Environment and Development Economics 4 (1999): 203–236

Policy Forum

Introduction: Biodiversity conservation: the problem of scale

Brian Walker is an ecologist with a difference. He understands that the most important ecology is the ecology of managed ecosystems, and that of all interacting species in managed ecosystems, the most important is *homo sapiens*. In the paper that is the focus of this policy forum he has offered a vision of the problem of biodiversity conservation that strikes a chord with the economists who have been asked to comment on it. The driving forces behind biodiversity loss are interpreted in terms of perverse economic incentives, property rights and policy failures. This clearly rings true for economists who have worked on the biodiversity problem. But the paper goes beyond this. It addresses an aspect of the problem that economists have not yet confronted: the scale at which conservation efforts should be co-ordinated. More particularly, it addresses the disconnection between the appropriate ecological scale of biodiversity conservation and the institutions responsible for that conservation.

The Convention on Biological Diversity rests on the principle of sovereignty over natural resources. It ensures that the biodiversity conservation strategies are determined first and foremost at the national level on the basis of national priorities, and the national research effort. The global public good aspects of biodiversity loss are supposedly addressed by the Global Environment Facility. But what happens when the appropriate scale of conservation activities that yield primarily local benefits extends beyond the nation state? This is the case with wildlife conservation in south-central Africa, the problem that originally motivated Walker's proposal. The framework provided by the Convention on Biological Diversity and the Global Environment Facility are not well adapted to deal with such a case.

Walker's specific proposal addresses one aspect of this problem: research infrastructure. He proposes the establishment of regional biodiversity research institutes to complement the work of the CGIAR institutes, but also to provide a means of co-ordinating national biodiversity conservation activities. The reactions to this proposal identify four sets of questions that are raised by the proposal. The first three cover familiar ground, and are explored by the economists invited to comment on the proposal: Barnes, Opschoor and Pearce. They are:

1 What resource access rights will encourage the socially rational use of wildlife resources?

https://doi.org/10.1017/S1355770X99240156 Published online by Cambridge University Press

2 Which market distortions (including perverse subsidies) encourage inappropriate use of wildlife resources, and how may they be corrected?
3 Is there any biodiversity conservation strategy that can survive the threat posed by population-growth-induced demand for land?

The fourth question addresses the specific proposal.

4 What is the appropriate scale at which to determine research priorities, and what is the appropriate relation between conservation science and conservation practice?

This last is not a question in which economists have a comparative advantage and they are relatively quiet on the topic. But they should be interested in the responses of at least two of the scientists invited to comment. Gadgil and Western both argue against Walker's proposal, and in favour of what Gadgil calls a 'bottom-up' approach and what Western calls a 'community' approach. While Western also argues strongly for incentives for communities to collaborate where appropriate he, like Gadgil, believes that the appropriate starting point for research is the landowner or landuser.

There is a sense in which this approach meshes well with the traditional economic solution to the externality problem—correcting the incentives to resource users—but it surely misses one of Walker's central points. In environmental terms, the European debate on the subsidiarity principle and the level of governance is about matching institutions to the spatial and temporal scale of environmental problems. In many cases the conservation of biodiversity is a problem that cannot be addressed at the local level or even the national level. It requires an institutional structure at a different scale. Walker has identified one dimension of this: research infrastructure. But although his point holds for other institutions as well, and although it has significant implications for the biodiversity work of organisations like the World Bank, the forum shows that there is some way to go before the point is generally accepted.

Charles Perrings
Editor

Maximising net benefits through biodiversity as a primary land use

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ABSTRACT. In many developing regions of the world conventional agriculture is failing to meet the needs of people and at the same time is becoming progressively less ecologi-

https://doi.org/10.1017/S1355770X99240156 Published online by Cambridge University Press

cally sustainable. It is proposed that in a number of these regions, both overall economic development and the welfare of the inhabitants would improve if the primary form of land use was based on multiple use of those regions' natural biological resources, rather than continuing the practice of replacing or displacing them with marginal forms of agriculture. Testing this proposition, and then (if appropriate) effecting it, requires answers to a number of ecological, economic and management questions, in particular to do with:
identifying those regions where biodiversity use has high potential
the appropriate spatial scales for planning and management
compatible combinations of different types of resource use
ecological and economic trade-offs between different resource use enterprises
how to arrive at the most efficient form of resource use
sustainable levels of biodiversity harvest
resource use decisions in relation to ecological drivers (such as climate and fire)
institutional and regulatory structures that dictate current resource use.

These questions, it is proposed, should form the basis of an international 'virtual' institute, composed of three Biodiversity Centres, one each in Latin America, southern Africa and Southeast Asia. Examples of multiple use, such as of wildlife in southern Africa, are used to illustrate the potential, and the management scale and other issues involved. If the development of this form of land use is to succeed, it will require technical and management advice and, in many cases, removal of 'perverse incentives' that prevent a change to the more economically and ecologically sustainable form of land use. From the beginning, the emphasis in the proposed centres would be on collaborative work involving governments, landowners and resource-based industries.

I thank Nick Abel, John Ive and Mike Young for their comments on an initial draft of the paper. Also Rusty Pritchard for his comments on the dynamics of social and economic systems in response to changes in institutional structures. I wish to express my appreciation to Prof H.H. Shugart and the Dept of Environmental Sciences at the University of Virginia, who hosted me for the period during which this paper was written.

1. Introduction

In much of the tropical and sub-tropical developing world, conventional agriculture is failing to meet the expectations and needs of the people who depend on it (see, for example, reports of the International Food Research Institute, IFPRI 1995). Most temperate regions, on the other hand, with more fertile younger soils and relatively simple ecosystems, though not without their problems, have in the main seen very successful agricultural development. There is, of course, successful agriculture in the tropics and there are examples of improved local economies with an improving natural resource base—some of the rice regions in SE Asia, some irrigated cropping systems (cotton, sugar cane, pastures) and some of the multiple use agro-forestry schemes. But there are also many examples of resource decline and low production, particularly in the humid tropical rainforest and in the semi-arid savanna regions. It is worth noting that most of the successful tropical agriculture is in areas with recent (usually volcanic) soil (Higgions *et al*. 1982).

The basic proposition of this paper is that in many developing regions (and in some developed regions) both overall economic development and the welfare of the inhabitants would improve if the primary form of land use was based on multiple use of the region's natural biological resources,

rather than continuing the practice of replacing or displacing them with marginal forms of conventional (modern) agriculture. In addition, conservation of biodiversity would also be improved. To pre-empt any semantic distractions, 'biodiversity' is here taken to include all the species and the genetic variation within them. Multiple use, as used in this paper, involves simultaneous use of resources on the same site, sequential use of resources on the same site, and different uses on different sites, as in a mosaic.

This is not a novel idea, and a number of recent publications (e.g., McNeely, 1988; Pearce and Moran, 1994; Groombridge, 1992) provide compelling economic and ecological arguments in favour of sustainable use of biodiversity as the preferred form of resource use for many parts of the world. The reason it has not been more widely adopted is ascribed very clearly to 'perverse incentives' (McNeely, 1988), that is, to being made relatively uncompetitive through the use of tax breaks, subsidies, price controls and distorted property rights (Pearce and Moran, 1994). The underlying reason for many of these perverse incentives is to ensure that control of the resources is retained by those in charge, so that they can more easily appropriate the profits. Where the political economy of a country promotes appropriation of benefits by large companies (often involving the government), single commodity harvests or monoculture production of crops on a large scale is preferred because it is easier to control.

Scale of operation is another reason why use of biodiversity may not succeed when it is actually a more sustainably profitable form of land use. As an illustration, the 20 projects described in the 1996 report of the Biodiversity Conservation Network (Anon, 1996) are all encouraging in some respects but in all cases their continued viability is under threat. This is largely because these sorts of biodiversity related projects (the main objectives of which quite clearly include biodiversity conservation) often tend to be small-scale village operations in a region of depressed, subsistence agriculture. In some cases they are stacked against large-organisation, government-sponsored, profit-driven ventures, regarded by the biodiversity project proponents as 'the enemy'. (The *vice-versa* view also exists, of course.)

The problem is compounded by the fact that poor people do not have the means to grow or buy enough food to live healthy and productive lives. Resolving the problems and lifting the economic status will in most cases require a radical change in resource use philosophy. In higher rainfall regions it relates to forest use. In drier, marginal agricultural regions it is concerned with changes to current practices of cropping and livestock production. This proposal concentrates mainly on the latter, but it applies equally well to the forested regions.

Although sustainable increased net benefits on the basis of biodiversity as a primary land use may well be the most economically and socially desirable form of resource use in many regions, making it happen will require some initial assistance. In particular, it requires answers to the following questions which, I propose, should form the basis for an international research effort:

In which regions of the world is multiple use of biodiversity likely to be the most efficient form of resource use?
Within those regions, what are the appropriate, or requisite, scales at which resource use and planning should be conducted?
Which combinations of resource use, in which proportions, and in which spatial patterns, are compatible with long-term persistence of biodiversity?
What is the form of the trade-offs, in terms of the regional goals for ecological, economic and social sustainability, between the different resource use enterprises?
How does a society arrive at the most efficient form of resource use?
What levels of biodiversity harvest are sustainable?
How do ecological drivers of ecosystem dynamics (climate sequences, fire) influence the resource use decisions for maximising net economic benefits over time?
What are the international, national and local institutional structures and regulatory frameworks that dictate current resource use, and how will use change in response to changes in these structures?

If this set of questions can be answered for a few regions in the world, in different continents, they would provide the basis for an upturn in sustainable resource use. There is already a considerable body of knowledge about particular aspects of the questions and there are many current projects and activities that are relevant to the issues involved. What is lacking is the inclusion of all aspects in one integrated analysis, involving a comparison between regions. A strongly focused research program aimed at these questions, involving ecologists, agricultural scientists, resource economists and sociologists, *and* the landholders and other stakeholders in the regions concerned, would be a cost effective investment in third world development. It needs to have continuity to remain effective in extending the application of the developing technology. For that reason it calls for some sort of institutional framework, and a proposal for that is suggested in the last section of this paper.

Although the focus of this proposition is the developing world tropics, problems with agricultural development in semi-arid regions are not confined to the developing world. However, a solution to the problem is more tractable in the developed world since changes can be made in the context of a relatively healthy economy and satisfactory standard of living. In the developing world there is the additional requirement of first having to raise standards of living in order to achieve a long-term solution, and whatever replaces the existing forms of land use must be capable of doing that (i.e. raise the general standard of living).

Third world marginal agricultural problems are difficult enough to resolve with their present population levels and environmental conditions. Scenarios of future changes suggest that they will become more difficult as the human population doubles within the next 50 years and climate change effects become increasingly significant (Walker *et al*., forthcoming). Future global change forecasts highlight a major discrepancy between the developed and the developing world in terms of the demands for food and the impacts of climate and land use change. Despite much variation, and

acknowledging current limitations in understanding, the net effects of climate change on northern temperate agriculture are likely to be positive, whereas for tropical agriculture they are likely to be negative.

In summary, agricultural land use in much of the developing world is less than satisfactory and the associated on- and off-site costs are high. The pressures on these marginal areas will be increasing as global change intensifies, exacerbating the present problems, and will coincide with massive reductions in native vegetation and biodiversity in general. All this at a time when ecosystems will need maximum resilience to cope with the effects of climate change compounded by human population growth.

Rather than promoting and assisting further agricultural development in these regions, development and aid agencies would do better by promoting the wise use of biodiversity, at regional scales.

2. A model for regional scale use of biodiversity

There are numerous regions in Africa, South America and Asia where the evidence suggests that multiple use of native biota would be the most efficient and profitable form of land use. Examples include the arid savannas of southern Africa (such as those used in the Multispecies Project of the WWF in Zimbabwe), a number of the project areas in the Biodiversity Conservation Network, mentioned earlier, and the Alternatives to Slash-and-Burn project of ICRAF (International Centre for Research into Agroforestry) in Indonesia (van Noordwijk *et al*., 1995). A brief summary of the southern Africa example follows, as an illustration of the sort of development that is occurring.

Over much of northern South Africa, Botswana, southeastern Zimbabwe and adjacent Mocambique, Namibia and southern Zambia extensive livestock production (both commercial ranches and subsistence agriculture) is the predominant form of land use, together with irregular, marginal dryland crop production. Until recently there has been a relatively small safari hunting industry and some attempts made at game farming in Zimbabwe and South Africa. Small but significant areas of irrigated commercial crop production occur within the region. Although most of the proceeds from the irrigation areas go outside the region, they are important for employment. Most people are at subsistence level, eking out a living.

The 1992–1994 drought in southeastern Zimbabwe resulted in the death of most of the domestic livestock in the region, and there was no dryland crop production during this period. Most of the wildlife survived, in the National Parks and on game and cattle ranches.

There has recently been a very significant change towards utilising the wildlife as the main form of land use. Many of the previous large, commercial cattle ranches have removed the remaining cattle and the internal fences, and enclosed themselves in joint wildlife 'conservancies'. They now make their living from multiple use of biodiversity—safari hunting, game cropping and sale of meat, hides and eco-tourism. This has led to a secondary industry of wood carving and other curios. Some village heads from neighbouring subsistence farming areas have started negotiations with some of the conservancies to have their areas included in the wildlife

conservancies, seeing this as a better proposition for making a living than their current low-level agricultural base. These developments are in advance of any government support or initiatives, and in fact the official incentives are mostly negative. Improved technology for agricultural development is still promoted as the desired land use.

Cumming (1993) has shown that there is a better financial return from wildlife compared to cattle production in Natural Region V of Zimbabwe (the low rainfall southeastern region), and that revenue from safari hunting has recently exceeded that from beef exports. He also uses Squires and Collinson's (1992) study in northern South Africa to show the much greater financial returns from wildlife tourism in the 71,000 ha Madikwe area, compared to the returns from cattle ranching. Of particular significance in this example were the figures for employment—1,214 jobs under wildlife tourism compared to 80 for cattle ranching. There are many similar developments under consideration and in progress throughout this region, all in advance of appropriate government institutional and incentives frameworks.

As with many other regions, it is proposed that multiple use of biodiversity would lead to an overall improvement in the regional economy, a higher standard of living for the inhabitants, and a much improved natural resource base. The constraints to achieving it have to do with institutional frameworks (in turn a consequence of the political economy), a lack of knowledge of how to use biodiversity, and getting the appropriate scale of operation. The scale of operation problem relates to putting biodiversity as the primary land use at the regional scale. Very small operations embedded in a sea of agriculture are not viable. Many of the more valuable species need large areas (albeit only occasionally) to persist. There is also increasing competition for water between the various land uses. As more water is dammed and diverted for irrigating sugar plantations, so less is available for the major river flows in the wildlife areas, and the riverine habitats are both the major focus for tourism as well as being seasonally crucial for the biota.

Underlying much of the advantage of multiple use of biodiversity in this region is the fact that a very significant proportion of the potential economic returns comes from non-consumptive use. The 'carrying capacity' of the region is therefore set *both* by some saturating level of tourism (beyond which tourism value begins to decline) as well as by consumption. The 'consumption' consists of some sustainable level of harvest from natural ecosystems (hunting, harvesting animals for sale of meat and hides, fuelwood, wood for carving, etc.) plus the production from land converted to high value agriculture (the maximum amount of which should be set by suitable soil and the real price of water).

Figure 1 shows the areas in the southern African region where biodiversity is already becoming a, if not the, primary form of resource use. There is clearly an emerging pattern of land use that could lead to a continuous region within which the natural biological resources constitute the primary form of land use, and where other forms of use, such as irrigated agriculture, could still be possible, but only to levels which do not threaten the sustainability of the wildlife resource. Whether the potential can be

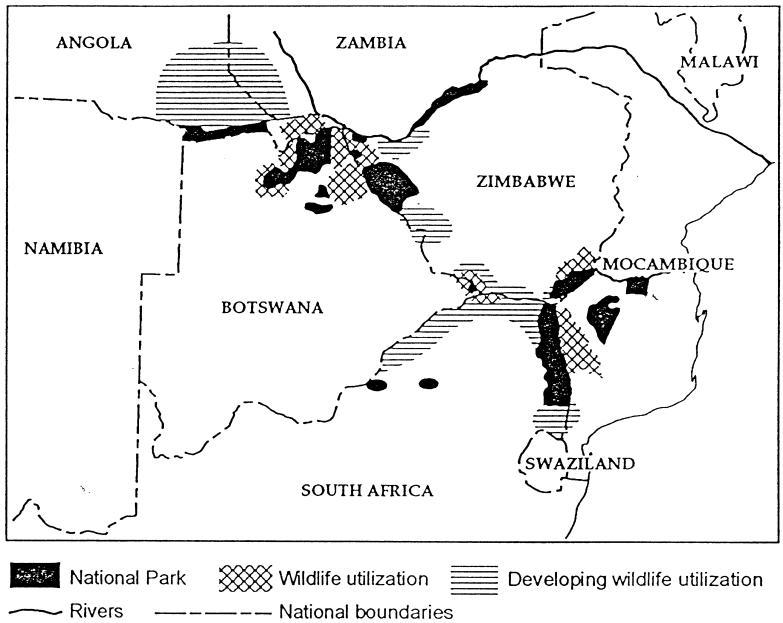

Figure 1. *Areas in Southern Africa referred to in the text where biodiversity is, or is becoming, the primary land use.*

realised depends on a number of factors which need to be researched, including such things as the land tenure conditions and property rights under which it will work, and the global and regional market for tourism.

The southern Africa wildlife example is matched by many others across the tropics. The community logging project in the rain forest of West Kalimantan, part of the Biodiversity Conservation Network (Anon, 1996), identifies corporate mechanized logging, conversion to agriculture, and legal and illegal hand logging by villagers as the major threats to the success of the project. It aims to operate a community managed and operated logging operation in a 5000 ha buffer zone bordering the Gunung Palung National Park, with value adding through a locally owned sawmill. Coordinating national, provincial and district government agencies are identified as the greatest challenge facing the project. Scale of operation is clearly also a significant factor.

Considering the full set of examples, while they illustrate the potential of biodiversity use, most of these projects suffer from a common drawback of being small-scale operations, lacking economies of scale. They need to be of a certain size in order to develop reliable markets and other infrastructure to support the 'industry' at affordable levels. Also, the individual, small resident-based enterprises are often in conflict with development plans of major national and multinational resource use companies, which means that they are often also in conflict with current

government policy. In some cases the conditions for being both economically viable and ecologically sustainable are limited. In the Peruvian Amazon, for example (C. Freese, pers. comm.), multiple use of forest products has been shown to exceed the value from using the land for agriculture, but when interest rates rise above 12.5 per cent over-exploitation of the forest products occurs.

In such cases of regional resource sustainability conflicts, the first requirement is to engage all the stakeholders, including governments and the large corporations with long-term investment interests, in the move to investing in and developing biodiversity as the primary form of land use. The proposition here is that the compelling reason for them to do so is because it is in their own best interests. Without incentives to the contrary, and including the necessary investment costs of alternatives to natural ecosystem services, in these marginal agricultural regions the returns from investing in biodiversity use are higher than those from investing in agriculture.

Given the odds against them, the present conflict situation between use of biodiversity at local village scales and the development of large agricultural schemes, is most likely to result in the failure of the small projects. Associated with this is the likely continuing decline in human welfare and in the status of biodiversity, and (because in the medium to long term many of the big agricultural schemes are not ecologically sustainable) less medium- to long-term profits for the big corporations. In a similar vein, the continued fostering by governments of improved, intensive agriculture for subsistence farmers in semi-arid regions will have much the same set of results, but with a decline in regional and national GDP in place of less corporate profits.

Given that there already exists a large body of technical research in many regions to suggest that the proposition is correct, and given that there are at least some 'non-perverse' situations, why is biodiversity use not more widely taken up? There are three possible reasons:

1. Lack of support and commitment from governments. A combination of bureaucratic inertia, other higher political priorities, a lack of appreciation for what is possible and a reluctance to break with existing policies often leads to governments hindering progress rather than facilitating it. From the point of view of government and industry what is proposed here is more difficult to control in terms of taxes and accessing profits. Despite the fact that, overall, it may well be demonstrably more beneficial for total and per capita income, it will be seen as less favourable than large scale 'production' schemes.
2. There is a need for not only a clearly defined land use 'goal' that identifies the benefits of biodiversity use, but also a transition pathway for getting there. It is necessary to show how, and in what order, to change existing forms and patterns of use, so that the existing interests and investments can evolve into the new system of resource use without undue losses and hardship (and therefore strong opposition). In short, the proposal needs a good business plan.
3. In regions where there is only communal subsistence agriculture and no large-scale commercial enterprises it is difficult to get anything started.

> Where there is no capital to deploy and few entrepreneurial or management skills, there is little in the way of nuclei to build on.

The social and economic dynamics in response to removal of subsidies and other perverse incentives is itself an important research requirement. There is a view that if these pressures are removed then resource use will revert to something like it was before the subsidies and incentives had their effects. But there is no reason to expect this, any more than we should expect removal of grazing pressure on a degraded rangeland to result in the return of the rangeland to its former state. There is a hysteresis effect in the rangeland dynamics (Walker, 1993) and it is just as likely that there will be hysteresis effects in the social and economic systems. Once a resource use system has been changed through subsidies and tax incentives (for example, from tropical forest to pasture or soy beans) the people who have moved into the region are unlikely to go back to where they came from if the subsidies are removed. Resource use will follow some different trajectory, that may or may not lead to a more sustainable system of biodiversity use.

Making biological resources the primary form of land use in regions that are marginal for agriculture will not by itself lead to an ecological, economic and socially sustainable region. (It remains an assumption that these three dimensions can be simultaneously met in any region.) Over-use and poor management of the integration of biodiversity with other uses will result in the same downward slide that characterises many of the regions today. Changing a distorted socio-economic system that currently favours agricultural development by large corporations to a distorted system that favours short-term harvesting of biodiversity by the same or similar organisations will not help. Also, even under an ideal system, no region can continue to absorb an ever-increasing human population, and stabilising of human numbers only follows an improvement in the economic and educational status of the population.

The future of much of the tropics today hinges on a race between increasing human numbers and the rate of improvement in human lifestyles and welfare. In this regard it is important to note the vital historical role of agriculture in getting the developed nations to where they are today, owing in large measure to the c. 2.5 times multiplier effect that agriculture has on the economy (Per Pinstrup-Andersen, International Food Policy Research Institute pers. comm.). Other sectors of the economy, like the service and information sectors, do not have this effect. However, in the marginal regions described in this paper, with a continued emphasis on land conversion to agriculture it is hard to imagine a satisfactory outcome; the contribution of agriculture to the economy is so small that the total, multiplied effect is also negligible. The multiplier effect of tourism in these regions is likely to be higher than that for agriculture.

3. A proposal

What has been presented above is a proposition. It needs to be thoroughly tested; and with the present rate of land use change in the regions being considered, there is an urgent need for research to answer the questions

posed in the Introduction. Given the evidence presented earlier, and in collections of papers such as in Daily (1997), one might conclude that it is not a technical problem and that further research is not required. This would be wrong, however, as determining the compatible combinations of resource use in a region, their optimal spatial patterns and proportions, and the yield response curves needed to set sustainable levels of use, all require research. The methodological basis for effective integrated regional models has a long way to go and there are many problems at the interface of ecology, sociology and economics that need attention (see, for example, Blood, 1994). The list of questions given in the Introduction will no doubt be extended as the proposition is fleshed out, but this set is a useful starting point.

A suggestion for a two-stage strategy for testing and developing the proposition is: First, bring together a group of ecologists, economists, sociologists, representatives of resource based industries, government planners and landowners to examine the feasibility of the proposal and, if it is found to have merit, flesh it out. The second stage would be the appointment of a Steering Committee to oversee the funding and appointment of a small core staff for an initial centre, or institute, aimed at one or two high priority, selected regions.

Three 'virtual' biodiversity-centred research institutes or centres are considered to be a minimum sufficient set, one each in Southern Africa, Latin America and Southeast Asia. The centres would act, in one respect, as complementary counterparts to the CGIAR (Co-ordinating Group on International Agricultural Research) system that has fostered agricultural development, but they would be far smaller in terms of infrastructure. Each would have a small core staff and would operate mainly by developing a network of researchers from existing national research institutions and international programs/organizations, working to share experience and expertise. The aim is not to try to replace or co-ordinate these existing programs (such as those of the IUCN, WWF, BCN, WB Overlays Program) but rather to add value by providing a few, permanent centres for networking and for providing continuity and integration in the conduct of research at regional scales on regionally agreed priorities.

The emphasis in the centres would be on collaborative work involving the relevant governments, landowners and industries, from the very beginning. This involvement of all the critical stakeholders in the work of the centres is essential if the results are to be implemented, from two points of view. First, the outcome of a well-designed research program into efficient resource use produces what a 'rational planner' would do. Since there is no such person (and since there are very few remaining advocates of central rational planning), it is only by getting all the stakeholders to own the research program and its outcomes, and to act together as a collective planner, that a generally acceptable resource use goal (one that will actually be implemented) can be determined. Second, given the existence of such an acceptable regional resource use goal, resource use change is effected through negotiation and trade-offs in a bottom-up manner, and for this process to be efficient it is necessary to involve everyone who has some influence on how the resources can be used.

References

Anon. (1996), 'Annual report of the biodiversity support program's biodiversity conservation network', c/o WWF, Washington, DC.

Blood, E. (1994), 'Prospects for the development of integrated regional models', in P.M. Groffman and G.E. Likens eds., *Integrated Regional Models: Interactions Between Humans and Their Environment*. New York: Chapman and Hall, pp. 143–153.

Cumming, D.H.M. (1993), 'Multispecies systems: progress, prospects and challenges in sustaining range animal production and biodiversity in East and southern Africa', in *Proceedings VII World Conference on Animal Production*, Edmonton, Alberta, vol. I Invited papers, published by Canadian Society of Animal Science and University of Alberta, pp. 145–159.

Daily, G.C., ed. (1997), *Nature's Services: Societal Dependence on Natural Ecosystems*, Covelo, California: Island Press.

Groombridge, B., ed. (1992), *Global Biodiversity: Status of the Earth's Living Resources*, Compiled by the World Conservation Monitoring Centre, London: Chapman and Hall.

Higgions, G.M., A.H. Kassam, L. Naiken, G. Fischer and M.M. Shah (1982), 'Potential population supporting capacities of lands in the developing world', Technical Report of Project INT/75/P 13, Land Resources for the Future. Food and Agriculture Organisation of the United Nations, Rome, and the International Institute for Applied Systems Analysis, Vienna for the United Nations Fund for Population Activities, New York. Rome.

IFPRI (1995), 'A 2020 vision for food, agriculture, and the environment. The vision, challenge, and recommended action', International Food Policy Research Institute. Washington, DC.

McNeely, J.A. (1988), *Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources*, Gland: IUCN.

Pearce, D. and D. Moran (1994), *The Economic Value of Biodiversity*, London: Earthscan Publications.

Squires, A. and R. Collinson (1992), 'Wildlife ranching and rural development: The Madikwe Game Reserve symbiosis', Paper presented at the 3rd International Wildlife Ranching Symposium, CSIR Conference Centre, Pretoria, South Africa.

Van Noordwijk, M., T.P. Tomich, R. Winahyu, M. Murdiyarso, Suyanto, S. Partoharjono and A.M. Fagi (1995), 'Alternatives to slash-and-burn in Indonesia', Summary Report of Phase 1. ASB Indonesia Report No 4. ICRAF, Nairobi, Kenya.

Walker, B.H. (1993), 'Rangeland ecology: understanding and managing change', *Ambio* **22**: 2–3.

Walker, B.H. (1996), 'Having or eating the rangeland cake: a developed world perspective on future options', in N.E. West, ed., *Rangelands in a Sustainable Biosphere*, Proc. of the Fifth International Rangelands Conference, Salt Lake City, Utah. Society for Range Management, Denver, Colorado, pp. 22–28.

Walker, B.H., W.S. Steffen, J. Canadell and J.S.I. Ingram (forthcoming), *The Terrestrial Biosphere and Global Change: Implications for Natural and Managed Ecosystems*, Cambridge: Cambridge University Press.

Walker, B.H. and W.S. Steffen (forthcoming), 'Interactive and integrated effects of global change on terrestrial ecosystems', in B.H. Walker, W.S. Steffen, J. Canadell and J.S.I. Ingram. *The Terrestrial Biosphere and Global Change: Implications for Natural and Managed Ecosystems*, Cambridge: Cambridge University Press.

Economic potential for biodiversity use in southern Africa: empirical evidence

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Walker's paper encapsulates what many non-agricultural resource managers have been thinking for some time. Essentially, it suggests that there is potential for replacement of much conventional agriculture in developing regions with biodiversity use activities. It considers conventional agriculture to be non-sustainable and ascribes the fact that biodiversity use has not been more widely adopted so far, to perverse incentives. In this response I examine some empirical results from southern Africa to see to what extent this premise is economically sound.

Biodiversity use has potential in the semi-arid and arid regions of the southern African subcontinent. Here, significant populations of wildlife, which appear able to generate use values through tourism and consumptive activities, persist. The alternatives to biodiversity use, and indeed the predominant current land uses in these areas, involve use of rangeland to produce livestock, in both traditional livestock keeping/agro-pastoralism, and commercial livestock production.

The key questions to be asked are, firstly, whether the conventional forms of land use involving livestock are indeed unsustainable and, secondly, whether use of biodiversity can sustainably generate more value than these conventional uses, in terms of both livelihoods and economic welfare.

Values associated with conventional agriculture in southern Africa

Traditional livestock-keeping/agro-pastoralism is an important form of agricultural land use on communal land in the drier areas of southern Africa. It consists of small-scale, risk-averse, low-input, more or less open access, livestock husbandry, yielding a range of direct use values, including milk, live animal sales/gifts, meat, draft power, manure, and store of value, as well as some cultural non-use values. Commonly associated with this is localized, low input, low yielding, small-scale crop production, drawing on draft power and manure from the livestock. Livestock are mostly cattle with some goats, and crops are mostly millet, sorghum and/or maize. In arid areas crop production is less important.

Bailey (1982), Flint (1986), Barrett (1992) and Ashley and LaFranchi (1997), for example, have studied the value of traditional livestock-keeping/agro-pastoralism to the household in terms of both market and

https://doi.org/10.1017/S1355770X99240156 Published online by Cambridge University Press

non-market benefits. Flint (1986), in southeast Botswana found that net incomes from agro-pastoralism were secondary to non-farm income, and that the potential for it to boost rural incomes or employment was modest. However, he concluded that arable and livestock incomes were significant and often crucial components of household income, and that the two were often complementary. Preliminary estimates indicate that traditional livestock keeping has a small but positive net contribution to the national economy (value added to national income).

As stated by Walker, traditional livestock keeping has been widely regarded as ecologically unsustainable, resulting in land degradation through vegetation change and erosion. The tendency for open access to grazing on communal land, and the emphasis on live animal values, results in high stocking rates, and intensive use of rangelands. However, irreversible losses of productivity, associated with this intensive use of rangeland have never been scientifically measured. Biot (1988, 1993), Abel *et al.* (1987), Abel and Blaikie (1989), Scoones (1990, 1993), Abel (1993), White (1993) and others have generated strong evidence, on the contrary, that in much of semi-arid southern Africa, these systems are resilient and productivity decline is negligible or very slow. However, these intensive grazing systems do result in displacement of wild ungulates, and loss of diversity both biologically, and in terms of productivity (Barnes, 1998).

Commercial livestock production, is prevalent on private and leasehold ranch land. It involves livestock production to produce slaughter stock (mainly cattle but also sheep). Commercial livestock ranching is capital intensive and generally has a low profitability (Bekure, 1982; Barnes, 1998; Barnes and de Jager, 1996). In Botswana, Barnes (1994, 1998), found that government subsidies substantially increased the private profitability of commercial beef production, while in Zimbabwe, Jansen *et al*. (1992) found that commercial livestock producers were being taxed rather than subsidised. The *economic* value of commercial livestock ranching (to society as a whole) was generally found to be low but positive. Results from at least one long-term study (Fourie *et al*., 1987) indicate that these systems can be ecologically sustainable.

Barnes (1994, 1998) used linear programming to analyse the allocation of resources within all land allocated to, or being used for, wildlife in Botswana. This analysis included the possibility of commercial livestock production (but unfortunately excluded traditional livestock keeping). Results show that in an economically optimal allocation of resources, most wildlife land should be used for wildlife, and only a minute proportion should be allocated for commercial livestock production.

Values associated with biodiversity in southern Africa

Commercial wildlife use takes place on public, private, and communal lands. It involves a wide range of activities or potential activities, including wildlife-viewing tourism, safari-hunting tourism, community wildlife use, game ranching, intensive ostrich or crocodile production, elephant culling, etc. Recent legislative changes giving communities access to custodial rights over wildlife have opened the way for wildlife use to contribute to livelihoods.

Research by Jansen *et al.* (1992), Bond (1993, 1995), Barnes (1998), Barnes (1995a, 1995b) shows that the economic characteristics of wildlife use activities are varied. They range from extensive, small-scale subsistence use to capital-intensive farming. Financial and economic profitability as well as efficiency in use of land, capital, labour and management differ widely between activities. Various activities also have differing land and site suitability requirements. In terms of current and potential economic value, *tourism* activities have been found to be by far the most significant biodiversity uses (Barnes, 1995a, 1995b, 1998).

Economic analysis of the allocation of resources in the Botswana wildlife sector (Barnes, 1998), has indicated that initial emphasis should be placed on non-consumptive tourism, safari-hunting tourism, and community use of wildlife in high value areas. A general finding is that biodiversity use, as an exclusive land use option, is only economically secure in small parts of the overall landscape. There is a need for research into the tradeoffs between traditional livestock keeping/agropastoralism and the other uses (wildlife uses, other natural resource uses and commercial livestock production).

For livelihoods in rural communities, commercial wildlife use activities contribute much needed cash and, as such, are often complementary to other household coping strategies such as livestock keeping and crop production (Ashley and LaFranchi, 1997).

Wildlife and forest conservation, as a land use alternative, is manifested in national parks, game reserves and forest reserves, and it overlaps with commercial wildlife utilisation. It is invested in for its non-use value to society. Non-use values for wildlife are *economic* values, very difficult to measure, and are reflected as willingness to pay, which can potentially be captured for national benefit. Very little research has been done on these, but work by Holland (1993), Oellerman *et al.* (1994), Barnes (1996, 1998), and Barnes *et al.* (1997), has found evidence of positive non-use values associated with wildlife in southern Africa. Since they could be significant, and we do not know what they are yet, development should be planned to minimise loss of these values (Barnes, 1998).

Conclusion

Empirical evidence suggests that biodiversity use, primarily that involving wildlife, has an important economic role to play in the semi-arid and arid parts of southern Africa. There is evidence that in core wildlife areas such as the Okavango delta in Botswana, wildlife use can generate significantly more for livelihoods and for national economic welfare than can conventional livestock production, and possibly traditional livestock-keeping/agropastoralism. This is happening within the current land allocation framework. It is being strengthened as the incentives and disincentives facing landholders are made more economically rational.

However, analysis has shown that there are some real physical constraints (markets, stocks, land suitability) on the expansion of wildlife uses, which will prevent these from replacing much of conventional agriculture, at least, in the short and medium term. The economic benefits deriving from wildlife use, natural resource use, traditional livestock keeping, tra-

ditional crop production, and commercial livestock production are widely diverse in nature. This makes them *complementary*, rather than competitive, for meeting livelihood needs, and economic objectives. There is no clear evidence of *inherent* ecological or economic non-sustainability, with any of these uses, although the sustainability of all is ultimately threatened by human population growth. Economically rational allocation of resources in semi-arid southern Africa will almost certainly involve all activities.

The 'virtual' biodiversity-centred, research institutes, proposed by Walker, are entirely appropriate and long overdue. They could play a vitally important role in ensuring that the full potential values for biodiversity use and biodiversity conservation are captured sustainably, and that investment in biodiversity resources is economically rational. Walker's proposed set of questions, to be addressed as part of this international research effort, are also entirely appropriate. The paramount task will be to work with the CGIAR to determine how spacial and other resources should be allocated between various agricultural and biodiversity uses so as to maximize human welfare. The research effort would best focus on how uses can complement rather than displace each other, although exclusivity should not be ignored. Research should also focus on developing policies and strategies likely to effect the human demographic transition, as well as maximizing and capturing all (use and non-use) economic values.

References

Abel, N.O.J. (1993), 'Reducing cattle numbers on southern African communal range: is it worth it?', in R.H. Behnke, I. Scoones and C. Kerven, eds., *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas*, London: Overseas Development Institute, pp. 173–195.

Abel, N.O.J. and P.M. Blaikie (1989), 'Land degradation, stocking rates and conservation policies in the communal rangelands of Botswana and Zimbabwe', *Land Degradation and Rehabilitation* **1**: 101–123.

Abel, N.O.J., M.E. Flint, N.D. Hunter, D. Chandler and G. Maka (1987), 'Cattle-keeping, ecological change and communal management in Ngwaketse', I.L.C.A., Addis Ababa, Integrated Farming Pilot Project, Ministry of Agriculture, Gaborone and Overseas Development Group, University of East Anglia, Norwich.

Ashley, C. and C. LaFranchi (1997), 'Livelihood strategies of rural households in Caprivi: implications for conservancies and natural resource management', Research Discussion Paper No. 20, Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek.

Bailey, C.R. (1982), 'Cattle husbandry in the communal areas of eastern Botswana', Ph.D. Thesis, Cornell University, Ithaca, New York.

Barnes, J.I. (1994), 'Alternative uses for natural resources in Botswana: wildlife utilisation', in S. Brothers, J. Hermans and D. Nteta, eds., *Botswana in the 21st Century*. Gaborone: The Botswana Society, pp. 323–336.

Barnes, J.I. (1995a), 'Current and potential use values for natural resources in some Namibian communal areas: a planning tool', Unpublished Working Document, Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek.

Barnes, J.I. (1995b), 'The value of non-agricultural land use in some Namibian communal areas: a data base for planning', Research Discussion Paper No. 6, Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek.
Barnes, J.I. (1996), 'Economic characteristics of the demand for wildlife viewing tourism in Botswana', *Development Southern Africa* **13**: 377–397.
Barnes, J.I. (1998), 'Wildlife economics: a study of direct use values in Botswana's wildlife sector', Ph.D. Thesis, University of London, London.
Barnes, J.I. and J.L.V de Jager (1996), 'Economic and financial incentives for wildlife use on private land in Namibia and the implications for policy', *South African Journal of Wildlife Research* **26**: 37–46.
Barnes, J.I., C. Schier and G. van Rooy (1997), 'Tourists' willingness to pay for wildlife viewing and wildlife conservation in Namibia', Research Discussion Paper No. 15, Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek.
Barrett, J.C. (1992), 'The economic role of cattle in communal farming systems in Zimbabwe', Pastoral Development Network Paper No. 32b, Overseas Development Institute (ODI), London.
Bekure, S. (1982), 'The economics of commercial ranches', in R.K. Hitchcock, ed., 'Botswana's first livestock development project and its future implications', National Institute of Development and Cultural Research, University College of Botswana, Gaborone, pp. 209–216.
Biot, Y. (1988), 'Forecasting productivity losses caused by sheet and rill erosion in semi-arid rangeland: a case study from the communal areas of Botswana', Ph.D. Thesis, University of East Anglia, Norwich.
Biot, Y. (1993), 'How long can high stocking densities be sustained?', in R.H. Behnke, I. Scoones and C. Kerven, eds., *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas*, London: Overseas Development Institute, pp. 153–172.
Bond, I. (1993), 'The economics of wildlife and land use in Zimbabwe: an examination of current knowledge and issues', Project Paper No. 36. WWF Multispecies Animal Production Systems Project, Harare.
Bond, I. (1995), 'Wildlife and livestock as options for landuse in Zimbabwe', in J.A. Bissonette and P.R. Krausman, eds., *Integrating People and Wildlife for a Sustainable Future*, Bethesda: The Wildlife Society, pp. 203–206.
Flint, M.E.S. (1986), 'Crop and livestock production in the Pelotshetlha lands area: the main report of the IFPP Phase 2 Farm Management Survey' (2 volumes), Integrated Farming Pilot Project, Ministry of Agriculture, Lobatse, Botswana.
Fourie, J.H., N.J. de Wet and J.J. Page (1987), 'Veldtoestand en neiging in Kalahari-Duineveld onder n'ekstensiewe veeboerderystelsel', *Journal of the Grassland Society of Southern Africa* **4**: 48–54.
Holland, J.D. (1993), 'A determination and analysis of preservation values for protected areas', Ph.D. Thesis, University of Natal, Pietermaritzburg.
Jansen, D.J., I. Bond and B. Child (1992), 'Cattle, wildlife, both or neither: results of a financial and economic survey of commercial ranches in southern Zimbabwe', Project Paper No. 27, WWF Multispecies Animal Production Systems Project, Harare.
Oellermann, R.G., D.A.G. Darroch and J.R. Klug (1994), 'Valuing preferences for wetland preservation: a Wakkerstroom case study', *African Journal of Range and Forage Science* **11**: 89–95.
Scoones, I. (1990), 'Livestock populations and the household economy: a case study from southern Zimbabwe', Ph.D. Thesis, University of London, London.
Scoones, I. (1993), 'Why are there so many animals? Cattle population dynamics in

the communal areas of Zimbabwe', in R.H. Behnke, I. Scoones and C. Kerven, eds., *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas*, London: Overseas Development Institute, pp. 62–76.

White, R. (1993), Livestock Development and Pastoral Production on Communal Rangeland in Botswana, Gaborone: The Botswana Society.

Living off 'biodiversity': whose land, whose resources and where?

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I applaud Brian Walker's article and the editor for using it as the basis for a policy forum. By extending the multi-species or multi-use concepts current in southern Africa to encompass 'biodiversity'[1] Walker brings into sharper focus the many local, regional and global research and policy issues of conserving biodiversity by *using* it. He also raises the key issue of scale and the dubious viability of small, often spatially isolated, enterprises based on wildlife use. It is on the issue of scale that I wish to extend the debate by suggesting that biodiversity, as a primary land use, could advantageously cover 40 per cent, or more, of the land area of southern Africa. Under such a scenario the question of 'whose land, whose resources and where?' becomes paramount.

Whose land?

The current extent of wildlife as a land use in southern Africa is greater than Walker indicated. Some 1.3 million km^2, or nearly 20 per cent of the SADC region, is already nominally under some form or other of wildlife use (Cumming, 1991). Nearly 10 per cent of the SADC region is state land under protected area status, 6 per cent is communal land game areas of various types and 4 per cent is under freehold title in the commercial farming sector. The demographic and economic parameters of the region preclude a major expansion in state protected areas. The area of large-scale commercial farm land is declining (e.g., Murphree and Cumming, 1993) and current policies in much of the region serve to extend subsistence agriculture into marginal lands (Cumming and Lynam, 1997). Clearly the only

[1] Taking 'biodiversity' to mean indigenous plant and animal species and the amenity value of wild land.

https://doi.org/10.1017/S1355770X99240156 Published online by Cambridge University Press

feasible way in which biodiversity as a land use is likely to expand in the region is if commercial and communal farmers choose to use their land in this way. Why might they make that choice?

At a global scale southern Africa's competitive advantage in rangeland production lies in its diverse and charismatic large wild mammals which attract tourists—an important factor where c. 60 per cent of the region is arid or semi-arid savanna and steppe which formerly carried spectacular herds of large wild mammals. Wildlife systems, because they can be coupled in a variety of ways to the service industries of tourism, can generate wealth through what might be termed 'tertiary production'—an escape, at least partially, from the biological limits of plant and animal production which so constrain pastoral and ranching systems. As Walker argues, biodiversity as a land use may well provide the multiplier effects needed to boost the depressed economies of the region.

Commercial livestock ranching systems (which replaced the wild herds and are barely a hundred years old) produce meat, hides and fiber. In communal agro-pastoral systems livestock also provide milk, draft power, manure and a means of investment. Gross livestock production figures for the SADC region, however, reveal per capita and per animal production figures that are about one twentieth of those in temperate regions (Cumming and Bond, 1991). Furthermore, humans now outnumber livestock (when measured in animal units) in the region where livestock numbers have increased only slightly over the last three decades and producer prices have declined. In much of southern Africa livestock production is not an option because of the presence of tsetse fly, other diseases, nutrient-poor soils or lack of water. In parts of the Zambezi Valley in Zimbabwe, where tsetse were eradicated and immigrant farmers and their livestock displaced emerging wildlife-based options, Murindagomo (1997) concluded that wildlife could be more profitable than cattle at a household level if cattle subsidies were removed and appropriate institutions governing access to wildlife resources and benefits were introduced.

Whose resources?

Livestock belong to individual farmers but under the law wild species do not—so issues concerning the incentive structures associated with resource access rights remain to be resolved. These rights are complicated by the paradoxical nature of *wild life* which, by definition, cannot belong or be owned without capturing or constraining it—whereupon it ceases to be wild. For the most part the state controls, or attempts to control, access to indigenous plants and animals on all land despite the reality that farmers are the *de facto* managers of the natural resources on the land they occupy. Until such time as farmers, particularly communal farmers, are legally able to manage and benefit from wild resources they will continue to opt for other land uses and displace 'biodiversity'.

It is not surprising, therefore, that where appropriate policy instruments and legal institutions exist farmers have moved into wildlife production in southern Africa. The shift has been particularly marked in the commercial farming areas of Namibia, South Africa and Zimbabwe because it is in this sector that enabling legislation and policies were established in the late

1960s and early 1970s (Cumming, 1991). Over the last decade policy and legal changes have supported the development of wildlife-based enterprises in the communal sector (e.g., Metcalfe, 1994). However, the devolution of resource access rights and benefit flows have still to reach the level where farmers (as opposed to the local government or traditional authority) can make enlightened choices between alternative production systems.

Where?

To flourish large wild mammals generally require much larger areas than is generally covered by a village or single ranch and cooperative or communal management regimes become important at larger spatial scales. In the commercial farming sector innovative developments in joint management have resulted in the formation of conservancies such as Save Valley Conservancy in south eastern Zimbabwe which covers 17 properties and an area of 3,415 km^2 (du Toit, 1992). Recent legislation in Namibia has empowered communal land farmers who can now establish Conservancies (Ministry of Environment and Tourism, 1995) which cover areas of several thousand km^2. But even at this size management units may not match ecological scales in arid zones. A potential solution to the problem in many areas is for existing large protected areas to form the core of a larger wildlife enterprise. Using Waddington's (1977) metaphor of an epigenetic landscape one might imagine the development of a terrain of 'landuse fitnesses' defined by appropriate criteria of human and resource benefits and the corresponding forms of land management to cover the full spectrum of landscapes in a region.

With few exceptions the largest and most visited national parks in the region are bounded by poverty. Neither conservation or social goals are likely to be met if these areas continue to remain ecologically and culturally isolated islands. The alternative is for them to become partners in the larger landscape and enterprise of 'biodiversity farming'. The Zambezi Valley of Zimbabwe provides a clear example of a juxtaposition between national parks and subsistence farming—some 45 per cent of the land area is under state protection and is surrounded by communal farming land, formerly Tribal Trust Land which is now state land. Rural District Councils and some communities on the boundaries of protected areas are trying to maintain wildlife as a land use in the face of high population growth and immigration from overcrowded areas elsewhere in the country. With a few exceptions, returns to households from wildlife are generally less than $30.00 per annum. The Parks & Wild Life estate is capable of generating returns to neighbouring households in excess of $1,000 per annum but provides little if any return to the economy of the surrounding communal lands which receive food aid in most years—a situation in which both land uses are unsustainable (Cumming and Lynam, 1997). This example has wide applicability and national parks in the region, all of which are facing diminishing support from the national fiscus, could well furnish the needed springboard to a better future for people and biodiversity in the semi-arid and arid lands of southern Africa.

Finally, how necessary is more research? In almost all areas of the debate

research on which to generate more detailed and localized rational policy debate is lacking. Where good data exist they are often ignored because they were generated by 'outsiders'. In southern Africa, because of its racial history, research dealing with landuse and policy is a particularly sensitive area. A sense of local involvement and ownership in the policy research process, at several levels, will therefore be a vital component in moving the policy debate forward. This means involving local farmers, scientists, officials and existing networks from the outset in a consultative and very participatory research programme—it can probably only be done, as Walker rightly argues, by developing a 'virtual college'.

References

Cumming, D.H.M (1991), 'Developments in game ranching and wildlife utilization in east and southern Africa', in L.A. Renecker and R.J. Hudson, eds., *Wildlife Production: Conservation and Sustainable Development*, AFES misc. pub. 91–6. University of Alaska Fairbanks. Fairbanks, Alaska, pp. 96–108.

Cumming, D.H.M. and I. Bond (1991), 'Animal production in southern Africa: present practice and opportunities for peasant farmers in Arid Lands', a report prepared for the International Development Research Centre, Regional Office for Eastern and Southern Africa, Nairobi, 31 July 1991. (WWF Multispecies Project Paper No. 22, vvx + 142pp.)

Cumming D.H.M. and T.J.L. Lynam (1997), 'Landuse changes, wildlife conservation and utilisation, and the sustainability of agro-ecosystems in the Zambezi Valley', Final Technical Report, Volume 1, 138pp. European Union Contract B7–5040/93/06. WWF Programme Office, Harare.

Du Toit, R.F. (1992) 'Large-scale wildlife conservancies in Zimbabwe: opportunities for commercial conservation of endangered species', in W. van Hoven, H. Ebedes and A. Conroy, eds., *Wildlife Ranching: A Celebration of Diversity*. South Africa Game Organisation, Pretoria, pp. 295–300.

Metcalfe, S. (1994) 'The Zimbabwe Communal Areas Management Programme for Indigenous Resources', in D. Western, R.M. Wright and S.C. Strum, eds., *Natural Connections: Perspectives in Community-based Conservation*. Washington, DC: Island Press, pp. 162–192.

Ministry of Environment and Tourism (1995) *Wildlife Management, Utilisation and Tourism in Communal Areas—Policy Document*., Ministry of Environment and Tourism, Windhoek, Namibia.

Murindagomo, F. (1997) 'Wildlife, cattle and comparative advantage in semi-arid communal lands and implications for agropastoral options and government policy: a case study in the Sebungwe region, Zimbabwe', D.Phil Thesis, Department of Agricultural Economics and Extension, University of Zimbabwe, Harare, 437pp.

Murphree, M.W. and D.H.M. Cumming (1993), 'Savanna land use: policy and practice in Zimbabwe', in M.D. Young and O.T. Solbrig, eds., *The World's Savannas: Economic Driving Forces, Ecological Constraints and Policy Options for Sustainable Land Use*. Man and the Biosphere Series, Vol 12. UNESCO and Parthenon, Paris, pp. 139–178.

Waddington, C.H. (1977), *Tools for Thought*, Palladin, Granada Publications. Frogmore, UK.

Bottom-up science

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In this thought-provoking article Brian Walker takes a hard look at the current scenario in humid as well as semi-arid and arid tropics. In many of these regions the productivity of agriculture is low, human populations are growing and natural resources eroding under pressures of over-use. Conventional development policies of governments have largely failed to solve these problems, and Walker provides an objective analysis of why this is so. He points out that a combination of bureaucratic inertia, different political priorities, a lack of appreciation for what is possible and a reluctance to break with existing policies often leads to governments hindering progress rather than facilitating it. From the point of view of governments alternative, environmentally more desirable resource use strategies are more difficult to control in terms of taxes and facilitating better access to profits to industry. Governments therefore tend to keep on pushing large-scale production schemes, even though they may well generate a lower level of per capita income. The experiences I am personally familiar with from India often conform to this picture (Gadgil and Guha, 1995). Walker's hypothesis is that a combination of non-consumptive uses of a broader base of biodiversity resources than those employed by intensive agriculture and animal husbandry may often be environmentally, socially and economically more sustainable. This is certainly plausible.

There are obviously manifold barriers to making such a transition. These include inadequate understanding of the resource dynamics which display patterns highly variable in space as well as time. The barriers also include a divorce between long-term dependence on natural resources by the poorly organized, weaker segments of the society, and control over resources which is largely in the hands of organized services industries sectors with little concern for long-term sustainability of the resource base. The barriers involve a lack of co-ordination between national, provincial and district government agencies as well. It is evidently important to understand the operation of such barriers, and of ways of overcoming them in order to identify transition pathways for moving towards more sustainable ways of using a broader base of biodiversity. Thus far I am fully in agreement with Brian Walker. But I would like to raise some questions as to his proposal on how to set about identifying these transition pathways. Walker proposes setting up an international 'virtual' institute composed of three Biodiversity Centres, one each in Latin America, southern Africa and south-east Asia. These Biodiversity Centres would

pursue a strongly focussed research program involving ecologists, agricultural scientists, resource economists and sociologists, and the landholders and stakeholders in the region concerned. I would like to submit that it might be more appropriate to reverse this order, and instead consider instituting an action research programme involving landholders and stakeholders in the region concerned and ecologists, agricultural scientists, resource economists and sociologists. After all, like bureaucrats, scientists too have their own agendas, and to paraphrase Brian Walker a combination of academic inertia, other career priorities, a lack of appreciation for what is possible and a reluctance to break with existing systems of professional incentives could lead to scientific institutions hindering progress rather than facilitating it. I therefore propose that just as people are being involved as co-managers along with bureaucrats in caring for natural resources such as forests or irrigation waters, they should be inducted as fully fledged partners in scientific research directed at solving problems of resource management as well. Just as they may bring to natural resource management intimate knowledge of the local resource base, and strong motivation for its prudent use by virtue of their long-term stake in the health of the resource base, so should they bring to research a familiarity with all facets of the system and a commitment to apply the research to solve concrete problems on the ground.

As a part of a large-scale collaborative effort I have been involved in an experiment termed People's Biodiversity Registers (PBRs) to organize such an effort in India over the last three years (Gadgil 1996a, Gadgil *et al*., in press). An initial set of 50 such registers have been prepared over 1995–97, covering 50 village clusters, distributed over seven different states. The registers have been prepared by college students and teachers, workers of NGOs or forestry officials on the basis of extensive discussion and field visits with local people. These registers involve a mapping of the landscape from over which the local people meet their manifold requirements of living resources, for subsistence as well as for marketing; and a delineation of the different user groups of people in terms of their relationship to the natural resources. This is followed by systematic group as well as individual interviews and field visits involving representatives of different user groups and individuals particularly knowledgeable about living resources. These lead to an inventory of all plant and animal species known to people, their distribution over landscape elements as recognized by the people and changes in their abundance and distribution over time. Particular attention is paid to the reconstruction of the recent ecological history focussing on changes in the landscape as well as in populations of plant and animal species. This also involves exploring the various forces, proximate and ultimate, driving ecological change. Of particular relevance in this context are patterns of access to and harvests of wild as well as husbanded living resources, and the appropriation of the benefits of their utilization by different segments of local society as also by outsiders. Continuance, erosion or emergence of practices of sustainable use and conservation of biodiversity, local as well as state sponsored, are carefully assessed. This is related to co-operation and conflicts amongst locals, as also with outsiders in the context of use of natural resources. The last

module of PBR deals with suggestions emerging locally on sustainable use and conservation priorities and the various measures needed to implement them (Gadgil, 1998).

The response to this exercise, both amongst a wide cross-section of local communities, and amongst teachers, students and NGOs has been very positive. I have come to believe that such documentation, organized not just as a one-time effort, but as a programme of regular monitoring, could be a very sound basis for attempting to engineer a transition to more sustainable patterns of use of a broader base of biological diversity. This could be accomplished through systems of co-management implemented in an adaptive fashion. In fact, attempts are currently under way in the south Indian state of Kerala to use PBRs as a tool for such adaptive co-management. It is, of course, essential to relate the information and experiences emerging from these local exercises in the broader context of natural and social sciences, and we are currently attempting to do so through establishing a positive relationship with the academic community (Gadgil, 1996b).

This whole programme would then constitute a 'virtual' biodiversity institute as visualized by Brian Walker, but organized differently, in a bottom-up, rather than a top-down fashion. I believe that this is likely to serve far better the very significant objectives set out by him in this important article.

References

Gadgil, M. (1996a), People's Biodiversity Register. A record of India's wealth. *Amruth*, 1–16, October.

Gadgil, M. (1996b), 'Documenting diversity: an experiment', *Current Science* **70**(1): 36–44, 10 January.

Gadgil, M. (1998), Let the people speak. *The Hindu Survey of the Environment*, 107–137.

Gadgil, M. and R. Guha (1995), *Ecology and Equity: Use and Abuse of Nature in Contemporary India*, London: Routledge, pp. 213. also published by Penguin India, pp. 213.

Gadgil, M., P.R.S. Rao, G. Utkarsh, P. Pramod, New meaning for old knowledge: The People's biodiversity registers programme (*in press*) Ecological Applications.

Making the benefits of biodiversity conservation visible and real: institutional aspects in a biodiversity research programme

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The problem of biological diversity conservation essentially is not so much that of preserving all currently existing species, but rather of how to

protect the ability of ecosystems to provide life support in a more general sense, including the ecological services on which humanity depends. That requires the development of the informational, institutional as well as economic conditions in which the use of environmental resources will be sustainable—that is, maintaining a level of diversity, as well as a scale of economic activity that will respect the resilience of the ecosystems at least in so far as these matter in supporting human production and consumption (Perrings and Opschoor, 1994). Diversity conservation may go beyond this minimum, if (internationally) there is a willingness to invest in the conservation of ecosystems for non-instrumental reasons, e.g., based on existence values.

The effectiveness and perhaps also the efficiency of this type of biodiversity conservation is scale dependent; the protection of biodiversity is an issue of habital management, or land use; Panayotou (1994) gives five reasons why this is so, having to do with economies of (spatial) scale, uncertainties about the value of different species, the complexities of ecological interactions in life support systems (which may have the added benefit of protecting other species than those that have recognised instrumental values), irreversibilites in biodiversity loss, and the likelihood of joint products in 'non-biodiversity benefits' of a habitat-based approach such as watershed protection. This habitat approach entails that efforts to protect biodiversity may affect the livelihoods of large numbers of people, who may depend on other uses of these habitats.

The proposal

Brian Walker's proposals recognise the value as well as the potential costs of a strategy as outlined above. He banks on the possibility of creating a win–win situation to be based on the development of systems of multiple use (including biodiversity preservation) in large regional settings; in fact he proposes to experiment with such systems in three large units: southern Africa, southeast Asia and Latin America. In each of these, he proposes to set up (regional, 'virtual') biodiversity centres to carry out research to identify such win–win strategies and the informational, institutional and economic conditions for that. Multiple use in those spatial units would involve the simultaneous use of resources on the same site, sequential use of resources, and different uses on different sites (Walker, this volume). The hypothesis is that such systems would improve the regional economy and standards of living, and would do so better than traditional forms of regional development.

One may wonder what is new here; Walker himself argues that the idea in itself is not novel. He also asks the more interesting question why proposals such as this one are not yet widely adopted, and relates that to incentive failure (both the stickiness of so-called perverse incentives and the absence of adequate, more appropriate ones), the issues of scale involved, and the (lack of) options available to the direct inhabitants of these areas and their use of the resources they contain. Underlying these issues there are the problems of the lack of clarity about the usefulness of biodiversity preservation and the benefits that such conservation effort may—or might—give rise to. These benefits must be made better under-

stood, more visible and real, to affect decision making by economic agents. Walker proposes research questions including items such as: what are these benefits?; where might they show up more readily?; what are the trade-offs?; is the win–win hypothesis a valid one?; how do societies make the transition to such systems of large-scale multiple use?; what are the institutional systems and regulatory regimes that stand in the way and/or would favour such shifts? The relevance of these questions does call for a systematic approach and Walker's proposals for regional research programmes and centers seem appropriate, though costly and not easy to get implemented. He envisages these centres to be complementary counterparts of CGIAR (Co-ordinating Group on International Agricultural Research) and to add value to related efforts by, e.g. IUCN, WWF, etc.; I would add that perhaps linking such effort with large international research programmes on Global Change such as Diversitas and the IGBP/IHDP-programme on Land Use Cover and Land Use Change (LUCC) would be interesting options; perhaps the START-system of regional research programmes would provide another mechanism, with some potential for addressing sources of funding in the USA, Japan and Europe.

Institutional aspects

I welcome the attention given to institutional aspects and regulatory regimes. Elsewhere I have attempted to categorize different kinds of institutional failure (Opschoor, 1996) leading to perverse or inadequate incentives, including types of transaction failure, empowerment failure and policy failure such as: missing markets, imbalances in bargaining power, preference failure (due to inadequate knowledge and time preference), biased sectoral policies, and enforcement failures. Many of these seem to predominate in the field of issues related to biodiversity preservation. A well-focused, comparative and design-oriented research programme at the regional level encompassing several countries, cultures and resource management regimes as well as different levels of economic development, might provide insights into the strength of institutional impediments and ways to overcome these, that could be transferable between specific settings and possibly from one region to another. Such programmes might also be used to experiment with innovative, but not well tested, instruments such as transferable development rights, designed to provide mechanisms to create win–win situations including transfers to those who might suffer from biodiversity conservation (Panayotou, 1994). In a very relevant report to the Interntional Human Dimensions Programme on Global Environmental Change (IHDP) Pritchard *et al*. (1998) argue that the ecosystem properties that pose most difficulties for management are those that relate to linkages across spatial scales, and advocate a multi-scale approach of the institutional aspects as well. This has to do for example with spatial 'mismatches' (where the boundaries of management do not coincide with those of the ecologically relevant units) and difficulties in the transmissions of incentives signals from the macro level to the regional and the local ones. Based on Berkes and Folke (1998) they argue for a rethinking of natural science as well as social science

aspects related to resource management, which, in my view, is best done in concerted and regionally focused research programmes. These may be expected to generate new insights in ecologically adaptive management practices across all forms of (multiple) land use, and appropriate and effective social mechanisms and institutions. Research issues suggested by Pritchard *et al*. include the monitoring, communication and indicator building of biodiversity change (including their social context and relations); the resilience and evolution of institutions; ways of transcending naive functionalist approaches to resource management; mechanisms for conflict resolution; the roles and impacts of major international players such as the World Bank, WTO (Pritchard *et al*. 1998).

Limits to win–win

Caveats may be in order in relation to the expectations on win–win possibilities. Many of the social benefits of the type of biodiversity conservation discussed here relate to the so-called 'infrastructural functions' (or 'primary values') of ecosystems—the capacity of these systems to develop and maintain themselves—that do not readily translate into marketable goods or services. And where biodiversity conservation does yield such goods and services (and hence generates secondary values such as use values and option values and existence values) the associated income streams (essentially related to use values only) might not be sufficient to compensate the revenues of more conventional forms of land use. Mechanisms and systems must then be designed that transform these infrastructural functions and option and existence values into cash flows. One way would be to deploy regulatory strategies such as zoning combined with compensatory schemes such as the transferable development rights mentioned above. The essence of the problem is that flows of—often non-manifest—benefits extending over extremely long periods of time need to be amplified into price signals affecting the decisions on land use today, thereby overcoming the compressive effects of time preference and discounting. There may also be problems due to decreasing returns, associated with the enlarged capacities to generate marketable environmental goods and services from biodiversity conservation, as well as due to diminishing returns of scale. The latter could be due, for example, to increasing costs of enforcing and policing regulatory regimes related to the biodiversity-orientated use of natural resources, as the experience with poaching demonstrates. In addition, as pointed out by Walker, there must be a readiness to do away with the perverse incentives and to tackle the issue of vested interests that are associated with the current forms of land use in the areas concerned.

Conclusion

With substantive suggestions such as those proposed above, and on how plans such as Walker's might be embedded in a wider setting of research on global environmental change, I do hope that these plans can be developed into a relevant, workable and supportable project proposal.

References

Berkes, F. and C. Folke (1998), *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, Cambridge: Cambridge University Press.

Opschoor J.B. (1996), 'Institutional change and development towards sustainability' in R. Costanza, O. Segura and J. Martinez-Alier, *Getting Down to Earth: Practical Applications of Ecological Economics*, Washington, DC: Island Press, pp. 327–351.

Panayotou T. (1994). 'Conservation of biodiversity and economic development: the concept of transferable development rights', *Environment and Resource Economics* **4**, 1: 95–110.

Perrings C. and H. Opschoor (1994), 'The loss of biological diversity: some policy implications'. *Environment and Resource Economics* **4**, 1: 1–13.

Pritchard L., J. Colding, F. Berkes, U. Svedin and C. Folke (1998), 'The problem of fit between ecosystems and institutions', IHDP Working Paper No. 2, Bonn.

Economics and biodiversity conservation in the developing world

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Brian Walker has neatly summarized the case for further emphasis on conserving biological diversity through sustainable utilization. This is a message some of us have been advancing for some time (e.g. Barbier *et al*., 1990; Pearce and Moran, 1994; Pearce, 1999). The following propositions highlight some of the reasons for pursuing this approach and some of the problems that arise.

1 As Walker notes, if markets function fairly freely, then some sustainable utilization will occur 'naturally', as with the emergence of wildlife conservancies in southern Africa. Table 1 summarizes some of the evidence on rates of return to alternative land uses in that region. It is clear from table 1 that there is substantial scope for saving biodiversity through prevailing market forces.

2 Most biodiversity loss is due to land conversion, especially the conversion of forests to agriculture (Swanson, 1995; Vitousek *et al*., 1997). In turn, land conversion occurs because of population growth. The role of economic growth in biodiversity decline is clearly significant at low levels of income per capita, but, potentially, growth can conserve biodiversity at higher levels of income because of an income elastic 'demand' for conservation. Simply drawing lines round areas and calling them 'protected' will

Table 1. *Rates of return to wildlife utilization in Southern Africa*

Country	*Type of land use*	*Financial nternal rate of return %*	*Economic internal rate of return %*
Namibia	mixed livestock/game	4–7	
	game viewing	4–10	8–20
	upmarket tourist lodge	10	
Botswana	cattle	5	
	game ranches	6–7	
	safari hunting	16	45
	upmarket tourist lodge	18	28
	ostrich farming	19	14
	crocodile farming	18	14
South Africa	cattle	−32	
Zimbabwe	cattle	2	13
	mixed cattle/wildlife	3	
	wildlife	11	22

Source: Pearce, 1999.

only work when either the disincentives to degrade those areas are very high, or when the opportunity cost of protection is very low. The former is the model for many protected areas, but, in reality, governments do not have the means to monitor, police and enforce sanctions against misuse. The latter is the reality for many of the world's protected areas: they are safe simply because they occupy terrain that has no agricultural or development value. Hence, if high opportunity cost areas are genuinely to be protected there has to be a different approach based on the provision of incentives to stakeholders to share in the benefits of biodiversity utilization.

3 Very much more biodiversity decline would be avoided if distortions to free markets were reduced or removed. Table 2 illustrates the scale of world subsidies to various activities which have high potential for biodiversity loss: energy, agriculture, water and fisheries. Note that even fairly conservative estimates put OECD subsidies at 7–10 times total official overseas aid. While there is wide acknowledgement of the role played by subsidies in developing countries, Table 2 suggests that distortions are larger in the OECD countries, offsetting the 'natural' tendency to conserve

Table 2. *Estimate of subsidies to biodiversity-degrading activities*

	OECD $billion	*Non-OECD $ billion*	*World $ billion*
Water	2	53	55
Energy	19–24	62	81–86
Agriculture	335	36	371
Transport	107–226	na	107–226
Fisheries			70
Totals	463–587	151	684–808

Source: author's estimates

https://doi.org/10.1017/S1355770X99240156 Published online by Cambridge University Press

more bioidversity because of income elasticity demand for conservation. Moreover, the sheer size of rich country subsidies is testament to the difficulties of removing subsidies. The European Common Agricultural Policy and US and Japanese protection of agricultural sectors are all cases in point.

4 Still more biodiversity would be conserved if the non-market values of biodiversity were converted into market values through the creation of markets. It is not enough to demonstrate that biodiversity has economic value. The economic value has to be captured as real cash flows to those who matter. The 'menu' of market creation procedures is growing: debt-for-nature swaps, set-aside and other franchise agreements, carbon-offset deals, carbon-neutral pricing, environmental funds, biodiversity prospecting and so on (Pearce, 1995).

As noted above, the opportunity cost of conservation is often low. To that end 'demonstration and capture' of economic value is not paramount. But it is paramount when the opportunity costs are significant. Moreover, opportunity costs are highest when the area in question are under the gravest threat. Identifying biodiversity 'hotspots' is all well and good, but, precisely because they are the areas under greatest threat, they are also the areas where conventional conservation will not work. Hotspots are synonymous with threats and threats are a surrogate for high opportunity cost, which in turn means that generating market value where none currently exists is extremely important. Even then, the reality may be that conservation will lose out when the backdrop is rapid population change (Norton-Griffiths, 1996).

5 With a focus on markets that work without radical change, on removing distortions so that markets can work better, and on the creation of markets, biodiversity stands a chance. But the odds against it are still formidable. No-one can prevent the world's population rising by 50 per cent, and the chances of it rising by 100 per cent in the next 100 years are very high. Hence the pressure on land for conversion will remain unless technological changes, such as biotechnology, raise food productivity so much that the pressure is taken off marginal land. Because the odds against conservation are so high, bold initiatives like Brian Walker's deserve our support.

References

Barbier, E., J. Burgess, T. Swanson, and D.W. Pearce (1990), *Elephants, Economics and Ivory*, London: Earthscan.

Norton-Griffiths, M. (1996), 'Property rights and the marginal wildebeest: an economic analysis of wildlife conservation options in Kenya', *Biodiversity and Conservation* **5**: 1557–1577.

Pearce, D.W and D. Moran (1994), *The Economic Value of Biodiversity*, London: Earthscan.

Pearce, D.W. (1995), *Blueprint 4: Capturing Global Environmental Value*, London: Earthscan.

Pearce, D.W (1999), 'The economics of African wildlife utilisation', in D.W. Pearce, *Economics and Environment: Essays on Ecological Economics and Sustainable Development*, Cheltenham: Edward Elgar.

Swanson, T. ed. (1995), *The Economics and Ecology of Biodiversity Decline*, Cambridge: Cambridge University Press.
Vitousek, P., H. Mooney and Melillo J. Lubchenco (1997), Human domination of Earth's ecosystems, *Science* **277** (15 July): 494–499.

Biodiversity utilization as a form of land use

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Brian Walker contends that conventional agriculture in many regions of the developing world is failing to meet the growing food demand or the test of sustainability. Few would disagree. Whether multiple use of natural resources can alleviate the problem without tackling its root cause is, however, debatable.

Arguing for utilization of biodiversity ignores that fact that traditional subsistence societies in much of Africa did use a wide resource base, including crop and livestock husbandry, fishing and hunting. Livestock production alone often exceeded that of wildlife, was relatively efficient ecologically and supported a sizeable human population on the land (Western, 1979). But, as the population burgeoned in recent decades, traditional economies faltered and were supplanted by agricultural production reliant on few species. The shift is no more an irrational choice in the developing world than in the developed. To the contrary, the adoption of 'conventional' agriculture permitted populations to expand well beyond the levels attained by biodiversity utilization, often with less degradation (Tiffen *et al*., 1994). Consequently, conventional agriculture is the avenue of choice, offering in the process better access to health care, education, markets, credit and other benefits of development.

The real concern, as Walker points out, is the unsustainable nature of the conventional agriculture and its adverse impact on biodiversity. Here again, I question whether biodiversity utilization in itself assures greater sustainability. Over-consumption, dating from the Pleistocene Overkill through to modern natural resource management, illustrate the elusiveness of sustainability under a wide range of conditions. Biodiversity utilization in contemporary forestry and fishery practices are proving just as unsustainable, despite scientific guidance (Noble and Dirzo, 1997; Botsford *et al*., 1997). Broadening the spectrum of species harvested may actually increase the impact on biodiversity utilization (Rice *et al*., 1997).

The challenge of creating the enabling conditions for sustainability therefore applies to all forms of landscape utilization.

Despite these caveats, I whole-heartedly support Walker's call for biodiversity utilization as a primary (or even supplementary) form of land use. My reasoning is that intensive agriculture, albeit sustainable, does not conserve much in the way of biodiversity. Sustainable biodiversity utilization does. Walker cites promising examples in the savannas and tropical forests. To these can be added coral reefs. In Kenya, tourist income based on marine parks exceeds that of fisheries by a factor of two and a half (McClanahan and Obura, 1996).

The global effort Walker calls for in support of biodiversity utilization should, however, be cast in a broader context than direct utilization alone. Ecological services, amenity value (tangible and intangible), intergenerational equity and existence values are significant indirect reasons to conserve biodiversity. Such non-monetary values, once recognized, give biodiversity some immunity from market forces lacking in direct utilization. Furthermore, because the greatest proportion of biodiversity survives outside protected areas, its fate will be determined more by what happens in the rural landscape than in fragmented parks liable to insularization and other threats (Western, 1979).

If, as Walker shows, there are examples emerging of biodiversity utilization despite the lack of policy and economic incentives, then hope for its expansion must surely grow given better circumstances. My concern with the southern Africa examples he gives is that they are exceptional in several respects. For the most part, they are located in marginal agricultural areas, depend on utilization based predominantly on specialized and often fickle niche markets (including tourism and sport hunting), and have largely been initiated and catalyzed by non-indigenous settlers. Similar schemes should, nonetheless, be applicable in Africa and elsewhere. However, the problems confronting efficient and sustainable utilization by traditional and transitional societies constrained by poverty, immediacy of need, high population density and the lack of tenure rights – as well as the requisite educational and managerial skills – will prove far more difficult.

My own view is that we have to look ahead to ask how a post-transitional global society in the late twenty-first century or beyond is going to support 12 billion plus people when half that number already sequesters a high proportion of earth's natural resources (Vitousek *et al*., 1997). It is hard to conceive an alternative to urbanization and industrialization, supported by intensive sustainable agriculture based on sound ecological principles and high-tech, integrated management practices. If intensified sustainable agriculture is realizable, more land can be redeployed for biodiversity uses, including specialized products (food, drugs, clothing, household items, etc.), recreation, amenity purposes, ecological services and non-utilitarian conservation. Given the sharp increase in demand for recreation and other uses of the outdoors likely to result from education, urbanization and higher income in future (Brightbill, 1960), surely our highest priority should be to speed up the transitional process?

Working towards the larger goal of global sustainability gives us hope for biodiversity in the long term. The question is, how do we create an enabling environment for maintaining biodiversity in the meantime? Beyond the obvious importance of protected areas lies the challenge of

eliminating perverse subsidies, demonstrating the value of biodiversity, addressing ownership and access rights to its assets, equity in sharing benefits and costs, establishing larger management units for common gain (and better ecosystem conservation) and the other factors impinging on sustainable utilization.

Walker recognizes these and other impediments and proposes 'virtual' biodiversity institutes to test and develop his proposition of utilizing biodiversity as a way to maintain it. He suggests that such centres would complement the CGIAR (Coordinating Group on International Agricultural Research) system responsible for developing and promoting new agricultural products and methods.

The proposal initially seems compelling, given how successful CGIAR has been in developing new high-yielding cereal crops. On reflection, I think the adoption of biodiversity utilization by rural community's calls for a different approach.

Biodiversity utilization and the challenges it faces involves neither the high-tech developments nor simple farm-delivery systems of conventional agriculture. It is inherently far more complex, involving a large number of imbedded and inter-related opportunities and constraints. While not precluding the biodiversity institute at a later stage, my own experience in community-based utilization leads me to advocate an alternative, more productive and cost-effective starting point.

Given the nascent programmes emerging around the world (Western *et al.*, 1994) despite the constraints, the first steps in encouraging biodiversity utilization should be to foster and spread these efforts by inter-community communication and by providing a supportive environment and financial incentives. Mainstream socioeconomic groups should be the focus of such incentives, with the aim of creating awareness of the options, managerial capacity, micro-enterprise credit and marketing skills. Trial and error should be encouraged as a way of promoting pluralism in the utilization and valuing of biodiversity. A mix of partners, including government and private, conservation and academic institutions should also be encouraged, built around landowners. Finally, there should be incentives for landowners themselves to form larger associations in the interests of deriving mutual benefit from ecosystem-level as opposed to farm-level management.

Stimulating such fledging efforts and creating a flow of information and exchange between communities and agencies will ensure the complex mix of uses and locally appropriate adaptations essential to the growth of biodiversity utilization. This contrasts with the more conventional approach to development, based on preliminary brainstorming, scientific analysis and technological transfer. It is, nonetheless the very reason for the initial growth and spread of community-based utilization. As such, it should be encouraged. Biodiversity utilization programmes in Kenya illustrate such an alternative grass-roots approach.

Here, a pilot biodiversity utilization project funded by a US Agency for International Development programmes has led to the formation of a National Landowner's Wildlife Forum. The forum itself will take the lead in promoting biodiversity utilization as an economic and sustainable form

of land use and developing a code of conduct. The national agency, Kenya Wildlife Service, in conjunction with donors, conservation bodies, tour operators and other parties, is encouraging this initiative by working through the forum to establish a trust fund designed to build landowner capacity and offer credit facilities for biodiversity enterprises. Priority will be given to utilization programmes falling within a national Minimum Viable Conservation Network.

This approach creates awareness and involvement among landowners at the outset. By making them the primary moving force, it also creates the conditions for distributed utilization, conservation and responsible management. The landowners and other agencies involved are beginning to define the research, monitoring and planning needs to improve understanding and integrated management. A biodiversity trust fund is under discussion to further these efforts. The process creates a demand for information and services, rather than the reverse.

Even with biodiversity utilization programmes taking root, it is inevitable that much biodiversity will be lost due to the inertia of existing demographic and socioeconomic forces. To buy time, a smorgasbord of old and new conservation approaches, including protected status and enforcement, easements, leases, subsidies, donor and NGO support and so on, will be needed to complement utilization programmes. These efforts are indispensible to the conservation of our most important and vulnerable biodiversity assets for the foreseeable future.

References

Brightbill, C.K. (1960), *The Challenge of Leisure*, Englewood Cliffs: Prentice Hall.

Botsford, L.W., J.C. Castilla and C.H. Peterson (1997), 'The management of fisheries and marine systems', *Science* **277**: 509–515.

McClanahan, T.R. and D.O. Obura (1996), 'Coral reefs and nearshore fisheries', in T.R. McClanahan and T.P. Young, eds., *East African Ecosystems and their Conservation*, Oxford: Oxford University Press.

Noble, I.R. and R. Dirzo (1997), 'Forests as human-dominated ecosystems', *Science* **277**: 522–525.

Rice, R.E., R.E. Gullison and J.W. Reid (1997), 'Can sustainable management save tropical forests? *Scientific American*, April: 34–39.

Tiffen, M., M. Mortimore and F. Gichuki (1994), *More People Less Erosion*, Chichester: Wiley.

Vitousek, P.M., H.A. Mooney, J. Lubchenco and J.M. Melillo (1997), 'Human domination of earth's ecosystems', *Science* **277**: 494–499.

Western, D. (1979), The environment and ecology of pastorialists in arid savannahs. In: *The Future of Hunter-Gatherers in Africa*, ed. J. Swift. International African Institute, London.

Western, D. (1989), Conservation without parks: wildlife in the rural landscape. In: *Conservation for the Twenty-first Century*, ed. D. Western and M. Pearl, Oxford University Press, Oxford.

Western, D., R.M. Wright and S.C. Strum, eds. (1994) *Natural Connections: Perspectives in Community-based Conservation*, Washington, DC: Island Press.