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Concluding remarks

Towards the sustainability of the Lake Naivasha Ramsar site and its catchment

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Abstract

Sustainable development remains a pressing priority for the Lake Naivasha Ramsar site, as a matter both of long-term protection of the lake ecosystem and of the economic and social progress that depends upon it. This must be addressed at catchment-scale to protect the 'ecosystem services' that constitute the region's primary resources. Sustainability principles highlight energy, fertilisers, pesticides and other aspects of chemical use, plastics, erosion and sedimentation, wildlife, water and socio-economic issues as central to sustainable development strategy, influenced by both intensive and subsistence farms across the catchment. Market forces and long-term self-interest provide compelling arguments for sustainable development, the delivery of which will depend upon education and the spreading of good practice, perhaps backed up by stewardship schemes. Alternatively, the adverse consequences of continued unsustainable practice are highly significant for the region.

Introduction

Fertile volcanic soils, relatively constant climate, high levels of solar radiation, a near-constant day-length and ready access to fresh water are features of the shores of Lake Naivasha, Kenya 0° 45′ S, 36° 26′ E. These features, in combination with an inexpensive labour force, have attracted a large number of intensive horticultural enterprises to the flat lands of the lake shore and on its inflowing river floodplains. Cut flowers and out-of-season vegetables are the predominant outputs, flown from Nairobi on a daily basis to provide luxury products for European markets. This form of development has proven extremely profitable and contributes the bulk of the nation's foreign exchange from horticulture, which was the third most-important after coffee and tourism in 1999 (Grant, 1999). It comprises a major element of the economic development of the Naivasha region, together with geothermal energy production. Tourism, sport and commercial fisheries are of lesser importance (LNRA, 1999). The wider lake catchment, by contrast, comprises land tilled for subsistence and cash crops with rough pasture. There is evidence that land use practices in this wider catchment may compromise the quality of the lake and rivers as well as the long-term viability of this form of small-scale farming (Everard et al., 2002a; Kitaka et al., 2002).

Some problems have developed with this proliferation in the extent and intensity of lake shore and catchment farming, notwithstanding their obvious economic and social benefits in the short term. Collectively, they reveal the challenges to sustainable farming in the Naivasha region. These problems are likely to be common to all such vulnerable tropical wetland areas, which are nevertheless priority sites for development due to their high productivity (Everard et al., 1995). Such wetland systems have in the past suffered from unsympathetic intensive development, which has led to their destruction or degradation with the loss of wetland 'services' and biodiversity (Dugan, 1990; Denny, 1991 & 1994; Everard, 1997). Naivasha was designated a Ramsar site in 1995 in recognition of its global importance to wildlife (LNRA, 1999), heightening the political and ecological imperative of sustainable development. A lake management plan has

begun to address lakeside issues through a process of consensus-building (Enniskillen, 2002) but extension of planning to the catchment scale is required to approach sustainability of the lake and catchment systems, and the livelihoods that depend upon them (Everard et al., 2002a). Such information about both the lake itself and its catchment is essential to gain an understanding of the behaviour and the factors influencing the state of the lake (Everard, 1999a). They are also critically important in determining the contributions of lakeside and catchment development, both urban and agricultural, to changes in lake properties and ecology.

Sustainable development

Rising populations and declining environmental 'headroom' mean that the substantial challenge of sustainable development is unavoidable for governments and for business (WCED, 1987; Hawken, 1993). This challenge is heightened in developing nations characterised by fast-growing populations and increasing expectations of material quality of life (WCED, 1987). The challenge is nowhere more intense than in vulnerable yet productive wetland areas, such as Ramsar sites (Denny, 1991; Everard et al., 1995). Part of the conditions of Ramsar Designation is that wetland management plans be devised to ensure Wise Use, defined as "*sustainable utilisation for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem*" (Ramsar, 1971). The Ramsar Commission consider Wise Use to be synonymous with sustainable development (Ramsar, 1996).

Everard (1998, 1999b) has discussed the widely-misunderstood, but nonetheless fundamental, distinction between true sustainable development and mere compliance with obligations, or with peripheral 'greening' activities. Sustainable development is the *process* of achieving the *state* of sustainability; the capacity for indefinite continuance through innovative development patterns in balance with the earth's supportive capacities. Critically, it includes the business sector – both agricultural and industrial – which provides wealth-creation and other societal services through exploitation, sustainably or destructively, of natural and human capital (Everard, 1998, 2000). Indeed, the capacity of big business to influence the sustainable development agenda, either positively or negatively, now exceeds that of national governments (Hawken, 1993). A commitment to sustainable development by a business or a government has necessarily to imply far more than mere altruism or 'public relations', enabling it strategically to place itself 'ahead of the game' in a fast-changing world of rising population and diminishing resources. For the small-scale enterprise, such as the subsistence or cash crop farmer, the principle of protecting the natural and human capital upon which future livelihood and profitability depends is more immediate and relevant, although the communication of this concept must necessarily differ. Sustainable development is therefore a mechanism by which both tomorrow's market and tomorrow's 'shocks' – food shortages, other resource scarcities, rising costs, more stringent regulation, soil loss, public perception, etc. – can be pre-empted by strategic action today (Everard, 1998).

Since publication of the 'Brundtland Report' (WCED, 1987) and the signing by 150 nations of the *Declaration of Principles for Sustainable Development* at the 'Earth Summit' in Rio de Janiero in 1992, the evidence for significant progress with sustainable development remains elusive (Everard, 1999b). Indeed, a third of the natural world was lost between 1970 and 1995, a sixth of the world's land area was degraded by poor agricultural practices, and 25% of global fish stocks are currently depleted with a further 44% are being fished at their biological limit (UNDP, 1998; WWF, 1998). The process is continuing at an increasing rate. Wetlands in developing countries are under particular threat (Dugan, 1990; Denny, 1991, 1994; Everard et al., 1995, Thenya, 2001).

Part of the problem has been in deducing what sustainable development actually means in robustly scientific terms that are also generically applicable to day-to-day decisions in business and government (Hawken, 1993; Holmberg et al., 1996). For the purpose of addressing priorities in the Naivasha region, definitions must also be workable from the national to the farm scale. The Natural Step (TNS) provides a systems model for articulating what sustainability means, and how practical progress with sustainable development may be achieved, fitting these needs (Holmberg et al., 1996). TNS principles are being used increasingly world-wide for various sustainable development initiatives (Everard, 1999a). At the core of TNS is a model of the sustainable cycling of matter and energy in the biosphere of this planet, and an emphasis on transition from unsustainable linear resource flows to cyclic processes that prevent the systematic accumulation of pollutants and the degradation of natural

and social capital. The breaches of the four first-order 'system conditions' deriving from this systems model enable identification of unsustainable practice and, in conjunction with other TNS tools, help formulation of plans leading enterprises – both large and small – incrementally towards sustainability.

An important aspect of this TNS approach to sustainability is that it supports decisions made on the basis of self-interest (Holmberg et al., 1996), at all scales from the local to the global. This aspect of the TNS approach means that solutions are more likely to be developed and accepted at national and regional government levels, and by businesses, and thereby to become integrated into core decisions rather than merely peripheral 'greening' or public relations exercises that tend not to endure (Everard, 1998, 1999b). Altruism alone is a luxury often beyond the means of those closest to basic subsistence. It also assumes relatively sophisticated understandings of cause and effect, and is not the most durable quality amongst even the most affluent. Everard (1998, 1999b) has discussed the relevance of the TNS approach to the water cycle, and TNS principles consequently provide the background to thinking about sustainable agriculture in this paper. Further elaboration of these high-level principles is provided by Holmberg et al. (1996).

Sustainable development challenges

It is possible to make preliminary assessments based upon the state of the Lake Naivasha ecosystem revealed in this volume. The first TNS system condition relates to the fact that, in a natural system, elements including nutrients are cycled with no net accumulation of waste and that, over geological time scales, any such substances (e.g. fossil carbon, nutrients, heavy metals) have become 'locked away' from the biosphere within the Earth's crust. Many human activities today however break this natural cycle by importing materials from the Earth's crust back into the biosphere where they then accumulate, resulting in problems such as pollution or eutrophication. Part of the challenge of sustainable development is to reduce the linear movement of these, originally mined, materials to levels that natural systems can reintegrate without accumulation (Table 1).

The second TNS system condition relates to human-manufactured substances not formerly found in nature. In a sustainable natural system, substances do not accumulate as they are broken down and reintegrated into natural solar-powered cycles. Many substances produced by society, including pesticides, CFCs, elemental chlorine and plastics, are not readily broken down and tend to accumulate, with unforeseen future potential impacts on human health (Table 2).

The third TNS system condition addresses physical degradation of life support systems. Natural resources such as water, forests and other ecosystems, and soil structure, as well as their supportive processes which provide life-support services that also contribute to economic activities and 'quality of life'. Procurement, usage and disposal/reuse of all such resources should be reviewed by all larger businesses within the context of a wider sustainable development strategy. For smaller subsistence farming, dependence upon the goods and services provided by healthy ecosystems is often critical to self-sufficiency (Table 3).

The fourth TNS system condition relates to socio-economic factors essential to long-term sustainability. Sustainable livelihoods depend upon ecosystem services within catchments, equitable share of their benefits, and collective stewardship. Without an equal share of potential economic and 'quality of life' benefits, there is likely to be no shared concern for, nor strategic approach to, problems relating to the shared ecosystem services. Sustainable development of the Naivasha region will therefore need to involve all stakeholders (Table 4).

Issues relevant to the achievement of sustainable agriculture at Naivasha

Recognising that we are not starting from the perfect position of undamaged habitat nor equitable wealth distribution, there is clearly a pressing need to address sustainable development if the unsustainable trends observed at Lake Naivasha are not to be perpetuated. Indeed, given the fast-rising population – the population of Kenya stood at 35 million in 1997 and is rising by an estimated million people per year – and increasing environmental and political pressures on the Lake Naivasha region which currently forms one of most important economic resources of the country, sustainable development is the over-riding priority.

The assessment using the TNS model outlined above provides a helpful and holistic framework of interconnected issues – including physical resources, ecosystems and ethical elements – relevant to the achievement of sustainable agriculture at Lake Naivasha.

Table 1. TNS System condition 1 in relation to Lake Naivasha

System condition 1: *In the sustainable society, nature is not subject to systematically increasing concentrations of substances extracted from the Earth's crust*. This relates to release of materials immobilized in the lithosphere (e.g., heavy metals, nutrients, radionuclides, fossil carbon) which an unsustainable society reintroduces into the biosphere at rates substantially exceeding nature's reintegration or redeposit rates (Holmberg et al., 1996).

The primary risk from the intensive agriculture at the lake edge are:

- Energy intensity in agricultural practice, particularly from fossil fuel sources
- Haulage of produce to Nairobi
- Reliance on European markets, hence primary dependence on aviation fuel
- High inputs of fertilizers which tend to leach into adjacent water bodies and groundwater

The primary risk from extensive catchment agriculture are:

- Loss of nutrients to waterways through soil loss
- Threats from possible increases of agricultural and energy inputs

Table 2. TNS System condition 2 in relation to Lake Naivasha

System condition 2: *In the sustainable society, nature is not subject to systematically increasing concentrations of substances produced by society*. This relates to synthetic substances alien to nature, and other substances produced by society at high rates, which therefore cannot rapidly be broken down and reintegrated in the biosphere (Holmberg et al., 1996).

The primary risk from intensive agriculture around the lake are:

- Intensive use of pesticides, some of which have been banned in developing countries
- Incautious reuse or disposal of plastics in growing tunnels, packaging and other processes
- Disposal of other chemicals used in laundry, processing, factory systems.

The primary risks from extensive catchment agriculture are:

- Use of pesticides where crop pest predators have been lost through habitat destruction
- Threats from possible increases of agricultural and energy inputs

Energy

The energy-intensive nature of the larger intensive agricultural activities around the Lake Naivasha shore are offset at least in part by the need for only brief periods of artificial lighting to extend day-length and the avoidance of heating, as compared to the requirements of agriculture in the European countries where the major markets currently exist. However, since the Kyoto Protocol in December 1997, and the subsequent re-negotiation of national greenhouse gas targets and trading agreements in Buenos Aires in the middle of 1998, momentum is growing at the international scale for controls on all sources of greenhouse gases. There are a number of energy impacts that agricultural concerns around Naivasha would be advised to review. The potential for a full transfer to photovoltaic, passive solar, geothermal and other technologies is significant in Kenya, and mature techniques such as natural ventilation and 'intelligent building' controls can further contribute to energy efficiency on site.

The energy entailed in transportation of produce from large commercial growers, including both road and aviation, is significant. Vehicle emission standards in Kenya are less stringent than those in Europe. However, the potential for costs savings through increasing fuel efficiency are significant given the distances (goods are hauled approximately 100 km from the lake to Nairobi's Jomo Kenyatta International Airport and along steep-gradient roads). Furthermore, as European retailers take more account of the ethical and environmental impacts along their entire supply chains in response to consumer demand and public perception, the more pressing will come the issue of tackling resource wastage whether compelled by domestic legislation or not.

The dependence of the major parts of the large agricultural businesses in the Lake Naivasha catch-

Table 3. TNS System condition 3 in relation to Lake Naivasha

System condition 3: *In the sustainable society, nature is not subject to systematically increasing degradation by physical means*. This relates to the 'engines' of processing in the biosphere; the quantity of productive surfaces, and the adaptable and efficient pathways provided by diverse ecosystems (Holmberg et al., 1996).

The primary risks from intensive agriculture around the lake are:

- Direct conversion of functionally important and rare habitat into intensive agricultural land
- Fencing that disrupts migratory behavior in animals (daily and seasonal)
- Water use, over-harvesting from groundwater and surface water sources
- Use of geothermal energy, the impacts of which on groundwater are not known
- Loss of native crop species and varieties, and essentially sustainable agriculture practices
- Degradation of soil structure and loss of topsoil through over-grazing or poor tillage practice
- Displacement of native crops and agricultural practices by intensive practices
- Increasing invasion by non-native weed species

The primary risks from extensive catchment agriculture are:

- Increasing habitat loss through more intensive land use due to population pressures
- Soil loss through erosion from over-grazing or unwise tillage practices
- Loss of ecosystem services, particularly wetland services through riparian development
- The spread of non-native weed species
- Threats from possible increases of agricultural and energy inputs, including tillage

Table 4. TNS System condition 4 in relation to Lake Naivasha

System condition 4: *In the sustainable society, human needs are met worldwide*. This relates to social considerations permitting compliance with sustainable resource use, including equity and resource efficiency (Holmberg et al., 1996).

The primary risks from intensive agriculture around the lake are:

- Disenfranchisement of local people through land ownership patterns
- Centralisation of economic benefits by large businesses and state companies
- Displacement of local nomadic people using lake shore habitat
- Disturbance of traditional tribal practices
- Loss of retreating and other itinerant forms of subsistence agriculture and cash cropping
- Inequitable wages
- Inadequate protection from the risks of agriculture (i.e. pesticide usage)
- Marginalisation of the poorest people to the poorest land
- Provision of luxury goods for developed world markets in place of subsistence for local people

The primary risks from extensive catchment agriculture include:

- Loss of farmland and productivity for future use by poor current land use practices
- Loss of 'quality of life' by extensive habitat and wildlife loss
- Threats from possible increases of agricultural and energy inputs
- Cash-cropping at scales that compromise the need for local food production

ment on aviation to supply European markets should be an issue of great concern in the light of trends in international policy and consumer pressure regarding taxation and controls on greenhouse gas emissions. Aviation fuel is currently not taxed, and is exempt from controls on greenhouse gas emissions under the Kyoto Protocol, rendering aviation artificially cheap. However, there is growing international pressure for taxation of aviation fuels. Indeed, since the Intergovernmental Panel on Climate Change estimated that air traffic accounts for nearly three times its previously-estimated contribution to global warming, there is

widespread and growing pressure from NGOs (non-governmental organisations) worldwide for appropriate taxation. Considerable research is already under way in the aviation industry about how to tackle this issue, which is widely regarded as inevitable in the longer term. Such measures are likely to affect the profitability of this form of farming in the medium to long term.

Furthermore, public pressure in Europe is squeezing big retailers to reduce the 'food miles' of produce on their shelves, with a move to local production for staples. All of the above factors have the potential to impact on the 'bottom line' economic performance of farms in the Naivasha region. They serve as classic examples of the ways in which unsustainable environmental and ethical practice will lead to decreased economic sustainability of businesses in a changing world, making more urgent a review of sustainable development policies across the farming sector.

There is a burgeoning population of small-scale subsistence and cash crop farmers throughout the catchment of Lake Naivasha, right up to the high gradient regions in the Nyandarua mountains, where energy use is a far less important issue at present. This scale of agriculture, including both tillage of land and grazing by stock (mainly goats and cattle), is performed on a largely sustainable basis at least with respect of energy inputs, which is substantially reliant upon manual labour. Where produce is transported for trade, this is largely done by bicycle, donkey cart, or people. However, increasing energy intensity is a trend that must be observed carefully, be that increasing usage of farm machinery (for example the use of tractors in the flat uplands of the Kinankop) for more intensive wheat and maize production, or the increasing use of mechanised transport. The low energy intensity of small-scale production in the catchment is arguably an obstacle to freeing people in the region from more productive uses of their time, and must be balanced carefully with other social aspects of sustainability. Local hydro power, photovoltaic and wind generation schemes are perhaps important areas for further consideration, as may be sustainable plantation of fuel-wood.

Fertilisers

Phosphorus and nitrogen are the main contributors to eutrophication in water bodies. Lake Naivasha, naturally nutrient-poor owing to the thin volcanic soils in its catchment, is particularly vulnerable (Harper et al., 1993; Kitaka et al., 2002). Agriculture worldwide is one of the key activities implicated in the transfer of nutrients into water bodies (Environment Agency, 1998).

Examples of best practice in some intensive farms, and included in advice to members of the Lake Naivasha Growers Group (LNGG), focus on a range of control measures. These include education of key staff as a means for preventing accidental losses of fertilisers, secure bunded storage of fertiliser stocks, metering of targeted application through drip feed, and delivery only of sufficient nutrient as determined by soil condition as a strategy both for reducing chemical costs and preventing leakage to the wider environment. One farm has also implemented treatment wetlands to reduce nutrient release from laundry facilities and surface run-off. These examples of best practice provide one element of an integrated and holistic sustainable development strategy. Adoption of European 'Best Practice' will be a defensive measure against future customer pressure, and as a wise proactive investment in resource stewardship including cost controls.

Management of intensive lake shore farms progressively to reduce chemical inputs and outputs is essential to sustainable development of the region. However, in addressing the sustainability of the lake, one has to ensure that its interactions with the whole catchment are adequately taken into account. (Kitaka et al., 2002) have found a close association between suspended particulates and phosphorus in the Naivasha catchment, and conclude that inputs from erosion in the catchment are highly significant compared to inputs from the generally tightly-managed lake shore farms. Everard et al. (2002a) present evidence of extensive poaching and erosion right up to the headwaters of most of these river systems. Though large intensive farms are absent from the less fertile and generally highly erosive soils away from the lake shore, Boar & Harper (2002) suggest that the input to the lake of sediments and their associated pollutants from the lake's riparian zone is a consequence of the loss of the buffering capacity of the *Cyperus papyrus* 'ecotone' which has been progressive in the last two decades (Fig. 1).

Pesticides

The accumulation of pesticides in Lake Naivasha is not yet at a serious level (Gitahi et al., 2002) but it potentially has three primary unsustainable impacts:

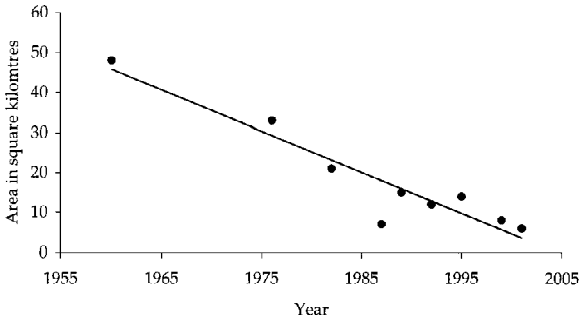

Figure 1. The decreasing area of *Cyperus papyrus* at Lake Naivasha. Data from Boar et al. (1999), Boar & Harper (2002) and Figure 1 of Enniskillen (2002).

- **Ethical** where effective training and protection of staff is not ensured, or where substances banned in developed countries due to known harmful effects continue to be used. There are also ethical implications entailed in the promotion of pesticide sales, and the fostering of reliance on chemically intensive agriculture, by small-scale farmers who can least afford it and who are likely to benefit least (if at all);
- **Ecological** where the pesticide substances are not fully contained on the larger intensive farms, and particularly where they upset the balance of nature by accumulating up food chains, impair critical links in the food chain, or damage vulnerable species or ecosystems. For the smaller-scale farmers, soil loss is a particular problem near watercourses and, where they are used incautiously, pesticides are likely to enter the river systems adsorbed to sediment particles; and
- **Market** stemming from obvious breaches of the above two, or where procedures or residue levels exceed those required by legislation in major markets (for example by European Union Directives). Equally, where used by small-scale farmers acting as 'outgrowers' (supply chain for the bigger growers), pesticide residues are likely to present problems for the final customers in Europe. Inputs deriving from any one of the larger intensive farms at the lakeside or in the catchment, or from a number of small-scale farms in the catchment, are likely to prejudice the reputation of all farms in the region in the eyes of their major markets.

One of the keys to understanding how pesticide usage may become sustainable lies in looking to how they influence, or might potentially influence, nature. This focus is important since it is the natural systems that are the ultimate source of all life-support and economic 'services' such as water and air purification, soil formation, mineral cycling. In the Lake Naivasha context, this includes factors such as clean fresh water, soil fertility and structure, biogeochemical cycling, and natural predators of crop pests. The ultimate aim is therefore not necessarily to avoid the use of pesticides; this may not be technically or economically feasible in the short term, and benign alternatives such biological control measures may not always be effective. It is instead to ensure that neither the pesticides nor their residues accumulate in natural systems, through incautious release at rates that nature can not break down and reintegrate.

Examples exist of best practice in some of the larger intensive lakeshore farms. These are focused on education of key staff in pesticide handling, secure and bunded stores, precision application, treatment of wash water, and interception of run-off. Some of this best practice is incorporated in the LNGG *Codes of Good Practice* which is commendable as part of a wider holistic sustainable development strategy. At least one farm is investing heavily in biological control agents and practices to bypass reliance on pesticides and to reduce the accumulation of pesticide residues in produce at levels unacceptable to European customers. Again, compliance with European 'Best Practice' is both a defensive and proactive measure.

Plastics

Plastics are used widely in intensive agriculture on the lake shore, both as growing tunnels and in packaging. Measures should be in place to ensure not only their collection and safe disposal, but also their efficient recycling. In a rural/urban region of hundreds of thousands of people, the quantity of plastic in litter is substantial. Present issues are:

- Accumulation of litter around the lake may attract condemnation from tourists, and adversely affect customer perception of supply chain stewardship by European retailers;
- Reuse of potentially contaminated waste chemicals drums, etc., that might cause health problems;
- Breakdown products from plastics, such as potentially hazardous plasticisers and stabilisers, might accumulate in local ecosystems with harmful results such as endocrine disruption, stimulation of cancers, or ecological imbalances. A full phase-out from persistent and bioaccumulative additives

is recommended, as implied by TNS system condition 2.
- Potential reuse of drums and other plastic packaging for domestic purposes such as carrying water, which risks contamination of users by substances such as pesticides.

A full re-evaluation of dependence on plastics, and their sustainable use, reuse and disposal, should feature as one component of an integrated sustainable development strategy. The LNGG *Code of Good Practice* guidance already addresses aspects of the issues, and small local enterprises are developing which recycle plastics either into moulded fence posts or woven domestic matting.

Erosion and sedimentation

Erosion is a significant issue in the catchment of Lake Naivasha, contributing to increasing loads of sediments and attached substances to the lake. The adoption of the principles, in the Lake Naivasha Riparian Association (LNRA) guidelines, of lakeshore buffer zones of 100 m from the shoreline, or 50 m behind a papyrus fringe, is a welcome measure to prevent sediment entry from lakeside farms. Boar & Harper (2002) provide data to support the fact that the papyrus fringe around the lake is of significance in preventing the entry of suspended sediments by diffuse run-off into the lake. Their recommendation for its conservation, first made a decade ago (Harper et al., 1990), has been taken up in the management plan (LNRA, 1999: Enniskillen, 2002).

Erosion and sediment input is a significant issue throughout the catchment, in addition to having a serious impact on the lake because of the loss of the buffering papyrus. In colonial times, there was a prohibition upon cultivation within 15 ft (approximately 5 m) of the river, and conversations by the first author with older catchment residents suggest that this contributed to richer riparian vegetation, greater habitat structure, and water and sediment retention throughout the river system. Re-instatement of these important riparian wetland features, and of their ecosystem services, is therefore important, whether achieved by voluntary or compulsory means. The former is much more likely to succeed, and a strategy for tackling this through community involvement is essential.

Wildlife

The physical 'footprint' of farms, as indeed of all forms of human development, inevitably displaces wildlife. Furthermore, many examples of unacceptable degradation of critical riparian habitat are readily observed around the lake (Enniskillen, 2002, Fig. 1). This habitat loss is a consequence of agricultural development, even if the land is subsequently managed sympathetically. Consequently, it is necessary to mitigate in some way this habitat loss in ways that genuinely address the needs of critical species that may have been displaced or disturbed, and of ecosystem 'services' lost.

Examples of good practice occur in the form of 'buffer zones' between the lake and river systems and some riparian farms. This is helpful not merely for good ecological reasons, but also as a matter of good sense in the light of the significant fluctuations of lake level such as that following the 1997/8 'El Nino' rains.

In the upper catchment, agreements on critical areas for wildlife and the protection of wetland services are urgently required (Bennun & Njoroge, 1999) – including for example 'buffer zones' along watercourses – as an element in the sustainable development of the Naivasha catchment. However, it is also important to recall that sustainable development for purely altruistic reasons is unlikely to be persuasive, or indeed a morally defensible approach, to present to those closest to subsistence. The 'enlightened self-interest' aspect of sustainable development is of far more direct relevance to small-scale farmers, and is one that is more likely to be adopted and maintained. Benefits derived from wildlife and ecosystem services, such as revenues from tourism, soil conservation, refuges for predators of crop pests, and flood protection should therefore form the basis for their protection.

Water

Like all life-supporting cycles, the water cycle *per se* is truly sustainable. However, current human exploitation of it is not. Furthermore, water is a vital resource, and will not only be limiting to development globally in the next millennium – it already is so in many countries, including Kenya and parts of developed nations such as the UK, Australia and the USA – but also touches all aspects of human life and is therefore affected by all sectors of society (Everard, 1999b). Any serious sustainable development policy, whether at farm/enterprise, regional, national or supra-national

level, must therefore address water, since it underpins and is impacted by all facets of human life.

Efficient water usage and re-usage in the arid Kenyan environment is essential to avoid damaging sensitive wetland habitats and denying others access to a fair share of water (Orie, 1996). For the intensive farms around the lake, it is important for their commercial success to prevent the perception by European customers of being irresponsible with the use of water and other resources. The designation of Lake Naivasha as a Ramsar Site accentuates the high global profile of the lake in the eyes of the public and the media. The consequences of irresponsible water usage – indeed anything less than an agreed 'best practice' guide – is therefore likely to attract bad press and therefore to damage market share.

The requirement to meter water abstraction in riparian farms (LNRA, 1999) highlights the need to review the efficient and equitable usage of water as a key component of sustainable development. In Naivasha, such eco-technologies include:

- Rainfall harvesting to reduce demand on abstraction from sensitive habitats. A further benefit of this approach is the desynchronisation of floodwater arising from hard surfaces, abating erosion, and also the loss of suspended and dissolved substances to the lake and rivers during heavy rainfall;
- 'Greywater' reuse and other methods of water reuse;
- Intermediate water treatment technologies, such as the use of treatment wetlands, and management and construction of these systems in line with best practice guidance such as that provided by Nuttall et al. (1997); and
- Further research and policy change is required with respect to the regional water abstraction licensing system which, in the absence of any robust quantified hydrological model for the lake, is unlikely to bear any relationship with sustainable yield from Lake Naivasha or its rivers or groundwater systems.

Damming is common in the catchment for small-scale water supply, and indeed is advocated as best practice by some of the larger growers with farms remote from the lake. Dams bring with them a range of possible adverse consequence, including disruption of flows of water and sediment, creation of centres of waterborne disease and exotic species, disadvantaging those downstream and possibly resulting in inequitable distribution of resources in the region.

Aside from local dams, small-scale farmers remote from watercourses in the Naivasha catchment have little direct influence on water bodies. However, there is a real risk of cumulative impacts deriving from farming close to rivers via sedimentation, inputs of contaminants, and from the loss of habitat and ecosystem services provided by riparian habitat, impacting upon river systems and the lake.

Any exceedence of the 'carrying capacity' of the catchment will inevitably lead to adverse ecological effects and decreasing longer-term sustainability. Water allocation, both on the lakeshore and throughout the catchment, therefore requires holistic review with respect to ecosystem needs and equitable distribution to the human population.

Socio-economic issues

Social considerations are integral to the achievement of sustainability. The reason for ensuring the inclusion of all sectors of society in matters relating to the sustainable development of the Lake Naivasha catchment goes way beyond a vague notion of 'equity', howsoever construed. It relates to the issue of collective stewardship. If sectors of society are not party to understandings of their interdependence with the catchment, or feel that they have no stake in its future, or if the benefits others derive from catchment services marginalise the majority, then there is no obvious reason for changing unsustainable behaviour. Without an equal share of potential economic and 'quality of life' benefits, there can be no shared concern and strategic approach to the problems that compromise them. Consequently, the sense of self-interest will, for entirely understandable reasons, lack the 'enlightenment' that provides for consideration of the impacts of decisions and practices upon others, on natural resources, or for one's own longer-term interests.

The continual exclusion of the majority from economic success, social development and decision-making can only perpetuate their unwitting contribution to continual ecological decline and lack of social cohesion. There is no political incentive to stop the practice of 'land grab' (enforced government repossession and reallocation of land ownership common throughout Kenya) and to reduce cultural instabilities, and so the way forward is through private and communal initiatives.

Reputation

Reputation, even in a distant part of the world relative to the European markets, is of direct relevance to the financial 'bottom line' of the intensive lake-shore growers. Examples abound of multinational enterprises, and of national retail chains and manufacturers, that source from developing nations and have suffered adverse reputation and loss of market share as a consequence of one form or another of bad practice down their supply chains. Reputation is therefore a facet of sustainability that the proactive company will manage, not merely for altruistic reasons but as a matter of 'enlightened self-interest' (Everard, 1999b, 2000). The importance of a commitment to sustainable development based on one's own best long-term interests is an issue of great importance in focusing thinking about sustainable development, as it provides a basis for policies and actions that are durable and which contribute to the best outcome for the region as a whole.

The case for collective action

From the perspective of the outside world, including critically those that comprise the final retail markets for farmers around Lake Naivasha, all economic activities in the lake catchment will be blamed for degradation of the health of the lake. Market forces, or 'common sense', will not prevent damage to the lake at an unacceptable scale. The tendency is exemplified in the *Tragedy of the Commons*, wherein all individually seek competitively to maximise their take of what is generally assumed to be a limitless shared resource. A good example is provided by major sea fisheries in international waters, a significant proportion of which have now collapsed due to individuals competing to maximise individual yields which collectively go well beyond the sustainable limits of the fishery. The case for concerted and proactive collective action by the whole community of Lake Naivasha is persuasive. There are a number of such groups representing common interests around the lake, including the Lake Naivasha Riparian Association (LNRA), the Lake Naivasha Growers Group (LNGG) and the Kenyan Flower Council (KFC).

There is clearly advantage to be sought in linking the work of these groups to the direction and output of scientific research programmes on the lake. These groups therefore need to expand to include all stakeholder groups across the catchment. Better understanding of eco-hydrological links between catchment land use and the lake is also necessary, together with a common approach to stewardship that reflects the central importance of ecosystem integrity to sustainable social and economic wellbeing.

Education and influence within the catchment

The quality and character of water bodies are inseparable from processes within their wider catchments, including the activities of the human population within living landscapes (Everard, 1999a). Appropriate adjustment of social/political and economic activities is therefore critical to overall sustainable development of catchments, upon which long-term protection and/or restoration of ecosystems depends.

Everard et al. (2002a,b) highlight the habitat and biological diversity of river corridors in the catchment of Lake Naivasha, noting their vulnerability to excessive or unwise land use. Everard et al. (2002a) and Kitaka et al. (2002) also note that poaching and manuring by stock and erosion through over-grazing and tillage were common phenomena throughout the catchment. Discussions by the authors with teachers and subsistence and cash-crop farmers in the upper catchment revealed that many were unaware where the river near which they farmed drained, or that their activities could contribute to problems downstream and in the lake itself. Education and other forms of influence on land use practices throughout the catchment therefore form an important component of any holistic lake management plan aimed as achieving Wise Use of the Lake Naivasha Ramsar site (i.e. sustainability of the catchment serving the lake).

Such education and awareness programmes need not be expensive. Indeed, viewed at the regional scale, they may be highly cost-effective methods for delivering a range of social, public health and environmental messages, and can attract sponsorship from national funds, international aid sources, charitable trusts and businesses. In Kenya, for example, the National Environmental Action Programme (NEAP) proritises issues requiring awareness-raising, and particularly via schools and public education which may provide a framework within which to prioritise, seek further funding and implement the proposed land/water catchment stewardship strategy. On a bigger scale, the UNDP/UNEP Global Environmental Facility funding process adds money to national support in ways that protect biodiversity within a broader participatory initiative that also enhances social and economic

development, including the facility to apply for seed Project Development Funding.

The key to successful education programmes would appear to be effective local management from stakeholders, and the tailoring of delivery to the needs of local people. Strategies have a better chance of success if local communities, with their wealth of traditional management techniques, are involved from the first stages of development, and with their own needs clearly prioritised, rather than being patronised with 'developed world' solutions (IIED, 1994). Nirarita (1999) describes a successful schools programme in Indonesia focusing on Wise Use of wetlands, and integrating issues of demography and environment, family planning, pollution and conservation, with an emphasis on 'local content and local context'.

The message that sustainable development is a matter of 'enlightened self-interest', implicit in The Natural Step approach, is helpful in focusing on the needs of communities and developing awareness. It can help address not merely conceptual issues, such as the wider geography of the catchment and the potential for harm downstream, but the long- to medium-term benefits accruing to farmers and their families at the local scale in terms of sustaining their basic needs. Simple examples of self-interest include:

- Prevention of soil erosion as a means to protect fertile soils and rich grazing over time. This can be effected by simple buffer zoning techniques, contour tillage and drainage, and appropriate stock density rules. Moisture content and soil structure are also protected where erosion is avoided through rainwater infiltration. Advise must be tailored to local culture and need.
- Protection of natural ecosystems ensures the continued availability of natural resources such as fresh water, timber, bush meat and lianas through low-frequency cropping, etc.
- Natural ecosystems also provide a refuge for the predators of common crop pests, averting the need for future reliance on expensive and potentially dangerous agrochemicals.
- Trees, if cropped at a sustainable rate, help maintain soil temperatures, promoting optimal grass growth rates, and also help prevent erosion. Regulatory controls are required to address unsustainable clear-felling and other extensive destruction of ecologically important forest areas.
- Targeted and appropriate use of agrochemicals (particularly fertilisers and pesticides) can save substantial costs.
- Prevention of pollution, both directly and through diffuse route, will ensure the continual supply of water that is both clean and free from disease.

Local champions using best practice on their own shambas (small subsistence farms) in the catchment could potentially serve as demonstration sites. These have advantages over the use of remote educators, as they are 'hands on', local to those one seeks to influence, connected directly to their needs and daily realities, and proving the principle of 'enlightened self-interest' in practice.

The potential benefits of a stewardship scheme

The development of a regionally specific stewardship scheme is a logical extension of the ideas in this paper, contributing to a business-led protocol for sustainable development that will yield a range of direct benefits.

Industries dependent directly upon ecosystem health have been amongst the first to recognise that the sustainable exploitation of primary natural resources is fundamental to their economic sustainability (Everard, 2000). Examples of this recognition include the enormous strides taken by the paper industry over recent years towards the goal of sustainable profit through sustainable resource management and manufacturing (Porritt, 1998). Forest industries and those using forest products have joined together in Europe to establish sustainable stewardship schemes for both wood production and forest growth, including the Forest Stewardship Council (FSC), the UK Woodland Assurance Scheme (UKWAS) and the nascent Pan-European Forest Certification scheme. For marine fisheries, the parallel Marine Stewardship Council (MSC) scheme has been led by WWF and Unilever, whilst there are plans for the establishment of a related Land Stewardship Council (LSC) for sympathetic land usage in agriculture in the UK (Tickell, 1999).

Furthermore, the stewardship idea is one with which developed world corporations are comfortable, and particularly the larger European manufacturers and retailers (Unilever, 1997). Lake Naivasha would provide an ideal case study for the development of such a scheme in Kenya. Whether this takes the form of an internal certification marque within a company, or one for which external auditing was required for any grower from the Naivasha region, across Kenya, or

across tropical Africa, the benefits for stimulation of trade through contribution to the wider sustainability of the region are clear.

The *Kenya Flower Council* (KFC) is already a significant step down the road to the type of independently verified stewardship scheme suggested here. For good business and competitive reasons, further progress is strongly recommended. The new business direction for many multinationals is sustainable development, although many openly acknowledge the struggle entailed in getting to grips with the meaning and measurement of the concept in practice (for example, Unilever, 1997; Wessex Water, 1998). However, sustainable development is for them a pressing priority and, in the light of diminishing environmental capacity and increasing population across the world, is one that is not likely to disappear.

Conclusions

Global society is a long way from sustainability (or, in other words, the capacity for indefinite continuance). The pressure to tackle sustainability will intensify over the coming years, and the challenge will be no more intense than in developing nations where the pressures of growing population, increasing expectations of material 'quality of life', and decreasing environmental capacity will be felt most directly. Tropical wetlands offer fertile land for development, both agricultural and industrial, that may act as a source of basic commodities for society as well as a source of foreign revenue. The challenge of achieving their sustainable development is therefore pressing, ensuring that the ecological productivity and diversity of natural systems – soil formation, biogeochemical processing, wildlife, etc. – continue to be sustained and to underpin the economy in the longer term. Sustainable farming on sensitive and important wetlands such as the shores of Lake Naivasha, and its increasingly populated catchment, is at the forefront of this challenge, ultimately delivering Wise Use as required under the Ramsar Convention.

Tackling sustainable development in a concerted and serious manner is a mechanism by which the social development and economic benefits of the Naivasha regions can be secured on a sustainable basis. The achievement of business with 'zero-impact' on the systems from which life-support, economic and 'quality of life' benefits derive is not likely to be quick or easy. However, the potential for loss of unique ecosystems, global market share, and social wellbeing and stability is so great that the challenge of sustainable development must be grasped as a matter of urgency.

Sustainable development of Lake Naivasha can only seriously be conceived at the whole-catchment scale, and the challenges, whilst differing between the lake shore and in the catchment, must be addressed in harmony within a unified regional plan. Aid may well be required, and indeed is available from a number of national and international sources, to realise this goal. Nevertheless, it remains a pressing priority to protect the long-term ecological, social and economic well-being of this vulnerable and productive region of Kenya.

Naivasha is a resource of global significance, and very much in the public eye. The message that sustainable development is a matter of 'enlightened self-interest' will therefore resonate with residents and local businesses reliant on foreign markets attuned to the adverse press reaction, and loss of market share, generated by apparent ecological or social exploitation along supply chains. The consequences of continued non-sustainability are as significant as are the gains to be achieved from seriously addressing sustainable development as a major and strategic issue for local businesses and regional development.

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