



**WORLD
FISHERIES
TRUST**

SUSTAINABLE USE OF AQUATIC BIODIVERSITY

Key Issues and Opportunities for IDRC

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1.0 SUMMARY AND RECOMMENDATIONS

This report considers aquatic biodiversity in its role of supporting livelihoods, and is intended to assist IDRC in planning investments in development research. The report is based on the scientific literature, World Fisheries Trust's own experience, analysis of the Action Plans in the National Reports of some fifty developing countries who have signed the Convention on Biological Diversity, and analysis of current and past IDRC research projects in agricultural and aquatic biodiversity.

Development investments in the "sustainable use of aquatic biodiversity" will inevitably relate to fisheries (including capture and culture fisheries), especially fisheries management. The two main current trends in fisheries management are ecosystem-based management and a "people-centred" outlook that focuses on the importance of biodiversity for livelihoods and a greater role of communities in management.

Aquatic biodiversity is poorly understood and declining. How does IDRC promote sustainable livelihoods in an area where the resources themselves are subject to a bewildering variety of adverse influences? Neither a purely traditional management system nor one relying solely on modern technical tools is likely to function well on its own.

In WFT's view, IDRC-sponsored research in the sustainable use of aquatic biodiversity should be undertaken within one or more of the following themes, which represent the "big picture" for aquatic biodiversity and development.

Aquatic Biodiversity and Development Themes

1. Creating cross-sectoral awareness of aquatic biodiversity
2. Strengthening civil society and influencing policies affecting aquatic biodiversity
3. Improving understanding of the role of natural aquatic diversity in the lives of the poor
4. Identifying, monitoring, assessing and conserving aquatic genetic resources important to the poor
5. Offering management and other technologies where appropriate
6. Raising general awareness of aquatic biodiversity and its role for communities.

Perhaps the most important of these themes is the need for cross-sectoral awareness and linkages. One of the biggest obstacles to ensuring sustainable livelihoods from aquatic biodiversity is the number of sectors that impinge on aquatic resources. Rivers and oceans cross boundaries and are affected by the actions of people in mining, forestry, industry, urbanization, and many other areas. Water itself is a medium for transport, irrigation, power generation and recreation, and is vital as a raw material for industry.

The effect of all these interactions and conflicts around water is that it is difficult to cleanly pick out "issues" for action. For example, the effects of dams on aquatic biodiversity merit research. Is "dams" an issue that IDRC should concentrate on with a cluster of projects, such as increasing harvest from a reservoir? Or, because dams affect aquatic biodiversity on several levels, should IDRC help build sectoral links and policies to prevent or lessen the damage?

In the end, we looked for research goals that (1) are compatible with IDRC's established philosophy of research in natural resources and (2) had the best likelihood of catalyzing action in areas beyond the aquatic sector in isolation. We considered the seventeen issues identified by the countries themselves, noted natural alliances and overlaps, and arrived at two **Recommended Research Goals** for IDRC.

Technical Research Goal
MAINTAIN AQUATIC GENETIC DIVERSITY

Genetic diversity is the cornerstone for livelihoods that exploit aquatic resources. Maintaining genetic diversity in wild and cultured aquatic organisms is fundamental, especially at a time when genetic diversity is declining. IDRC should support projects that describe and conserve local genetic diversity; promote awareness of the importance of genetic diversity in communities; promote policies for sharing the benefits of genetic diversity; promote the small-scale culture of native species; evaluate the contribution of genetic diversity to the livelihoods of the poor; and encourage the protection of native genetic diversity (for example in reserves and protected areas).

Although the recommendation applies to all regions, the situation is especially critical for inland waters, where genetic diversity and the livelihoods based on it are most at risk.

Policy Research Goal
LINK SECTORS AND IMPROVE GOVERNANCE

Linkages and governance affect how genetic diversity can be preserved and used, and they ensure sustainability of project results. Participatory management depends on forging linkages and alliances that would have been unheard of a decade ago. IDRC should invest in projects and programs that promote the building of inter-sectoral linkages and the development of systems of governance that allow community participation in aquatic resource management. Finding ways to bring together technical experts, managers, communities, indigenous people, and representatives of all the other non-fisheries sectors that affect aquatic biodiversity should be an IDRC priority.

The goal carries a strong awareness component, within IDRC, between research partners and among stakeholders. Stand-alone workshops that bring stakeholders together are also recommended, especially if they focus on one of the four technical issues below (dams, aquaculture, protected areas and climate change).

To achieve the above goals WFT recommends three **Strategies**.

Strategy 1
SUPPORT THE EVOLUTION OF COMMUNITY BASED MANAGEMENT

Community-based fisheries management, or participatory management, is in a period of global growing pains. Development investment in any one model will not necessarily pay off, because models will be tried and abandoned. IDRC should accept the process for what it is and stay open to a variety of solutions. One way is to look for examples of successful management and begin

cautiously to "seed" other areas, where possible with the participation of people involved in the successful project.

Strategy 2 **BUILD GENERAL AWARENESS OF AQUATIC BIODIVERSITY**

“Aquatic biodiversity” does not mean the same thing as “aquatic abundance.” One of the greatest challenges for development research in this area will be to raise awareness of this distinction among the users and managers of aquatic biodiversity. Aquatic biodiversity will only begin to be used sustainably when people accept that the abundance of their target species depends on diversity of other species that are not their targets. Although most people know about aquatic abundance (for example, the collapse of the cod fishery), aquatic *biodiversity* still has a low profile in developed countries like Canada; in developing countries it is almost invisible as an issue. While most development projects pay lip service to public awareness, few take it seriously - yet it is knowledge that empowers people on all sides of an issue to collaborate and find solutions. In addition to raising awareness of aquatic biodiversity internally, IDRC can help fill this vacuum with strategic awareness projects aimed at all aquatic biodiversity stakeholders, with the desired result always being the increase in communication between them.

Strategy 3 **KEY TECHNICAL ISSUES:** **DAMS, AQUACULTURE, PROTECTED AREAS AND CLIMATE CHANGE**

Dams damage fish populations and human populations directly, and they also affect the way the two interact (by reducing fishing or changing water use patterns, for example). **Aquaculture** occurs at several scales, relies on biodiversity and also affects biodiversity while causing considerable controversy by its environmental effects. **Protected areas** are a promising “ecosystem-based” strategy that require detailed biological knowledge and the participation of local communities. And the effects of **climate change** on aquatic biodiversity trickle down to users, who may be in for some painful surprises over the coming decades that no amount of participatory management can overcome.

2.0 ANALYSIS OF EXISTING IDRC PROGRAMS

In addition to analyzing how developing country signatories to the CBD viewed their own aquatic biodiversity problems, we also analyzed IDRC’s existing strategy and investments for biodiversity, based on published programs and projects. This process allowed us to see how the countries’ aquatic biodiversity “wishlists” might resonate with the existing IDRC philosophy.

IDRC research projects in natural resources (including agriculture) are organised into four areas: the Community Based Natural Resources Management Program Initiative (CBNRM PI), the MINGA PI, the Sustainable Use of Biodiversity PI, and the NAYUDAMMA information bank of technical projects ‘from the South for the South’ that IDRC supports, directly and indirectly. The CBNRM PI is focused on Asia, and the MINGA PI on Latin America and the Caribbean.

To assess what IDRC is already doing in these areas, WFT examined individual projects within the above Program Initiatives, using the current IDRC website as source (and recognizing that this source depends on the frequency of website updates). Many IDRC projects do not fall neatly into one Program Initiative or under the sole responsibility of a specific PI team. Given the multidisciplinary approach of IDRC, some cross-border fluidity is to be expected. Even so, we had considerable difficulty establishing just what is being done and where.

The only strictly aquatic projects found in SUB were: ‘Collaboration Research Network on Conservation and Utilization of the African Tilapias’ (1996), ‘National Workshop on Coastal and Fisheries Co-Management (South Africa)’ (1997), ‘Workshop on Community-Based Management of Coastal Biodiversity in Indonesia’ (1996), ‘Aquatic Biodiversity - Mekong River Video’ (1996) and ‘Community Management of Marine Medicinals’ (South East Asia, 1997).

Many more projects with some relevance to aquatic biodiversity were found under CBNRM. IDRC clearly already invests in many projects that have a biodiversity component – but aren’t included in the SUB program. This suggests that increasing the investment in specifically aquatic biodiversity projects is not too much of a stretch.

How closely do IDRC’s existing “biodiversity investments” match up with WFT’s four recommended areas for IDRC investment in aquatic biodiversity? To get a rough answer to this question, we considered 85 projects within the past five years that have “some” relevance to aquatic biodiversity, based on an analysis of project summaries in the programs already noted (CBNRM, MINGA SUB and NAYUDAMMA). In terms of supporting WFT’s recommended strategies, they were distributed roughly as follows:

Support the evolution of community-based management. Fifty-two projects (61%) have strong conceptual links to this recommendation (includes projects that promote indigenous involvement in management). However, apart from the coastal resource management projects and a few others, few are specifically aquatic. Nevertheless, the principles of community based management are the same. Clearly our first recommendation should have little difficulty in finding a “home” at IDRC.

Promote Sectoral Linkages and Alliances. We judged 21 projects (25%) to have strong conceptual links to this recommendation. Some projects could just as easily have been lumped with the previous group.

Build general awareness of aquatic biodiversity. We found only three projects (4%) with this goal, and even then only as one of the expected outputs (a resource kit for researchers). Although planners routinely pay lip service to the need for “building stakeholder involvement through awareness”, this is clearly not an IDRC priority. In fairness, it is not a priority with any agency – despite the near-universal call for “more awareness!”

Key technical issues (dams, aquaculture, protected areas and climate change). Four of the 85 projects touch on dams, three relate to aquaculture, one to marine protected areas and one to climate change. This very small representation suggests a “passive” approach to technical areas like these. By the same token, if IDRC accepts WFT’s view that these technical issues are key issues in aquatic biodiversity, there is clearly room for expanding the portfolio.

Bearing in mind that the above groupings are hardly scientific and based on information currently on the IDRC website, it's still very evident where the present IDRC mindset coincides with our findings on key issues in aquatic biodiversity, and where these issues are not presently part of IDRC programming.

3.0 AQUATIC BIODIVERSITY AND DEVELOPMENT

The present report grew out of IDRC's participation in the recent international workshop *Blue Millennium: Managing Fisheries for Biodiversity*, co-funded with UNEP and organized by World Fisheries Trust. It reflects WFT's research experience in aquatic genetic resources, their exploitation and management. A good point of departure for this report is the summary report *Fisheries and Biodiversity: A Primer for Planners*. This report is one chapter of the Blue Millennium workshop, and is available on CD-ROM from WFT and will also be formally released by UNEP at COP 7 in The Hague, April 2002.

The CD also contains full text of WFT's analysis of National Biodiversity Strategies and Action Plans, which form the primary data set for the present report. We eliminated from our database most of the *developed* countries that have significant aquatic biodiversity, leaving 33 countries whose aquatic biodiversity is under threat from many directions. In most of these countries, aquatic biodiversity is an important livelihood base. We compiled "Wish Lists" which contain all the aquatic biodiversity needs made apparent in the National Reports. From them we synthesized key **Issues** for the sustainable use of aquatic biodiversity, some of which may respond to a community-level research strategy. The seventeen issues are presented in Chapter 5.

This report does several things. First, it makes clear the extent of concern within developing countries about aquatic biodiversity and its importance for livelihoods. It does this largely by analyzing the countries' "own words," in the form of their biodiversity strategies and action plans. Second, and most practical for IDRC and other development organizations, it provides a "template" against which requests for development research assistance can be held – including agricultural projects that may have an impact on aquatic biodiversity.

In preparing this report, WFT tried to identify themes that were valid across borders, and to focus where possible on policy development that would help countries avoid the genetic erosion trap so common in agriculture. We assumed an increasing pressure on native aquatic genetic diversity through aquaculture and hatchery programs, and we also looked for areas where agricultural projects could "add on" an aquatic biodiversity component.

Aquatic biodiversity is central to the livelihoods of countless communities in the developing world. However, aquatic biodiversity is under-represented in species lists and global conservation priorities, and the application of modern development principles is not so immediately obvious as it is for terrestrial biodiversity, which is better known and more predictably exploited. This report is the first step toward detailed recommendations on research areas and projects that make use of philosophies and experiences that already reside within IDRC, chiefly in the Sustainable Use of Biodiversity (SUB) program.

WFT's philosophy in preparing this report reflects the current development climate in which a balance is being struck between technical and social inputs. WFT believes that technical measures stand the best chance of succeeding when they are based on social agreements on and shared use of resources, and social agreements stand the best chance of enduring when local communities believe they are acting in their own best interests.

3.1 Agricultural and aquatic biodiversity: similarities and differences

Most projects funded under SUB deal with agricultural, not aquatic, biodiversity, and the uses of these resources by communities differ in that fisheries are often 'open access' - completely unlike carefully husbanded fields and orchards. Can we find parallels between 'terrestrial biodiversity' and 'aquatic biodiversity' projects?

Aquaculture, the farming of aquatic organisms, is in many ways similar to agriculture, and particularly so in its dependence on genetic diversity and selective breeding. Hence the thinking behind many SUB projects on genetic resources in agriculture is directly applicable to new projects on sustainable aquaculture - with the understanding that aquaculture is a relative newcomer on the human scene. This newness, however, is an opportunity for IDRC to help developing countries "get it right," especially where the small scale culture of local species is concerned.

In Asia, for example, despite the overall trend toward intensification of aquaculture and dependence on "improved" strains brought in from other regions or countries, there is great interest in, and potential for, persisting in the development of indigenous species for local culture. Thirty per cent of the National Reports analyzed for this report identify aquaculture as a biodiversity issue (see Chapter 5). WFT's Recommended Research Goal "**Maintain aquatic genetic diversity**" captures these parallels to agricultural research.

The SUB program's interest in medicinal plants provides another parallel, because these resources are generally open access, like most fisheries. Collection of medicinal plants and collection of aquatic organisms with pharmaceutical potential by coastal communities have many similarities.

Despite these similarities, aquatic biodiversity has many characteristics that set it apart from the genetic diversity of terrestrial plants and animals (see *Fisheries and Biodiversity: A Primer for Planners*). Human use of terrestrial plants and animals has long since passed the hunting-gathering stage, and farming communities have rich traditions of plant husbandry and breeding which it is appropriate for development agencies to help study and preserve. Aquatic organisms, on the other hand, are still predominantly hunted and gathered from the wild, with no equivalent to the human inputs into agriculture. Fishing communities carry no seeds of survival with them. When the fish disappear, they have nowhere to go. The great failure of fisheries management over the last half century has been to regard fishes and other aquatic life forms as watery crops to be harvested without consideration for their roles in ecosystems. While aquaculture is growing rapidly, it is still overshadowed by fishing on unimproved, undomesticated species that exist within those complex ecosystems.

The techniques used to gather information on aquatic biodiversity must therefore differ from those used for agriculture, because there is simply not the wealth of literature on aquatic genetic resources that exists for plants. In a practical sense, this has meant that national compendia and

reports on biodiversity, such as the National Reports to the CBD that provided much of the data for this report, have been rather light on the aquatic side. Nevertheless, this doesn't mean that aquatic biodiversity is secure. The effects of habitat loss, pollution, hatcheries/introduced species, overfishing and climate change are threatening fisheries and livelihoods around the globe.

The tools needed to manage aquatic biodiversity sustainably may also differ from those used in agriculture. For example, users of aquatic resources may need scientific knowledge on which to base sustainable harvests, especially knowledge of natural ecosystems (which are much less important in agriculture). They need to be aware of the biodiversity consequences of apparently benign technologies such as seed-gathering and aquaculture. They need communication channels with other stakeholders such as foresters and farmers whose actions affect aquatic biodiversity. For these and other reasons, an IDRC activity in the sustainable use of aquatic biodiversity may look fundamentally different from one for crops - it may, for example, have more to do with simply securing the resource for fishing, improving fisheries management, or developing more equitable policies for sharing aquatic resources.

3.2 Involving the users of aquatic biodiversity in research and management

Until the late 1980s, the myth of the inexhaustible seas was strong enough to confine concerns about aquatic biodiversity to academia. However, with the well-publicized collapse of many marine fisheries and the explosion of freshwater aquaculture, the 1990s saw a steady growth in awareness of the importance and precarious nature of aquatic biodiversity. Much of the impetus for this awareness has come from fishing communities whose way of life is changing radically as aquatic biodiversity is lost. These communities need to be key participants in development research on aquatic biodiversity.

In light of our imperfect understanding of the effects of human 'management' on aquatic resources, an important means of assessing development is to consult those with first-hand knowledge of the aquatic resources in their natural state: the users. However, it is important to realize that, while communities rely on aquatic resources for their livelihoods (through fishing, aquaculture or collection of ornamentals) their appreciation of the importance of biodiversity may be very low. A good example is Canada, where the role of genetic diversity in maintaining Pacific salmon stocks, on which millions of people have depended over the years, was not officially recognized until the late 1990s. Fisheries management in Canada is now in the throes of accommodating to awareness of the role of genetic diversity. It would be unreasonable to expect developing countries to be further ahead on this learning curve.

Nevertheless, local fishing communities often have traditional knowledge of great value for management. Community leverage in management negotiations is much improved by knowing distribution, occurrence and status of their local species. Communities can also become participants in biological studies needed to improve management of stocks. The genetic information we already have on fished species is only the tip of the iceberg. For example, regional laboratories are gaining expertise in DNA analysis and can form partnerships with communities for sample gathering. Training is needed in sample collection and handling for a variety of other kinds of studies as well, including studies of life history and other biological characteristics. Participation in sampling programs encourages linkages between communities, scientists and managers, and opens eyes in both directions, not least to the need for good science.

Local and indigenous groups can be pivotal in valuing and maintaining aquatic biodiversity. Strategic research investments by IDRC have already resulted in changes in local management of Pacific salmon stocks by BC aboriginals (for example the ongoing genetic resource conservation program of the Carrier-Sekani First Nation) and have brought aboriginal concerns to the policy table as national fisheries genetic resource policy evolves. Aboriginal concerns about access to fish genetic resources have also been raised through IDRC projects and are presently being incorporated in a global overview on the uses of aquatic genetic resources by local and indigenous communities (WFT, in preparation).

3.3 Participatory fisheries management, especially in inland waters

The contribution of inland waters to the global economy is under-appreciated. Inland waters contain 40% of all aquatic species, are subject to greater habitat threats than the oceans, and have by far the largest proportion of endangered and threatened species. Inland aquatic biodiversity can be expected to be lost at an accelerating rate, and freshwater species are more vulnerable to losing biodiversity at the genetic level than are marine.

Small-scale fisheries are a powerful inducement for conservation and sustainable use of aquatic biodiversity. Especially in freshwater habitats, fishing communities may be the best advocates for sustainable use (diverse fishery = diverse river). Their advocacy can be multiplied by giving them the tools to negotiate more effectively with the other sectors whose influence on habitat is likely more detrimental to aquatic biodiversity than is fishing. These tools are technical (for example, better knowledge of catch and effort) and socio-political (for example, negotiating skills).

Inland water fisheries are mostly small-scale and play a larger role in supporting communities in developing countries than do marine fisheries. However, inland fisheries are poorly documented, and detailed knowledge of freshwater species is still concentrated in universities. Increased investments need to be made in identifying and managing freshwater aquatic biodiversity in developing countries. Special attention should be paid to tropical floodplain fisheries in South America and Asia, including collection of better harvest statistics (which can be used to gauge the health of fisheries and biodiversity).

River communities in developing countries are prime candidates for successful participatory management (co-management) of fisheries. Because freshwater fish biodiversity is affected by so many outside influences, especially on habitat, the need to interact with other sectors of societies is particularly strong.

Development investments should be made in collective action to increase local participation in fisheries management. However, the project team needs to have a clear understanding of boundaries between the biological and social sciences. First, biologists must understand their own limitations in working with communities, and thus respect the role of social science in encouraging those communities to help biologists gather information on the fisheries; and, just as importantly, their role in empowering communities to negotiate with the rest of society. Social scientists must in turn recognize the importance of good scientific understanding of fish populations and their response to outside pressures, and the limited interest of fishing communities in becoming fish biologists or managers.

Second, social scientists must in turn recognize the importance of good scientific understanding of fish populations and their response to outside pressures, and the limited interest of fishing communities in becoming fish biologists or managers. Ecosystem-based management and community-based management require basic knowledge of the aquatic ecosystems in question. One cannot, for example, establish and manage protected areas without some understanding of the population dynamics and predator-prey interactions within them, and local communities cannot manage their aquatic resources without access to information on stock compositions, migrations, harvest impacts, and policies of other sectors that impinge on the resource. While the rhetoric of many NGOs and development agencies would have local communities managing their "own" aquatic resources according to time-honoured traditions, there is strong evidence that many such traditional systems were anything but sustainable. In a world where most stocks are harvested aggressively or subjected to severe habitat or climate pressures, access to technical management tools is important.

As the "hidden army" of advocates for fisheries sustainability, local communities will respond to any action that provides them with a voice in management. In communities where this ability to network and influence management needs to start from the ground up, a first step is investment in community fisheries awareness (school events, fish "days", festivals). Finally, efforts to introduce sustainable fisheries development need to identify and invest in strong local personalities. While fisheries development projects need to be participatory, a concerted effort should be made to identify and include local leaders, who need to be involved to ensure sustainability of project results. If participatory management is to work, the leaders who will ensure sustainability should be local community members. Local NGOs should also be empowered to promote fisheries management changes regionally and nationally, thus ensuring a network that reaches from community to state.

3.4 Effects of other sectors on aquatic biodiversity

Aquatic biodiversity projects are characterized by a very high requirement for multi-stakeholder input (because of the multiple impacts on the resource), and participatory management of local fisheries is a major theme of most fisheries symposia today.

Agriculture and forestry, both of which receive attention under SUB, are good examples of the outside influences on aquatic biodiversity. For example, agricultural chemicals pollute water and soil eroded from poorly tilled fields silts up spawning and nursery beds. Farmers plowing to the riverbanks destroy native vegetation that shades the water and provides food for fish and crustaceans. Forestry harms aquatic biodiversity largely by destroying habitats, through siltation and erosion. Because of these interconnections, it is imperative that the planners of even small-scale agricultural projects be aware of the potential fallout for aquatic biodiversity, and exploit connections to aquatic biodiversity awareness wherever possible.

This interdependence means that there are many potential linkages between existing SUB projects on agriculture and potential aquatic biodiversity projects.

3.5 The need for linkages and alliances

Because aquatic ecosystems are affected by so many human actions in addition to fishing, cross-sectoral linkages should be built into all fisheries development projects, either explicitly, through inclusion of other sectors, or through promoting local awareness of the project and its issues using media and schools.

Ideally, a commitment to cross-sectoral communication will require a good knowledge of the other actors involved globally in issues affecting water resources. Water is drawn away from rivers by agricultural interests, and is returned to rivers by pulp mills; it is dirtied by logging operations and cleaned by wetlands restorationists experimenting with natural filters in the form of water plants. Coral reefs are damaged by the anchors and flush toilets of yachts. Marine and coastal investors desire to build large luxury hotels to attract masses of economy-class tourists who will swim and bathe. In short, few of the competing users of water have any direct interest in the aquatic life of water, as their interests lie primarily in exploiting the water itself.

The overall goal of the seventeen Issues identified by the WFT study (Chapter 5) is a healthy aquatic environment that can be used sustainably by humans. However, progress made in each issue is dependent on progress made in the others.

For example, fishing with bleach causes **pollution**, for which **management capacity** must be increased, perhaps through the creation of **protected areas**, which must be **assessed and monitored**, and protected by sufficient **legislation**, which to be effective should permit **local communities to share in the benefits**. Naturally, such communities will take a greater interest in responsible management once they are **aware** of the consequences of losing their mangroves and wetlands. **Coastal and Marine Management** can protect these mangroves from erosion and pollution, or from pressure placed on fragile ecosystems by uncontrolled **tourism** or unregulated **aquaculture**. Aquaculture may involve the building of roads into remote coastal communities and the construction of cooling facilities, and such improved infrastructure can help those same communities export **native fish** that currently go to waste on the beaches during peak harvest times. Programs to **protect native species** can help preserve genetic resilience in the face of invasions of **alien species**, whether accidental or introduced for aquaculture. And, lastly, better **access to information** gathered locally by foreign scientists and dispersed in institutions abroad can help managers make informed decisions: on **reform in governance**, new methods of pollution control, benefit-sharing, identifying protected areas, preserving mangroves and wetlands, and so on.

Many developing countries, for example Indonesia and Fiji, stress economic growth over environmental health. For more effective programs aimed at sheltering aquatic resources or habitats and keeping them available for livelihoods of the poor, umbrella alliances must be forged with other sectors and other ministries, in order to fight degradation on the broadest of fronts. These alliances, especially for aquatic biodiversity, are complex, but their nurturing needs to be supported. Agriculturalists need to work together with aquatic resource managers, because water is fundamental for both agriculture and fisheries. Clean water is also a concern of the Ministry of Health; of sanitation and drinking water departments in City Hall; of golf courses and gold mines. While clean water is good for fish, it is even better for human society. The forging of alliances is not the same thing as the creation of better governance, although it may result in it. It can even

happen incidentally, for example by designing development research projects to include diverse partners.

The first steps in forging broader links will be in finding partners, not to share in specific programs, but to raise awareness of the cumulative impacts of these other-sectoral activities on the 'hidden' resources of water. An example of such a partner could be the **International Water Management Institute (IWMI)**, which is working to understand how river basins respond to socio-economic shifts, water scarcity or competition for water between different users. Their field laboratories are 'Benchmark Basins'; each site serves the dual role of research and capacity building with local partners, and each basin is a partnership between IWMI and a range of local authorities, including ministries of water and agriculture, national research and university communities, environmental groups, NGOS, and – 'as relevant' – local communities.

3.6 The importance of governance

Ranking the issues according to popularity, as we have done in Chapter 5, may produce some false impressions. As the most "popular" issue identified in this study, governance is a good example.

It may well be true that better governance will save world fisheries, stop the destruction of habitat, and feed the poor. It may also be true that bureaucracies show a tendency to self-perpetuation. What is indisputable is that, where government is poor and weak, corruption and waste flourish. Better governance may encourage stronger civil societies, which will work to reduce corruption and waste. Government workers may be as concerned as, and perhaps better informed than, civil society, but they too often work within an environment whose overhead costs and bureaucratic procedures eat up funds and enthusiasm. The very ability of government to dispense largesse also leaves it open to predatory forces, whether these be industrial fishing fleets, wealthy shrimp-farmers, or foreign mining companies escaping tighter environmental regulations at home. Civil society, being diffuse and almost a moral state, is largely immune from such attentions¹.

The World Bank has concluded that what it calls 'Poverty-efficient' allocation to reward good policy works much more effectively in reducing poverty than allocations made before good policy is in place. The Bank also concludes that ideas work better than money in generating reform and improving public services. In light of this, WFT believes that IDRC should give high priority to the development of better governance, in tandem with building inter-sectoral linkages and alliances.

3.7 Women in fisheries

None of the reports analyzed by WFT mention the role of women in using aquatic biodiversity.

¹ The corruption that fastens onto sources of easy money deserves more attention in aid circles. Of the 33 developing countries studied here by WFT, 23 have been ranked by the Gesellschaft fuer wissenschaftliche Datenverarbeitung in a study of corruption in 91 countries that included developed states. Finland, Denmark and New Zealand topped the list for 'cleanliness'. At the bottom of the ranking was Bangladesh, preceded directly by Nigeria, Uganda, Indonesia, Kenya, Cameroon, and Bolivia. At Number 30, Namibia ranked relatively a high and, not surprisingly, the National Report of Namibia made among the very best impressions among all 52 countries studied by WFT. What stood out early in the report was a firm commitment to self-reliance. While some funding for biodiversity conservation does come from abroad, Namibia sees most of its future funding coming from restructuring and reorienting domestic financing (government and private), through policy initiatives such as the Environmental Investment Fund.

While there are some success stories from agriculture where women have controlled the harvest and processing of local crops (for example the argan tree in Morocco), such success stories in aquatic resources are rare. The contribution of women needs to be better studied and, if it is resulting in a net benefit for local communities, it needs to be facilitated

In small scale fisheries, women help clean the fish, sell them in markets, and mend nets.. Where women have been successful as a group in dominating any one or all of these divisions of labour, none of these labours is independent of men or of larger organised groups which, in the interests of greater economies of scale, often move in on a good thing to make it better. In so doing, they inevitably displace the smaller operators. This happened, for example, in the Nile perch fishery of Lake Victoria. There the women who formerly dried the small native fishes along the beaches and distributed them inland lost their livelihoods in large part following the introduction of the Nile perch, a bigger and oilier fish that could be handled on an industrial scale and packaged for export. This case is a good example where a catastrophic effect on aquatic biodiversity (introduction of the perch and displacement of some three hundred endemic species) had corresponding social effects.

4.0 TECHNICAL ISSUES

Aquatic biodiversity is subject to a wide variety of impacts, and, unlike most agricultural biodiversity, it still exists as part of complex, “unsimplified” ecosystems. For these reasons, most research projects on aquatic biodiversity, even if they are aimed at a primarily social target (for example, a project on participatory management), carry a strong technical component. Of all the technical issues confronting aquatic biodiversity, WFT believes the following ones are most likely to respond to an IDRC-style approach.

4.1 Dams

Conspicuous by its absence in many National Reports is the effect of dams on aquatic biodiversity. Dams, whether for water storage or for hydroelectric power, can have devastating effects on both inland and marine species and the communities that depend on them.

- Dams convert sections of rivers to lakes. But the species that evolved in the river are rarely well adapted to living in standing water, and so lake species move in (or are stocked) and come to dominate. The dams block migratory fishes from proceeding to and from their spawning beds, and they prevent nutrients from being washed down the river to deltas. Coastal fishes that relied on the nutrients suffer, and erosion along the coasts increases, since deltaic sands and silts are no longer being replaced by sediments brought down from mountains and plains. Mangrove swamps find less soil to root in, and when the mangroves disappear, along with them disappear the nurseries of many marine and coastal species. Communities that live along the coasts have fewer fish to subsist on.
- Below the dams, the lack of replenishing sediment lowers riverbeds as the currents carve deeper into the ground. Once the riverbed sinks below the groundwater table, which it formerly replenished, the groundwater table drops as the normal flow of river water into the soil is reversed. The falling groundwater table sinks out of reach of all but the most deeply rooted woody vegetation, and the vegetation that dies off leaves bare patches of soil that get eroded by

rainfall and wind.. The resulting decline in their agricultural productivity is often hastened by the trampling of livestock, driven towards the river after shallower drinking sloughs dry up. And herds of cattle crowding riverbanks drop fecal bacteria into the drinking waters of communities downstream. To get clean water, communities drill wells, further lowering the groundwater table.

- Irrigation, intended to alleviate this situation, often brings problems that include the flushing of pesticide or fertilizer-contaminated water into rivers and lakes, causing poisoning and eutrophication.
- Above the dam, the rising waters displace riverside communities and drown farmland. Dams in which submerged forests are left to rot give off greenhouse gases more injurious than carbon dioxide.

The reason the effects of dams appear not to rank as a priority may be that dams are still widely perceived by governments in the developing world as symbols of 'progress'. Their economic benefits are immediately measurable. Electric power hums in power lines over villages lit since antiquity by candlelight, diverted river waters make deserts bloom, and the reservoirs behind the dams support new artisanal fisheries that take out many more fish than were harvested from the river. Unfortunately, none of these benefits are sustainable. The huge early catches of the artisanal fisheries, for example, shrink drastically once the food chain nourished by the rotting vegetation has absorbed all the nutrients.

4.2 Aquaculture

The culture of aquatic species raises fundamental questions about the sustainable use of aquatic biodiversity, including its collection, ownership, dissemination and preservation. Yet aquaculture is recognized as a “biodiversity issue” by a relatively low thirty percent of the countries sampled in this report, and few of them do more than promote it as an economic activity. Generally, such attention is positive and forward-looking. Some countries draw attention to drawbacks, such as the potential for increased pollution. Few acknowledge the effects on biodiversity. At this stage in the development of aquaculture, it appears that most fish farmers see their activities as primarily agricultural. There are economic inputs, and there are economic outputs, and the balance sheet is quite clear - for the present. Unfortunately, there are huge hidden environmental costs, including habitat loss, spread of disease, and introduction of exotic species.

Aquaculture clearly has an important role in increasing food security. It is, however, also a major source of export revenue, including in developing countries. The trend toward the use of a few domesticated species over large areas is also the trend in agriculture, where the drive is not for greater biodiversity but for a greater mass of consumable protein. Agriculture has long used highly domesticated species bred for productive efficiency and predictable phenotypes. Aquaculture, so far, has followed this pattern. Frequently, the species promoted are exotics (e.g. tilapias), "improved" strains of local species or transplants from other river basins within a country. The genetic effects of escape and establishment of these fish are usually ignored. The large-scale promotion and culture of a few domesticated strains can even be a disincentive for farmers to grow local varieties.

In the case of enhancement or stocking, releases to the wild are deliberate, but the animals released are genetically dissimilar to wild types. In most such "enhancement" programs, there is no assessment of results. The consequences of large-scale releases of hatchery-bred fish into the wild are rarely if ever considered or discussed with communities, and state extension departments are either unaware of these consequences or unwilling to confront them. Where enhancement is promoted as a means of increasing livelihoods, local communities should be enlisted in monitoring its effects, both in terms of increased protein and changes to genetic makeup of wild stocks. An investment in building user and extension awareness of the genetic effects of aquaculture and stocking would send a powerful message about the value of biodiversity and stimulate research on technologies for developing aquaculture systems that make use of it. A strategy that encourages networking between state agricultural departments, commercial large-scale fish farmers, state biodiversity planners, university researchers and communities is recommended. This strategy lends itself well to regional workshops.

Aquaculture can have effects on ecosystems beyond those of introducing exotic genes. A major trend in aquaculture is toward intensification, so that operations move from being low-trophic-level producers of protein to high-trophic-level fish that are actually net protein consumers. This trend is especially seen in Asia. However, extensive culture makes better use of natural ecosystems, for example paddies and floodplains, and should be promoted as a way of sustainably using existing aquatic biodiversity.

Not all kinds of aquaculture have negative effects on ecosystems. Small scale aquaculture in the developing world poses few such problems. In some countries, like Bangladesh, this kind of farming is dominant. Small-scale aquaculture projects can acknowledge and identify potentially promising new species or attempt to quantify the value of native biodiversity. Larger-scale, industrialized aquaculture, however, competes most strongly for natural ecosystems with native species. For example, mangrove swamps can be converted to ponds for the raising of high-priced prawns for the export market. Inland water bodies, as in Thailand, can be converted to salt water ponds for the same purpose - at a great cost in salinisation of surrounding soils and social reordering, since prawn culture attracts large amounts of money.

One environmentally promising aquacultural system combines land agriculture with aquaculture. In rice-fish farming systems in Asia, the fish eat the insects that otherwise must be combated with pesticides; their excretions fertilise the pond bottom, which can be dug out and spread on the land in the fallow season; and the protein from the fish improves the diet of the farmers. But this is hardly industrial-scale aquaculture, and it is industrial-scale aquaculture that most threatens aquatic systems.

The first step in reducing the environmental impact of aquaculture is raising awareness. What is needed first of all is a firmer definition of aquacultural projects as essentially *aquatic* rather than agricultural. To this end WFT would like to see a workshop or roundtable convened at the global level with NGOs whose main concerns are in raising agricultural productivity. An example of such an NGO is the International Institute for Tropical Agriculture (IITA), whose published recommendations on stocking lakes with exotic fish reveal little awareness of the impact of such stocking on native species.

4.3 Protected areas: a proven strategy

Aquatic protected areas seem to be working, and on several levels. Even very small areas have great educational value, showing local people, including fishermen, the potential richness of aquatic life and sending a strong message about human effects on ecosystems. Small protected areas allow biodiversity to be appreciated in local (not monetary) terms, and on a scale where lessons can be passed from generation to generation. Experience in several countries also shows that local support for small protected areas is contagious, so that neighbouring communities begin to create a chain of no-take or restricted fishing zones. Hence such small areas would be good development investments, as they appear to have the ability to multiply a modest initial outlays. Small protected areas in developing countries guarantee community involvement and offer the hope for an expanded network.

Choice of protected areas will have to consider the state of biological knowledge in the area, and should ideally be based on some knowledge of whether an area is a biodiversity source or a sink. Developing countries are well suited to protected areas because of strong local bonds to the sea/lake/river. Because of the great importance of small-scale inland fisheries, there is also a strong case to be made for investing in some pilot freshwater protected areas. However, the criteria and methods will be very different from marine areas.

Any investment in protected areas should include funding for long-term monitoring.

4.4 Climate change

None of the National Strategies and Action plans of the 33 countries covered in this report refer specifically to the impacts of climate change on aquatic biodiversity. Yet climate change, although man-induced, is the most difficult of the many impacts on aquatic biodiversity to undo. Its effects are global, not regional or local, and they occur at every level in the aquatic ecosystem. Habitat can be recovered, and fishing and pollution can be reduced, but climate change dwarfs all of these in terms of scope and intractability. For no other threat is the need for sectoral cooperation between regulators, legislators, policy makers and scientists so urgent. For these reasons, WFT urges IDRC to consider climate change an “over-arching” technical issue with the potential to undermine sustainability of project results.

Global warming has important consequences for aquatic communities. By the year 2100, climate change is expected to be the major threat to biodiversity in inland waters, replacing the effects of land use and invasive species. Those freshwater animals that cannot tolerate changes in temperature or water availability will be the first to be affected. Global weather patterns will be disrupted, probably made more severe; droughts will be longer and storms more violent and more frequent. More storms will increase erosion in logged-over river headlands and batter coastal estuaries and mangroves, feeding grounds and nurseries for many marine species. Long droughts will dry up lakes and wetlands not already drained and converted to farmland

Climate change must be recognized as a new and powerful influence on aquatic biodiversity, and capacity needs to be built to make fishing communities in developing countries aware of its implications. Modeling studies are needed to create scenarios that can be discussed in communities and with managers, who need to realize that fisheries "good times" may not last. Species that

depend on transient floodplains for reproduction and rearing, such as tropical migratory species, may experience a severe reduction of habitat and are at special risk. These species are critical providers for local communities but occur in regions where they are unlikely to be studied in depth.

Temperature increases in the range predicted by most models (3-5°C) will have many effects on aquatic systems, including increased water temperature, changes in stream flow, changes in lake size and thermal layering, a rise in sea levels and consequent loss of estuarine habitat, and a great increase in “extreme events” like floods and droughts. Any of these consequences alone will change the distribution and abundance of aquatic life; in combination their effects on fisheries may be drastic. For example, species that depend on transient floodplains for reproduction and rearing, such as tropical migratory species, may experience a severe reduction of habitat. The ranges of many species will also shift north. Warm-water species will become invasive.

5.0 ISSUES IDENTIFIED BY COUNTRIES

This section of the report presents the seventeen **issues** most commonly identified in the National Reports of developing country signatories to the CBD. Because the state is not the sole priority-setter (which would leave out much of civil society and the NGO sector), WFT also looked beyond the national reports for evidence of problem areas that, whether governments call attention to them or not, repeatedly crop up at scientific conferences and in published papers. For example, the Lake Fisheries Productivity and Quality Enhancement project of the Philippine Department of Science and Technology aims to halt the deterioration of Laguna de Bay. However, the Philippine National Report does not mention treating water pollution as a priority (choosing to concentrate instead on fisheries sector reform with a strong socio-economic emphasis). Nonetheless, since the water quality of the Bay appears to have been met with some degree of officially concerted action, the Philippines earn a slot under the heading "Pollution", along with states which may have identified the need to build waste treatment plants or undertake awareness campaigns.

In a more extreme case of governmental 'non-priorities', nothing was mentioned in the National Report of Mexico about the rural shrimp-fishing community that is excluded from the export industry because the fishers' artisanal mode of production is considered unproductive and inefficient. (Whether this community will benefit from the stated government policy to increase aquaculture remains to be seen). Where such contrasts warranted attention, WFT has tried to read between the lines, without crossing over into advocacy.

The seventeen issues presented here are anything but independent. Goals may often be reached through tackling a cluster of issues. For example, a strategy to improve fisheries management may rely on programs to tackle the three separate issues of **overfishing**, **water pollution** and identifying potential **protected areas**. And these issues themselves may be included in other goals, for example building up cross-sectoral capacity and heightening public awareness.

In some cases, especially where policy is concerned, we have had to infer a connection to aquatic biodiversity that is not explicitly stated. The National Reports and Action Plans of signatories to the CBD do not usually break policy actions down into separable categories (forests, agriculture, tourism, fisheries etc). Where some, for example Cameroon, speak of 'integrating indigenous land claims and interests into planning', they may not therefore have in mind specific plans for aquatic

resources. Naturally, indigenous control of resources or participation in the use of the resources will not usually be resource-specific, but area-specific. Without being bidden to, local communities would probably 'integrate' their aquatic resources into their own management plans. In such cases we have assumed an aquatic context for generalized policy actions.

The developing nations with significant aquatic biodiversity are listed alphabetically under the numbered Issues headings. The number in brackets following each title indicates the percentage of the 33 countries that identify the particular issue. The parenthesis that follows a country pertains to only that country, except where two countries linked by 'and' precede the parenthesis.

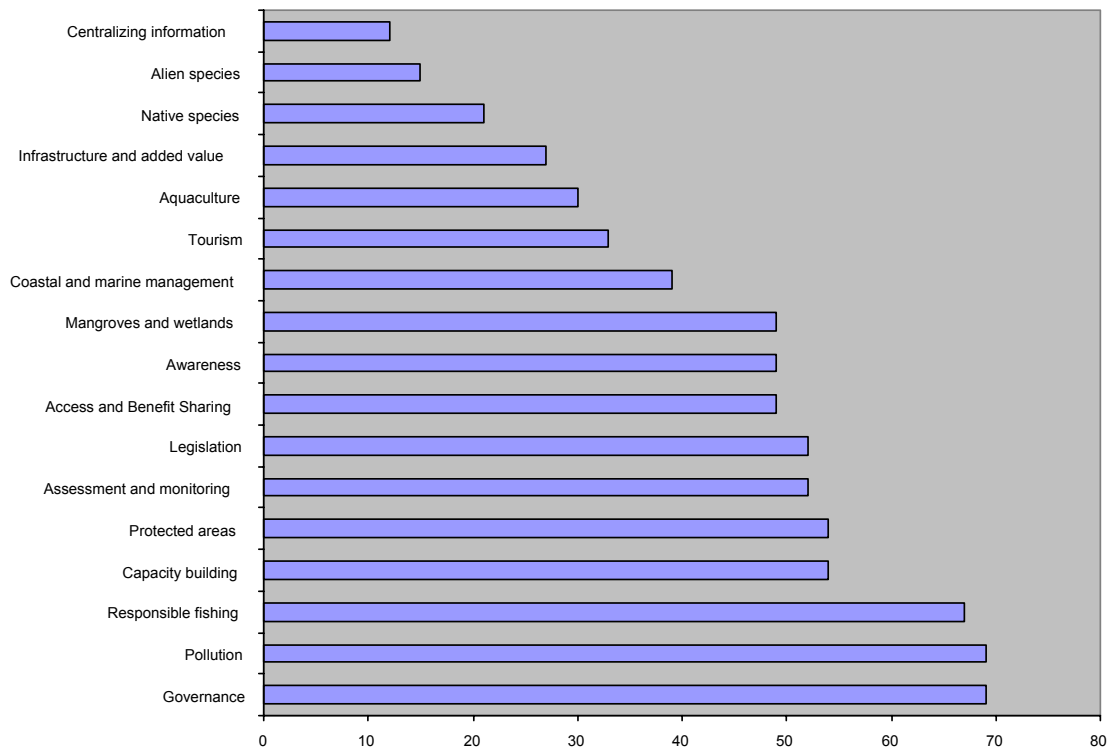


Figure 1. The 17 issues and their frequency of identification by countries

Issue 1: **GOVERNANCE** (69%)

Argentina	implementation of the CBD needs an intersectoral framework
Bangladesh	too many separate ministries involved in water-use decisions
Belize	adequate mechanisms needed for involving the private sector and communities and for inter-ministerial co-ordination
Bolivia	lack of planning and co-ordination
Brazil	Environmental Impact Assessments for dams; although NGO sector is active it lacks public and private policies and proper institutionalisation
Burundi	a body needed for biotechnology transfers
Cameroon	less duplication, better communication between scientists and policy-makers, better co-ordination between donor project team and in-country teams
Congo-Kinshasa	better monitoring of compliance with international, regional and sub-regional accords, more planning for aquatic ecosystems and natural habitats
China	function and responsibility of departments and interdepartmental coordination need clarification, local bodies need to be strengthened and coordinated
Fiji	mechanisms to ensure government interventions are relevant to the interests of stakeholders
Indonesia	decentralising management, conflict of interest at the national, provincial and local levels
Iran	reorganize institutional structures for sustainable use
Kenya	heavily sectoral; policy preference for short-term gains
Malaysia	need for national policy to override regional
Maldives	policy and regulatory frameworks
Mexico	better co-operation between fishers and scientists, necessary to define regional priorities and more specific actions at a local level
Namibia	opening the Sea Fisheries Advisory Council proceedings to the public would encourage debate on how to trade few jobs now for more jobs later
Nigeria	the Niger River Commission is more or less moribund
Peru	no national strategy on biodiversity, hence no trans-sectoral agreements
Uganda	some sectoral policies encourage wetlands drainage and conversion to unsustainable uses
Vanuatu	important initiatives to manage biological resources have been sector-based and focussed on specific resources
Vietnam	international management body needed for transboundary stocks; Ministry of Forestry, the authority responsible for protected areas, has no mandate to protect marine areas
Zambia	research and training activities are poorly coordinated; national fisheries legal and institutional framework undergoing substantial revision

Issue 2: POLLUTION (69%)

Argentina	improving land-use practices to combat river degradation
Bangladesh	reducing sewage and urban liquid waste run-off
Belize	unregulated growth of industries is affecting the Barrier Reef)
Bolivia	contaminated fish pose grave risk to human health, targeting extractive industries for improved clean-up)
Cameroon	land-based pollution from industries, urban centres and agro-industrial plantations
China	in Ninth Five-Year plan water issue ranks above all over threats
Colombia	need for economic incentives to apply clean technologies (i.e. polluter-pays
Congo-Kinshasa, Congo-Brazzaville	marine ecosystem shows increasing signs of degradation, in particular pollution by hydrocarbons)
Ecuador	life wiped out of many river basins, no economic incentives exist, lack of technologies to monitor marine pollution
Fiji	all but two of Fiji's dumps for domestic and industrial wastes are in mangrove areas or by rivers; heavy-metal levels in Suva harbour rival the most polluted harbours of Australia
India	building treatment plants
Iran	shrimp effluent, coastal pollution from sewage
Kenya	need for measures to minimize deterioration of water quality
Malaysia	better primary treatment, economic incentives and disincentives
Mexico	evaluation and control of terrestrial sources of ocean pollution needed
Mozambique	eutrophication of Lake Niassa, rivers polluted from headwaters in South Africa
Nigeria	exploitation and degradation increasingly impairing the Niger Delta on which the rural communities depend
Peru	mining waste, fishmeal processing waste, coastal areas lack sewage treatment, oil industry waste, toxic chemicals used in making cocaine paste
Philippines	pollution of wetlands from mine tailings, hazardous industrial wastes, factory discharge, agricultural fertilizers and pesticides and household wastes
Tanzania	water hyacinth invasions, soil erosion, toxic run-off
Thailand	water pollution from factories and shrimp farms has forced villagers to move their oyster beds farther offshore
Vietnam	marine pollution from estuary sedimentation, maritime activities and industrial wastes has degraded biodiversity

Issue 3: **RESPONSIBLE FISHING** (67%)

Bangladesh	reducing wastage, educating shrimp-fry collectors
Belize	control over collecting species; Belize may be the final repository of some species extinct in other parts of the region
Brazil	overfishing a problem in some river systems and coastal ecosystems, illegal methods
Burundi	reducing post-harvest wastage, reduce industrial overfishing in the pelagic zones
Cameroon	improving fishing methods
Congo-Brazzaville	reducing wastage
Ecuador	poaching and the export of threatened species are the main problem in the Galápagos Islands
Fiji	many fish species in heavily populated areas are growth overfished, several species stock overfished by artisanal
Indonesia	training and education, investigate 'joint' fishing ventures
Kenya	establish realistic harvest levels
Madagascar	reducing wastage in shrimp fishing, collection of amphibians, control trawling
Maldives	manage increasing demand for high-value fish
Mexico	of the 30 main fish stocks, 20 are now being exploited at about their MSY or need recovery plans
Namibia	excessive capacity in the industry provides a powerful lobby for interpreting scientific data too favourably
Nigeria	jurisdictional conflicts with shrimp trawlers intruding on river mouths, reduce bycatch, better use of shrimp by-catch
Peru	over-exploitation a particularly important threat to marine biodiversity
Philippines	chemicals, explosives; illegal fishing by mainland Chinese has contributed to a decrease in regional fish stocks; need to induce commercial fishing away from overfished shallow water
Tanzania	chemicals, overfishing of immature fish in large areas of Lake Victoria
Thailand	large trawlers get exemptions from 3 km limit
Vanuatu	localised resource depletion; most common threat to marine biodiversity is commercial over-exploitation
Vietnam	develop deep-water resources to ease pressure on inshore resources from population growth, overcapitalisation, and ease of entry into fishing sector
Zambia	overfishing the major threat to sustainable production, caused by too many fishermen and destructive fishing gear, fish poisoning and dynamite).

Issue 4: **CAPACITY-BUILDING** (54%)

Belize	for managing genetic resources, monitoring international conventions
Bolivia	training for young national scientists
Burundi	in managing purse seine fishery of Lake Tanganyika
Cameroon	for policy analysis
Colombia	no growth in the last 14 years in the number of specialists in biological diversity
Ecuador	very difficult to obtain information on human capacity, esp. private sector; corruption a major problem
Fiji	devolution of fisheries development activity will require retraining of government staff
India	greater human resources development in all areas of concern is necessary
Kenya	NGO sector needs strengthening, avoid duplication and even triplication of efforts
Malaysia	manpower and training are the areas in which international cooperation and financial help are most needed
Maldives	general lack of human resources and technical manpower in biodiversity issues
Mozambique	major constraint is lack of trained researchers
Namibia	skilled graduates are avoiding the sciences, institutionalization of CBD is poor
Philippines	capacity to research biodiversity and knowledge of economic and social dimensions are weak
Sri Lanka	working on building capacity for gaining a better understanding of indigenous biodiversity
Thailand	lack of personnel for biodiversity activities is a problem largely ignored for many years, several institutions still unable to identify specific activities relevant to the CBD
Vanuatu	until funding was received from UNEP in 1997 there had been no resources, staff or budget for the CBD; priority given to economic growth
Zambia	resources and trained manpower are scarce

Issue 5: **PROTECTED AREAS** (54%)

Argentina	building a network
Belize	management capability outstripped by growth of protected areas, management plans for some PAs should be mandatory prior to designation
Brazil	inadequate personnel
Burundi	improving ecological knowledge as basis for establishing Pas
Cameroon	suitable sites being sought
China	protecting coral reefs
Congo Kinshasa	no protected zones
Fiji	present system seriously inadequate
Indonesia	mapping, establishing regeneration zones, low local community participation, excessive centralization in management
Kenya	Forest Department has no power to protect catchment areas outside gazetted areas
Malaysia	need to pay attention to land adjoining marine protected areas
Mozambique	the Mozambican part of Lake Niassa is not protected
Nigeria	extending protected areas
Philippines	only about 5% of coral reefs remain in excellent condition
Thailand	more efficient management of Pas
Uganda	aquatic and wetland ecosystems are not well represented
Vanuatu	renewed interest in the potential of customary marine tenure to conserve inshore resources is being shown by government and resource users
Vietnam	twelve areas to be established as marine protection areas were to be approved as a national system in 1998, 60 wetlands proposed as protected areas

Issue 6: **ASSESSMENT AND MONITORING** (52%)

Bolivia	Pantanal
Brazil	research on the marine environment is comparatively recent, North coast poorly known, need to improve zoological collection country wide
Burundi	Northeast lakes
Cameroon	increasing scientific and economic data, partly to support policy work
Colombia	helping market reflect true value of biodiversity
Congo Kinshasa	inventories of aquatic fauna have been highly sporadic
Fiji	coral reefs
India	diversity yet to be fully surveyed
Iran	second of four main strategies relates to the formation of biodiversity information and monitoring systems
Kenya	lists for species but not for distribution; assessing economic benefits of biodiversity
Madagascar	biology, ecology, stocks and current evolution on the island as a whole not yet well defined
Malaysia	monitoring system for catchment areas
Maldives	major needs are stocktaking and assessment
Mozambique	research into artisanal fisheries in Lake Niassa vital; no comprehensive surveys of national biological resources have been carried out
Philippines	no clear institutional structure rationalizes agenda setting, oversees implementation or monitors biodiversity research
Vanuatu	little known about the full range of flora and fauna; need to assess local conservation actions that employ traditional taboos
Vietnam	no systematic data collection for freshwater captures, assess degradation in nearshore waters

Issue 7: **LEGISLATION** (52%)

Bangladesh	in the absence of regulatory measures to protect small plot owners from being obliged to sell or lease out their land to large shrimp farm operators malpractice is rampant
Belize	legislation needed on bioprospecting, introduction of exotic species, regulatory framework hampered by the lack of resources to enforce laws
Burundi	legal and regulatory dispositions are more coercive than incentive
Cameroon	coastal and marine sector the least covered
Colombia	illegal land use
Congo Kinshasa	no regulations protect aquatic organisms
Fiji	environmental protection and resource management laws need reform
Indonesia	although trawlers have been banned completely from Indonesian waters since 1984, enforcement has been ineffective
Iran	lack of regulations on shrimp culture site selection and effluent along the southern coasts
Kenya	comprehensive land use policy needed
Malaysia	need to integrate marine protection into development policies
Mexico	modernising environmental regulation has high priority, correcting lack of precision and coordination
Peru	improper land management, accidental catches of marine mammals not mentioned in protection laws, economic measures to promote investment have encouraged mining, hence toxic wastes
Philippines	lack of regulations contributes to overfishing
Thailand	lack of enforcement capacity
Vanuatu	developing appropriate environmental legislation a priority
Vietnam	lack of regulations to exclude bigger vessels from shallow water fishing grounds

Issue 8: ACCESS AND BENEFIT SHARING (49%)

Bolivia	local populations of protected zones have established management committees
Burundi	integrating local populations in preserving biodiversity is considered a 'primordial' strategy
Cameroon	difficulty integrating indigenous land claims and interests into planning
Colombia	inequitable distribution of benefits hinders awareness of the consequences of biodiversity loss
Indonesia	credit and marketing cooperatives
Kenya	explore new markets for wild products
Malaysia	improve living standards of coastal populations
Mexico	in one rural shrimp fishing community of Pacific Mexico local fishers are excluded from the export industry because their 'artisanal' mode of production is considered by the government to be too unproductive and inefficient
Mozambique	promote the full participation and sharing of marine benefits by local communities
Namibia	subsistence fishers will be favoured over large scale commercial harvesters
Peru	alleviating poverty through aquaculture and wildlife farms
Philippines	diversifying occupation among marginal fishers, reducing inequity, promoting Territorial Use Rights, fisherfolk cooperatives
Sri Lanka	national action on benefit sharing demands contributory action by the developed countries
Tanzania	although nearly 200 000 tons of fish protein are exported annually, there is a threat of protein malnutrition in the Lake Victoria basin
Uganda	continued heavy industrial exploitation of Nile perch raises social equity and food security concerns
Zambia	for Lake Kariba, need for community based fisheries management structures through the establishment of Village Management Committees

Issue 9: **AWARENESS** (49%)

Belize	overpopulation, greater public awareness programmes and consensus building for management
Burundi	overpopulation
Brazil	local participation in the conservation of biological and genetic resources is limited, but increasing; NGOs, businessmen and scientists are active in supervisory bodies
Cameroon	participatory approach has yet to yield fruit
China	increase awareness of wetland protection through publicity
Fiji	litter is conspicuous
Iran	the first of four strategies aims at promoting public participation
Kenya	low awareness and poverty hinder observance of laws
Madagascar	overpopulation
Mexico	population fails to observe laws either out of ignorance or because of the little importance they attach to discretionary interpretations
Namibia	generally very low level of civil society activism, some distrust of the CBD programme
Sri Lanka	enhancing public awareness and encouraging public participation
Thailand	public misunderstanding of CBD
Uganda	Ugandans ignore environmental issues and view activists as non starters in development
Vanuatu	sectoral and local measures to promote environmental education and awareness are a priority
Zambia	thanks to early successes in Game Management Areas, the cooperation of village inhabitants is pursued by institutions charged with the care of water and fish; much remains to be done to change attitudes to favour voluntary conservation and wise use

Issue 10: **MANGROVES AND WETLANDS** (49%)

Bangladesh	need for participatory wetland management; barrages and embankments affect the natural flow of water from wetlands and rivers
Bolivia	crucial to develop a wetland strategy
Brazil	chief threats to the coastal ecosystems include destruction and subsistence exploitation of mangrove swamps
Burundi	only one tenth of wetlands are protected
China	increase total area of mangrove reserves to 90% of the total mangrove area, renovation and pollution management
Fiji	bad dump siting pollutes mangroves and rivers
Indonesia	mangroves and wetlands are not well represented among Pas
Iran	large tracts of wetlands devastated during war with Iraq
Madagascar	improving poor regional planning, one of the great causes of disappearing wetlands
Malaysia	wetlands inadequately protected
Mexico	protecting mangroves reefs and lagoons demands great efforts in monitoring, conservation and restoration by new environmental management and information mechanisms
Mozambique	still needs to accede to the Ramsar Convention; hydrology of vital floodplains considerably modified by numerous impoundments, mangroves may be threatened by development of shrimp farming
Peru	over the last decade about half the wetlands on southern coast have disappeared; no national inventory exists on adverse effects
Thailand	almost 50% of Thailand's mangroves lost to shrimp farming since 1979
Uganda	wetlands threatened by drainage, effluent discharges, inappropriate land tenure systems, unregulated and unplanned developments, esp. fish farming
Vietnam	by 1995 mangrove forests had shrunk to 40% of 1990 area

Issue 11: COASTAL AND MARINE MANAGEMENT (39%)

Belize	control coastal development, disposal of agricultural and industrial pollutants into waters that flow to the sea
Brazil	infrastructure for monitoring and patrolling, coastguards need experience in environmental issues
Cameroon	erosion
China	infrastructure for monitoring and patrolling
Congo Brazzaville	monitoring and patrolling infrastructure
Ecuador	a national policy on oceans is anticipated
Indonesia	tanker traffic pollution in marine zone, better institutional integration and competence needed
Iran	monitoring and patrolling infrastructure, coastal development threatens coastal ecosystems
Malaysia	preparing coastal profiles, identifying user conflicts, need for regional and international co-operation in marine zone
Mexico	monitoring seas and coastal zones and better inspection, verification, and surveillance
Philippines	regenerating damaged habitat, new management system for coastal areas being implemented
Sri Lanka	preventing excessive coral mining
Vietnam	monitoring of deep-water and marine zone fishing grounds, illegal fishing

Issue 12: TOURISM (33%)

Argentina	creation of protected coastal areas stimulated mainly by tourism
Belize	more fishing and tourism may permanently damage the mangroves and reef system
Bolivia	the large border lakes along the Curichi Grande River attract ecotourism and sport fishing
Brazil	chief threats to the coastal ecosystems include uncontrolled tourism
Fiji	major mangrove areas have been reclaimed for tourism
Indonesia	tourism to be promoted
Malaysia	integrating sectoral programmes on sustainable development for tourism affecting the coastal areas
Maldives	growth in tourism has led to more demand for species other than tuna and increased coral mining
Philippines	Bacuit Bay being assessed for sustainable tourism
Thailand	coral reefs in the Andaman Sea severely damaged by ecotourism
Vanuatu	sport-fishing industry relies on tourism and may have potential for further growth

Issue 13: **AQUACULTURE** (30%)

India	shallow water area and creeks fringing Andaman & Nicobar Islands have great potential for coastal aquaculture
Burundi	small-scale pond culture could be further encouraged
Indonesia	mariculture
Iran	cold- and warm-water sturgeon species, trout and shrimp culture emphasised
Kenya	promote the use of native species
Mexico	National Program of Rural Aquaculture for the improvement of rural living conditions
Mozambique	development policy promotes aquaculture for crustaceans, fish and bivalve mollusks; avoid dangers of shrimp farming
Philippines	aquaculture to be intensified
Uganda	considerable scope exists for developing small-scale pond culture and enhancing reservoir and small-water-body fisheries
Zambia	trials implemented by large-scale private commercial operators to identify fish-culture species, fingerling production, and to develop use of mixed-culture systems

Issue 14: (27%)

Bangladesh* exports of fish that cannot be locally consumed

Burundi	much spoilage in sun-dried artisanal catch
Congo Brazzaville	distribution chains for freshwater fish end at Brazzaville
Indonesia	creating value-added marine products
Iran	increasing fish consumption and fish exports are major objectives
Mozambique	traditional food habits of the inland population, as well as lack of infrastructure, inhibit wider distribution; inland fisheries could develop if boats and gear for the artisanal fishermen were assured and the processing and marketing problems were solved
Nigeria	much miscellaneous fish that could be processed into fishmeal is usually dumped at sea
Uganda	more efficient post-harvest-sector operations
Zambia	most of the national catch reaches markets sun-dried or smoked because the main producing areas are remote from the main consuming areas

Issue 15: **NATIVE SPECIES** (21%)

Bangladesh	gradual loss of perennial water bodies has led to a severe loss of freshwater biodiversity
Burundi	no mention made in the NR of gene banks for fish
Cameroon	Lake Chad species threatened by shrinking of lake
Kenya	gene banking in situ, ex situ
Nigeria	Lake Chad species threatened, shrimp trawling degrading coastal demersal stock
Tanzania	gene banking, restoration of indigenous foodfish
Uganda	both Kenya and Uganda are expanding their fish-farming efforts, collecting founder stocks of haplochromines and other native fishes and considering plans to introduce them into smaller lakes and ponds in the region

Issue 16: **ALIEN SPECIES** (15%)

Fiji	Tilapia is considered harmful to certain native species, particularly the Ika ni Vatu (<i>Kuhlia rupestris</i>)
Kenya	determine costs of alien species introductions
Peru	no regulations govern alien species introductions into natural aquatic environments
Philippines	exotic species in wetland ecosystems, particularly in lakes and rivers, prey on, compete and hybridise with native species
Uganda	no detailed studies in the Ugandan part of Lake Victoria to establish the status of the surviving cichlid species

Issue 17: **CENTRALIZING INFORMATION** (12%)

Argentina	information dispersed among different institutes
Bolivia	papers on Bolivian biodiversity overwhelmingly published in foreign journals
Mozambique	scientific articles, reports, satellite imagery etc. are dispersed among agencies and individuals
Uganda	Issue and Topic papers on aquatic biodiversity remain scattered in a number of documents

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