

Conclusions and recommendations

Colombia & Venezuela sub-system

Habitat modification was selected as the priority concern of the Colombia & Venezuela sub-system. A range of factors are responsible for the alteration and loss of aquatic ecosystems, many of which were considered under the other major concerns studied by GIWA, particularly pollution. Coastal habitats are being degraded by a multitude of issues such as spills and discharges from oil-related activities and rivers discharging land-based sources of pollution including suspended sediments, urban and industrial wastewater discharges, and agricultural and mining runoff. Coral reefs are severely affected by sedimentation, the sediment originating from river catchments which have been subject to intense deforestation and inappropriate land-use practices. In the 1990s, mass coral mortality was associated with a huge phytoplankton bloom that caused severe oxygen depletion; this was attributed to a climatic anomaly and chemical pollution.

Despite considerable efforts by the governments in recent years, the sub-system is still confronted with the continued degradation of aquatic ecosystems and depletion of their associated resources. Environment institutions remain insufficiently funded and lack administrative, monitoring and implementation capacity. The absence of an integrated development strategy results in uncoordinated actions. Large areas of Colombia are unprotected from development activities as they are controlled by Guerrilla armies. Inappropriate incentives were given to farmers to use agro-chemicals and there is a lack of economic incentives to control pollution. The advantages of adopting cleaner technologies are poorly understood by industry and there is a lack of environmental education programmes. Institutional weakness is a cross-cutting issue affecting socio-economic, technological and scientific development.

Lately, attention has been centred on the urgency to develop integrated water resources management, to adopt preventative rather than reactive measures, to coordinate freshwater, coastal and marine management, and encourage information development and exchange.

Feasible policy options were identified that target key components identified in the Causal chain analysis in order to minimise future impacts on the transboundary aquatic environment. In Colombia, a basis for Integrated Coastal Zone Management has been initiated, which is relatively advanced but complex. However, due to the environmental and socio-economic inter-linkages between river basins and the coastal zone, the GIWA regional experts recommended developing this further by adopting *Integrated River Basin and Coastal Area Management (PO 1)* in the Magdalena-Cauca Basin and its adjacent coastal zone. In support of this policy option, there is a need to *Strengthen the scientific capacity of the sub-system (PO 2)* in order to provide accurate, timely and relevant scientific information to decision-makers. In the future, the regional experts anticipate that the impacts of habitat modification in the Colombia & Venezuela sub-system will diminish in severity if appropriate measures are implemented.

Central America & Mexico sub-system

Habitat and community modification was also identified as the priority concern of the Central America & Mexico sub-system. The transboundary ecosystems have been severely degraded as a consequence of agricultural and urban expansion, increased pollution loads and unsustainable forestry practices. As the population of the sub-system continues to increase, the demand for land escalates and environmental degradation intensifies. Poverty forces the inhabitants of the sub-system to exploit

resources at an unsustainable rate; as their land becomes unproductive they are forced to migrate to more environmentally sensitive areas.

The management of protected areas faces the challenge of conserving sensitive habitats whilst accommodating the growing numbers of tourists. Many of the sub-system's natural assets such as the beaches and coral reefs have been modified as a consequence of tourist activities. The expansion of agricultural and livestock activities in the San Juan Basin has led to the deforestation of practically all the lowland forests in Costa Rica and the modification of indigenous forests in Nicaragua, resulting in increased erosion and sedimentation in aquatic systems. The excessive use of pesticides and fertilizers in crop production, attributed to weak or non-existent regulations, also degrade aquatic ecosystems when entering water bodies via runoff or leaching.

Many of the root causes behind habitat modification in the Central America & Mexico sub-system stem from a lack of institutional capacity. Coastal zone and river basin management programmes are not integrated, and the sustainability or long-term impacts of development

projects are rarely considered. Decision-making processes are hampered by limited information availability and insufficient stakeholder participation.

To address these institutional inadequacies, the GIWA regional team recommend formulating and conducting capacity building programmes in order to strengthen the relevant institutions so that they can better manage the transboundary waters of the San Juan River Basin (*Institutional strengthening, PO 3*). Unsustainable practices are employed in the basin by the forestry, agriculture and fisheries sector, among others. Sustainable production can not only provide environmental benefits but can also alleviate poverty by protecting natural resources and providing alternative income sources (*Promote sustainable production, PO 4*). As a prerequisite, research is needed into locally applicable, sustainable practices and technologies. Mitigation measures, such as those outlined in this report, are needed to be adopted in the short-term in order to halt or reverse the ecosystem degradation trends experienced throughout the Central America & Mexico sub-system.