foresee several advantages for it compared to alternative policies. They consider that this approach is likely to be more effective than its alternatives in conserving genetic resources, will be more efficient in the utilization of such resources, and that it will strongly encourage 'improvements' in the genetic resource base, for example, the development of new plant varieties and new breeds of livestock. In addition, some argue that this approach will promote distributive justice by ensuring that a larger share of the economic returns or rents from the use of genetic resources flows to the guardians or the developers of these resources.

The matter is, however, quite complex. There is a danger that such policies may be 'oversold'. In several circumstances, because of inescapable market failures, such policies can prove to be less supportive of the conservation of biodiversity and less efficient in managing genetic resources than is claimed by their supporters. Furthermore, in some instances, their fairness is open to question (cf. Jugale, 2005). The purpose of this essay is to provide an assessment of these matters.

This is done by first noting some changes in the nature of international policies governing economic rights in genetic resources and considering how these can be related to a classification of natural assets. Then a variety of reasons for favouring private or communal property rights in genetic resources are outlined and these are compared with reasons sometimes given in support of intellectual property rights,

such as those rights granted by the issue of patents. The next section of this essay explores how market failures can undermine the rationale given for favouring property rights in genetic material and the marketing of this material. The penultimate section contrasts the policy approach taken to markets and property rights in CITES with that favoured in the Convention on Biological Diversity.

2. Global Development in Legal Rights in Genetic Material

Globally there is now much greater legal recognition of property rights in genetic resources than in the middle of the 20th century. Developments that have extended property rights in genetic material include the UPOV (Union international pour la Protection des Obtentions Vegetales) Convention. In English, this is the International Convention for the Protection of New Plant Varieties. This convention came into effect in 1961 and provides international legal property rights in new plant varieties (involving 'improved' genetic material) to plant breeders who develop these varieties and register these with the relevant authorities. These rights are recognised by nations that are signatories to the UPOV Convention. The UPOV Convention was revised in 1972, 1978 and 1991. Its objective is to protect those who develop new varieties of plants by granting international intellectual property rights in these. The 1991 revision of the UPOV Convention allows for the granting of patent rights in new plant varieties. Jugale (2005) argues that this is very unfavourable to less developed countries.

Originally, the granting of property rights in new plant varieties was rejected by developing nations. They felt that it was economically unjust to them because germplasm was often taken free of charge from developing countries, 'improved' in more developed countries to produce more desirable varieties of plants, and these in turn were liable to be sold back to developing countries at high prices and without recognising the benefit obtained by the developer as a result of using the original germplasm from developing countries.

"In 1986 this controversy resulted in the adoption of the International Undertaking on Plant Genetic Resources (IUPGR) in which the developing world agreed to recognise the legitimacy of the concept of plant breeders' rights in return for the creation of a

reciprocal concept termed ‘Farmer’s Rights’…These are rights granted in recognition of the contributions of farmers toward the conservation of genetic resources for use in the plant breeding and seed industries generally” (Swanson, 1997, p.102). While this has been internationally agreed to in principle, and the possibility has been aired of a body such as the FAO collecting funds for farmers and distributing these to relevant nations and for these nations to allocate these in turn to their relevant farmers, this agreement has not yet been implemented (Swanson, 1997, p.102). With the legal recognition international property rights in genetically modified organisms (GMOs), developing countries have expressed additional concerns about lack of payment to them for the rents obtained from genetically modified crops, such as GM soya beans (Xue et al., 2004). GMOs have been given international patent protection but in many cases, the organisms that have been genetically modified have their origins in developing countries.

Jugale (2005) outlines legislation that has been passed in India to protect farmers’ rights in genetic material. He argues that the UPOV Convention is unfavourable to less developed countries and is concerned about the Trade Related Intellectual Property Rights (TRIPs) agreement which requires all WTO members to legislate to protect new plant varieties.

In no jurisdictions are property rights granted in naturally occurring organisms. Currently, exclusive marketing rights are only granted when “it is demonstrated that human intervention has produced an organism that was not previously existing in nature” (Swanson, 1997, p.103). However, the Convention on Biological Diversity which came into effect in the 1990s opens the way for the granting of property rights in naturally occurring genetic resources. Swanson (1997, p.105) has argued strongly in favour of the granting of property rights in naturally occurring genetic material. He believes that bias in the legal system has undermined the conservation of natural genetic stocks. He states: “In essence, the legal system has contrived to treat the informational products of nature as ‘open access’. And thus the only appropriable genetic information is that which results from human intervention. Again, such a bias actively discourages any investment in the maintenance of the stocks of natural genetic capital, instead of encouraging the development of capital stocks that are compatible with the international property rights structure” (Swanson, 1997, p.105).

Swanson (1997) also maintains that property rights regimes and greater international trade in wildlife and their products (the products of natural genetic material) are likely to be more supportive of wildlife conservation than restrictions on such trade. The latter approach has been adopted in the Convention on International Trade in Endangered Species (CITES) as a measure to conserve endangered species. Swanson's attitude seems to have been influenced by his joint study of bans on trade in ivory (Barbier et al., 1990). The Convention on Biological Diversity, in contrast and to some extent in conflict with CITES, appears to be supportive of the type of approach recommended by Swanson (1997). However, as Tisdell (2006) points out, Swanson's preferred approach is only likely to be effective in conserving some wildlife species. Globally, many economically valued species (for example, those only with high non-use economic values) are likely to disappear if such an approach is adopted unless they are conserved in protected areas. Unfortunately, due to market failures (missing markets or partial markets), private and communal property rights regimes combined with marketing of genetic materials and natural products often do not result in a socially optimal outcome nor the best attainable one.

3. Classification of Genetic Material and Related Property Rights

The development of private and communal property rights in genetic resources are in a state of flux. In general, property rights have only been firmly assigned to legal entities able to show that they have developed organisms that do not occur in nature. Furthermore, such rights have been agreed on internationally in principle for farmers who have communally or otherwise over long periods of time evolved organisms that would not have evolved without their intervention or which would not have survived without their intervention. Nevertheless, a similar mechanism to provide compensation for use of genetic material has not been considered for hunters and gatherers who may also have, in a somewhat similar manner, conserved or even to a limited extent developed genetic material. In principle, the Convention on Biological Diversity makes such rights and compensation possible.

Nations are increasingly claiming global property rights in indigenous genetic material. These rights cannot be enforced retrospectively, but could be enforced in

relation to future global use of indigenous genetic material not previously known to be useful and which are still contained within a country's borders.

Retrospective enforcement by a government of property rights in indigenous genetic material that has already been distributed internationally as a result of previous open access does not appear to be a practical nor a legal possibility. Most nations now have obtained, as a result of open access, genetic material from many other nations without payment for using the genetic resources involved. For example, soya beans were introduced to the USA from Asia and maize was introduced from the Americas to most other countries of the world, including India. Similarly, the potato. The list of such introductions is in fact very long. To give an Australian example, the macadamia nut *Macadamia intergrifolia* is a native of southern Queensland and northern New South Wales. Although it is now cultivated in Australia, cultivation in Australia did not begin until 1963. Cultivation first commenced in the United States in Hawaii in the early 1900s using seed exported from Australia (Low, 1991, p. 92). No payment was made for access to this Australian genetic resource. The potential commercial value of the resource would have still been uncertain in the early 1900s. Furthermore, Australia has probably obtained reverse economic benefits from the development of macadamia nuts as a cultivated crop in Hawaii.

In order to envisage the type of property rights that have been or could be granted in genetic resources, it is useful to classify genetic resources in a systematic manner. This is done in Figure 1. As a first approximation, genetic resources or assets may be divided into those that produce organisms that occur naturally (Set A) and those that produce organisms that have not evolved naturally but are the product of human intervention in natural processes (Set B). The latter (Set B) can be further subdivided into organisms that have evolved, often by co-evolution and communal activities, as a result of efforts of several generations of human beings. Designate this as set C. Farmers' rights are being sought for genetic material in this set, C. In practice, it may be difficult to decide whether some organisms belong to set A or C. For example, the genetic composition of some wild species is altered by human activities. Set D covers new organisms that have been produced in modern times by legal entities manipulating or selecting genetic material to produce organisms that previously did not exist. A legal entity is able to obtain legal rights in such genetic material via plant

variety rights or patents, for example, for GMOs, depending on the nature of the genetic change.

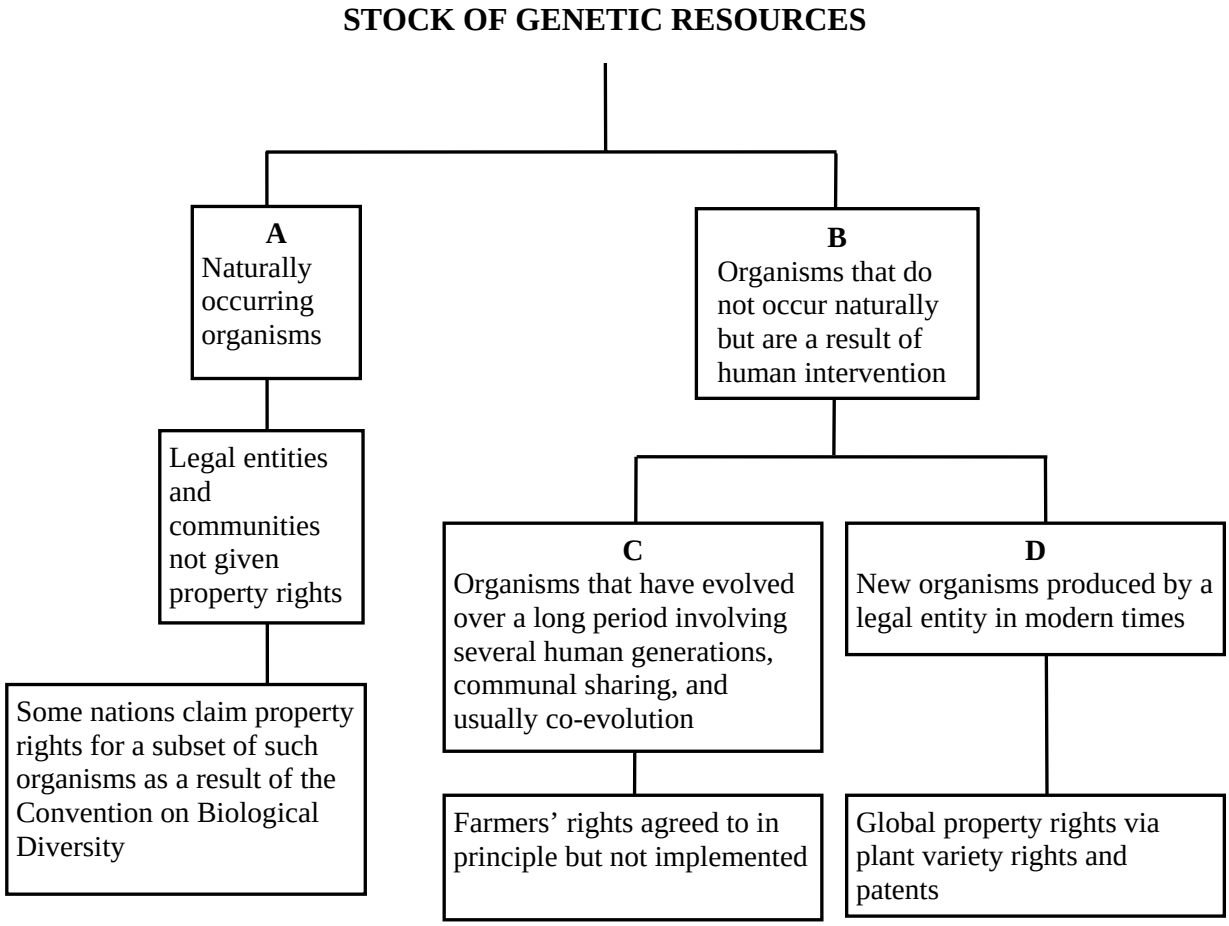

Figure 1 A classification of the stock of genetic resources and associated legal regimes of property rights in genetic resources.

Currently, global property rights in genetic material are biased in favour of set D. Higher income nations have the lead in developing this material. Farmers' rights have not yet been supported effectively. Legal entities or social groups have not yet been granted international legal rights in the genetic material contained in natural organisms but several nations now claim such rights, an outcome supported by the Convention on Biological Diversity. Thus, current property rights in genetic material are patchy and show bias in favour of Set D in Figure 1. It is, therefore, useful to consider why this bias may exist and to consider the reasons often given to justify property rights in genetic resources.

4. Reasons for Granting or Denying Property Rights in Genetic Resources

Legal views about the granting of property rights in genetic resources appear to have been strongly influenced by earlier practices in relation to intellectual property, particularly patents. Patents provide the patentee with a legal monopoly in a new invention for several years.

A variety of arguments have been advanced in favour of patent systems (Tisdell, 1972, Ch. 20). These include the following: (1) these systems provide an economic incentive for advances in applied intellectual knowledge and hence promote economic growth; and (2) they provide a reward for effort in research and development. In the opinion of some, this is just, and the granting of property rights in genetic material in category D in Figure 1 satisfies these considerations. Nevertheless, the economic benefit from greater technical or scientific progress as a result of the patent system has to be weighed against the social economic deadweight loss resulting from the grant of a monopoly in the invention for a specified period (Tisdell, 1972, Ch. 20). This means that greater technical or scientific progress does not in itself provide sufficient justification for patent systems, and in particular, for granting patents for GMOs (Tisdell and Wilson, 2004).

The main rationale for giving entities property rights in genetic stock in category C appears to be not so much that it will lead to further advances in intellectual knowledge but that it would reward **past** efforts and may encourage the conservation of this genetic material. However, this raises the question of for how long such property rights should be granted. If they are granted in perpetuity, this would differ from the practice adopted in relation to the granting of property rights in genetic material in category D. These rights are only granted for a finite period of time. In any case, much of the conservation and development of genetic resources in category C would have been undertaken by local people and communities for their own benefit. Past actions in this regard would not have been motivated by the possibility of obtaining outside rewards from these activities. Any such reward would, therefore, be an unanticipated economic bonus.

In relation to the granting of property rights to local communities or to national governments for genetic material in category A, an acceptable reason cannot be that it

is an economic reward for the effort of adding to intellectual capital. A possible rationale, however, is that it is an economic reward or incentive for conserving natural capital (compare Swanson, 1997). However, in many cases, payments arising as a result of such rights would constitute a rent because some (or much of) the pool of natural genetic resources in category A may be conserved incidentally rather than deliberately. In addition, it should be noted that the original endowment of genetic resources in a geographical area is not controlled by human beings but is due to chance or the original creation of these.

It is always difficult to get agreement on the choice of actions that are just. However, the free transfer of genetic material in categories A and C could be justified on the lines of one of Talmudic principles of a social improvement, namely that the free transfer results in a Paretian improvement, that is the transfer makes at least one or more of the parties better off without reducing the benefits of any. This principle is well discussed and illustrated by Ohrenstein (2007) taking an example involving house rent from the Talmudic literature. Cases undoubtedly exist where the free transfer of genetic material has not deprived the party from which it is taken of any pre-existing benefits from use of this material but has provided economic benefits to the recipients which they otherwise would not have. This implies that a Paretian gain occurs. In addition, it is possible that those who obtain the genetic material free of charge ‘improve’ the material or conserve a species (organism) which would become extinct in its place of origin. This may result in reciprocal economic benefits to those who originally possessed the genetic material. While this may not occur in every case, a Paretian improvement is very likely to occur in many cases. Talmudic principles indicate that in such cases, compensation need not be paid.

The argument for free exchange of genetic material in categories A and C may be further reinforced if the Kaldor-Hicks principle (the potential Paretian improvement) criterion is applied. First, the lack of payment for genetic transfer in categories A and C will eliminate transaction costs. This is an advantage because they involve non-productive expenditure. Secondly, the extension in use of the genetic resources will widen the economic benefits obtained. Thirdly, to **some** extent, any gains and losses of individual nations from genetic transfers tend to cancel out. For example, although the Americas gained from the introduction of soya beans from East Asia, East Asia

gained from the introduction of maize from the Americas. Similarly, India has had many economic benefits from genetic material introduced from the Americas, for example, potatoes and chillies and no payments have been made for these transfers.

It is clear that different economic reasons need to be advanced to support the granting of property rights in different types of genetic resources and that the granting of property rights in all genetic resources is difficult to justify ethically. Given the degree of support globally for property rights regimes and the use of markets, the question needs to be asked of how effective this approach is likely to be in conserving biodiversity and to what extent the possible economic benefits of this approach are likely to be limited by market failures. Let us consider this matter.

5. Market Failures and Transaction Costs Restrict Social Benefits from Property Rights in Genetic Resources

The potential for using patent systems and property rights in genetic resources to provide social benefits is limited by several types of market failure. The effective operation of such systems rely on those who are granted property rights being able to appropriate a significant proportion of economic benefits from the genetic resources involved. The ability of holders of property rights in genetic material to appropriate economic benefit is likely to be greatest when use value constitutes a high proportion of the total economic value of such material, that is, when private goods are mainly produced by such material. Conversely, other things equal, the higher is non-use value as a proportion of the total economic value of genetic material, the less is the ability of economic entities to appropriate economic benefits from it. In such cases, a high public good element is present. Thus, the property rights method in genetic material is likely to favour the conservation of genetic resources producing private goods in comparison to goods with high public good component. The concepts of total value of use value and non-use value are outlined and discussed in Tisdell (2005, pp.110-113) and useful examples are given in Ninan (2007, Ch.7)

Secondly, the granting of property rights in genetic material usually takes no account of any externalities generated. For example, the granting of patent rights in a GMO or property rights in a new plant variety depends merely on whether the GMO or new

plant variety constitutes a novel organism. The body granting such rights does not take account of any externalities that might be generated by its use. It is usually the function of other public bodies to take account of possible adverse environmental externalities from new organisms and limit their use if necessary. Fears exist that such screening processes may prove to be inadequate and could result in new organisms being used which yield high private economic returns to business but generate significant adverse environmental externalities. For example, one such concern is that genetically engineered herbicide-resistant crops will give rise to herbicide-resistant weeds (Tisdell and Wilson, 2003).

Market transactions and legal proceedings usually involve costs and these can be quite high in the case of property rights in genetic material (Swanson and Göschl, 2000). Transaction costs limit the scope for economically using market and legal systems for determining economic activity, and this applies to their use for using and developing genetic resources. For example, the transaction costs involved in ensuring Farmers' Rights might be so high that little economic benefit is received by farmers entitled to such rights (see Tisdell, 2005, Ch.5). Individual farmers and groups of farmers may not be able to afford the upfront costs that need to be incurred to enforce their legal property rights in genetic material. Enforcement involves social costs. First search is needed to detect if rights have been breached. These monitoring costs can be considerable. Secondly, evidence must be collected to support any claim of a breach. This further adds to cost. Then negotiations may begin with the party or parties accused of not respecting property rights. Again, this involves an economic cost and the outcome is uncertain. If negotiations fail, then the step of commencing Court action may be taken. Once again, this can be costly and the outcome uncertain. The situation is further complicated by free-riding problems and the costs of organizing collective action (Tisdell, 1996, Ch.8). This is because some of the potential beneficiaries from legal action may not contribute to its cost. They may, however, indirectly obtain an economic benefit if a plaintiff obtains a favourable judgment. This is because the judgment provides a precedent for others in a similar situation to the plaintiff. The possibility of class legal actions reduces the above mentioned problem to some extent but not entirely.

Another possibility is for governments to act on behalf of their farmers and other citizens (at least internationally) to enforce property rights in genetic material that otherwise would be unlikely to be enforced. The question then arises in these cases of whether payment for the use of the genetic material should be by intergovernment transfer. In any case, this approach is likely to involve significant costs for public administration. As a result, all or most of the sum available for transfer may be spent on the public service. Little if any of the funds may find their way to those who have helped conserve the genetic resources involved. Consequently, little equitable purpose would be served by the scheme. Furthermore, such schemes may turnout to be wealth-reducing rather than wealth-creating.

Where property rights in the use of genetic material can be enforced, this creates a monopoly. As a result, monopoly pricing is likely to occur. This results in human wants being less fully satisfied than is possible with the available resources. In other words, it is a source of Paretian economic inefficiency (Tisdell and Hartley, 2008, Ch.8). A special case is, therefore, required to justify this monopoly pricing from an economic point of view. For example, it is possible that the rate of technological progress and innovation may be stimulated by a temporary monopoly and this could make for lower economic scarcity in the future (Tisdell and Hartley, 2008, Chs. 8 and 9). In the type of situation being considered here, it may be that monopoly pricing is required to provide sufficient incentive to conserve the relevant genetic material. However, there are likely to be cases where this material would be conserved at a price lower than the monopoly price for its use. In such circumstances, charging a monopoly price would not be justifiable from an economic point of view.

Furthermore, the transaction costs involved in marketing genetic material and protecting private property rights in it favours very large corporations because economies of scale occur in transaction costs. Small firms are liable to be at a disadvantage in enforcing their property rights in genetic material. Therefore, a property right system for genetic material is likely to be relatively more beneficial to big business compared to small firms, including farmers.

Also it is possible that a system of property rights in genetic material may reduce biodiversity. For example, genetic items in category D involve additions to the genetic stock, that is, they involve the creation of new organisms. However, if these are

commercially successful organisms, they are liable to replace or displace existing organisms. Thus, the composition of the genetic stock alters. Both natural genetic diversity and existing genetic diversity due to human intervention could conceivably be reduced. There is a risk that commercially successful new organisms, such as some GMOs, could reduce rather than add to biodiversity. This is the fear of some conservationists, many of whom in turn are worried that this reduction in biodiversity might threaten economic sustainability.

Even in cases where genetic property rights do not legally exist, for example, for wildlife, some economists, for instance Swanson (1997), and conservation groups (IUCN-UNEP-WWF, 1991) advocate the granting of property rights to local communities or individuals in harvested wildlife and want greater international trade in this wildlife and its products. They favour the concept of conservation of wildlife by means of sustainable use. If such a strategy is successful, it will also conserve the genetic material inherent in this wildlife. Tisdell (2006) argues that while such an approach can be effective in conserving some species, it will fail to do so for many species, even when they have high economic value if this value is principally a result of a high non-use value. Non-use values involve attributes that are characteristic of pure public goods. Once again, the property rights approach, when combined with market guidance, is shown to be subject to shortcomings as a conservation measure.

In addition, even when private property rights are established in a wildlife species which has use value, this may not be favourable to the conservation of biodiversity generally as is pointed out in Tisdell (2004a). For example, when landholders are granted rights in wild species for hunting purposes, they sometimes kill species that prey on game in which they have property rights. They may also alter landscapes to favour their game to the disadvantage of other wild species. In other words, the landholder has an incentive to engage in activities which favour the conservation of a game species if it is profitable to do so, and these activities can involve the destruction of other species.

Furthermore, there is not always public support for use of species as a conservation measure. Tisdell et al. (2007) found from a survey in Australia that most members of the public surveyed were opposed to the use, particularly the commercial use, of endangered species as a measure intended to support their conservation.

6. The Effectiveness for Biodiversity Conservation of the Policies Followed in CITES and Those Favoured by the Convention on Biological Diversity

CITES and the Convention on Biological Diversity adopt different types of economic policies in their attempts to conserve biodiversity. The former restricts international trade in endangered species as a policy for conserving them. Trade restrictions make it less profitable to harvest the species. The latter convention seeks to encourage the use and commercial use of species in the expectation that it will become economically worthwhile for individuals to use them. This in turn it is believed, will provide economic incentives to groups and individuals to conserve their stock. It can be shown that in some cases, CITES policy can be an effective conservation measure, in other cases the types of policies favoured by the Convention on Biological Diversity are effective and there are still other situations in which neither set of polices is effective in conserving biodiversity.

CITES policies can be effective in helping to conserve species to which there is open access either legally or in practice. CITES polices reduce the size of the market for endangered harvested wildlife. This makes it less profitable to harvest the species concerned and in normal circumstances reduces harvesting pressure on the species. In turn, this should lead to an increase in their population. This assumes that the standard economic theory of the exploitation of open-access resources applies as is, for example, outlined in Tisdell (2005, Ch. 6; 2009, Ch. 4). It should also be noted that these are species that have use value.

This policy is ineffective in saving species that have no or little economic use value (but considerable non-use values) which may become endangered by habitat loss due to its transformation by human activity, for example, conversion of their natural habitat to farm land. It is also ineffective in cases where species become endangered due to human beings out competing them for the use of resources that are vital to the continuing existence of the species. Note that species that have a low or zero economic use value may have a high non-use value and therefore, a high total economic value. Even when individuals have property rights in such species, they have no economic incentive to conserve them because they cannot obtain a payment for the non-use value of the species concerned.

There is also a problem with the CITES policy approach when farming and/or ranching of a wildlife species can result in its conservation. Bans and restrictions on international trade proved to be an economic impediment to the development of the farming of saltwater crocodiles (*Crocodylus porosus*) which were once listed as endangered. Due to improved conservation management, the development of the farming of such crocodiles combined with payments to landholders for crocodile eggs and juveniles collected from their properties in the Northern Territory of Australia, the population of saltwater crocodiles have increased substantially in Australia (particularly in the Northern Territory) and the species is no longer endangered (Webb and Manolis, 1989).

The development of the farming of sea turtles has been hampered due to restrictions on international trade imposed by CITES. For example, the development of the closed-cycle farming of green turtles (*Chelonia mydas*) in the Cayman Islands was hampered by restrictions of CITES on international trade in green turtles and products derived from them. Similarly, the development of the farming of hawksbill turtles (*Eretmochelys imbricata*) faces impediments and extra economic difficulties due to restrictions by CITES on international trade in these species and products derived from them (Tisdell et al., 2007). Difficulties in social management of the conservation of the above mentioned species have arisen because they have simultaneously been subject to open-access harvesting and attempts to develop ranching and farming possibilities potentially supportive of their conservation.

The policy approach favoured in the Convention on Biological Diversity is much more supportive of efforts to conserve species by farming them or by ranching them effectively. The latter involves collecting eggs or juveniles from the wild and rearing them in captivity. This can increase survival rates and if combined with a payment to landholders where the eggs or juveniles are collected, can provide an economic incentive to landholders to conserve the species. However, the payment has to be high enough to provide sufficient economic incentive for landholders to adopt conservation measures actively. It can also provide some compensation to landholders for tolerating the relevant species if the species protected by law and are a pest to landholders (see for example, Tisdell et al., 2005).

In the case of species that have sufficient use or market value and in which property rights can be effectively enforced, the commercial use approach favoured by the Convention on Biological Diversity has merit. For example, if the value of products derived from the African elephant, such as ivory, hides and meat, is high enough, governments in Africa will find it economically worthwhile to conserve elephants in their reserves and protected areas. The funds received from the sales of such products enables governments to police and manage these areas in order to profit from the elephants and other wildlife there. This will result in more effective conservation of the African elephant as was pointed out by Swanson (1997) and the incidental conservation of other species.

Nevertheless, the effectiveness for biodiversity conservation of the approach advocated in the Convention on Biological Diversity depends on the possibility of economically establishing property rights in the species concerned. These rights may be private property rights, common-property rights or state rights. However, the approach will not be effective as a conservation measure if open access to the species occurs. Unfortunately, it is not always possible politically or economically to create property rights of the type just mentioned.

There are also species that cannot be profitably conserved even if property rights are established in these. Both CITES and the Convention on Biological Diversity do not address these cases. The conservation of these species can only be assured by collective or state action. This may involve for example the establishment of national parks and protected areas.

Therefore, it is apparent that the conservation of biodiversity calls for a mixture of public policies. Both market related policies and non-market policies are called for and the circumstances of individual cases need to be evaluated. At the same time, we should not lose sight of the fact that the greatest threat to the conservation of biodiversity is continuing economic growth driven by the desire for high levels of per capita income combined with rising levels of human population on a global scale.

7. Concluding Comments

The new global policy approach favouring the granting of private, communal, or in some cases, national property rights in genetic resources is not likely to be as effective a policy for promoting conservation of biodiversity, overcoming failures in genetic resource use, and promoting sustainable economic growth, as its strongest advocates claim. Furthermore, this approach is limited in its capacity to ensure a just distribution of economic benefits from the conservation and development of genetic resources.

It is important to be aware of such limitations because they have institutional implications. The main implication is that it is dangerous to entrust the conservation and development of genetic resources solely to the private sector. It is necessary for the public sector to play a significant role in the stewardship of genetic resources and the development of these resources. The exact role that the public sector should play needs investigation. A step towards this (as has been done here) is to demonstrate that the private sector cannot be expected to husband and develop genetic resources in an ideal manner because it is bound to exhibit predictable economic biases and shortcomings.

Both the conservation policies of CITES and those favoured by the Convention on Biological Diversity relate to organisms (or their products) that are or can be marketed. CITES seeks to conserve genetic material by restricting the use of markets for endangered wildlife and the product derived from them. On the other hand, the Convention on Biological Diversity favours the creation of markets as a means for conserving genetic material. But not all valued genetic material can be marketed. Hence neither of these approaches provides a complete answer to conserving the desired stock of biodiversity (see Tisdell, 2004b). Additional non-market mechanisms, such as the United Nations' Global Environmental Facility are needed. Furthermore, human beings need to moderate their economic demands on the biosphere if further substantial losses in biodiversity are to be avoided. These losses include biodiversity loss from rapid global warming. As is well known, this is a consequence of rising concentrations of greenhouse gases in the atmosphere (such as CO_2) which is attributable to the type of economic growth that has been experienced since the Industrial Revolution. Many policies for fine tuning biodiversity

conservation risk being swamped by biodiversity losses due to global economic growth.

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