

Executive summary

The Amazon Basin is the largest basin on the planet and also one of the least understood. Its drainage area covers more than one third of the South American continent, and its discharge contributes almost one fifth of the total discharge of all rivers of the world. The headwaters of the Amazon River are located about 100 km from the Pacific Ocean and it runs more than 6 000 km before draining into the Atlantic Ocean. In addition, the Amazon has 15 tributaries, including the Tocantins River, that measure more than 1 000 km in length. The Madeira and Negro rivers are the most important tributaries, contributing with more than one third of the total water discharge. The Amazon Basin contains a complex system of vegetation, including the most extensive and preserved rainforest in the world. The rainforest, known as the Amazon Rainforest, is not confined to the Amazon Basin but also extends into the Orinoco Basin and other small basins located between the mouths of the Orinoco and Amazon rivers. In addition, savannah and tundra-like vegetation can also be found. Extensive areas of scrub-savannah dominate the headwaters of the Brazilian and Guyana shields, while the regions of the Basin situated at high altitude in the Andes are characterised by tundra-like grassy tussocks called the Puna.

The Amazon Basin is shared by Brazil, Peru, Ecuador, Bolivia, Colombia, Venezuela and Guyana. More than half of this basin is located in Brazilian territory, but the headwaters are located in the Andean portion of the Basin which is shared by Bolivia, Peru, Ecuador and Colombia. The human density in the Amazon Basin is very low and people are concentrated in urban centres. In the entire Basin there are five cities with more than 1 million inhabitants and an additional three with more than 300 000 people. However, despite the high proportion of the population living in urban areas, the economy of the region is still primarily dependent on the extraction of exportable minerals, oils and forest products. The only exception is the contribution made by the industrial park established in the duty free zone in the city of Manaus. Products from timber, mining and petroleum exploitation

are the most important products exported from the Amazon Basin. Timber exploitation focuses on a few species, particularly mahogany (*Swietenia macrophylla*). The primary environmental consequence of this exploitation is the depletion of natural populations of the exploited species. The construction of roads to facilitate the extraction of timber from within the forest also provides access to farmers and other groups that colonise and expand into these newly accessible areas. Mining, particularly of alluvial gold, and oil extraction activities are scattered throughout the Amazon region. The main environmental problems associated with mining are pollution and increased suspended sediment loads caused by erosion which leads to the degradation of downstream habitats. Fishing is also an extractive activity that is traditional and important in the Amazon plains. Fish is a source of cheap, high quality protein for inhabitants of the Amazon Basin. Some selected species of fish are exported to other regions outside the Amazon Basin and also to other countries. Overexploitation exists but is restricted to only a few target species.

The development and expansion of agriculture is modifying the environment within the region. Large cattle farms are being established in vast areas along the southern and eastern borders of the Basin. Also, large soybean plantations are being established mainly in less humid areas near the borders of the Basin. Meat and soybeans may become important export products from this region, but it will result in the replacement of natural forests by pastures and soybean plantation. The importance of the Amazon forest in regulating the hydrological and carbon cycles has only very recently been recognised and the consequences of the large-scale deforestation are not well understood. As a consequence, deforestation and pollution were considered to be the most critical large-scale environmental problems in this region leading to the conclusion that Habitat and community modification and Pollution were the most important GWA concerns in the entire Amazon Basin.

Although the environmental and socio-economic impacts of each of the predefined GIWA issues and concerns were assessed over the entire Amazon Basin, the dimension and heterogeneity of the region rendered causal chain and policy options analyses of the entire region impracticable. As a consequence, these analyses focused on determining the root causes of and policy options for mitigating Habitat and community modification and Pollution only in the Madeira Basin. This basin was chosen because of its socio-economic importance to the region and its transboundary nature.

The Madeira River Basin is shared by Brazil, Bolivia and Peru and therefore, requires a transnational management agreement in order to ensure appropriate management of aquatic resources and the establishment of a socio-economic development plan. The Causal chain analysis determined that the root causes of Pollution and Habitat and community modification in the Madeira Basin were: governance failures, market and policy failures, poverty, and lack of knowledge and information. The lack of information affects the Basin in different ways, from the inability to detect problems and unsustainable practices to the lack of environmental warning mechanisms to raise awareness among decision-makers. The failure of governance was related to the difficulty in establishing acceptable mechanisms to settle conflicts among different interests. The lack of legitimacy of negotiations commanding decisions regarding investments and the absence of a basin-wide management plan were the two biggest problems associated with governance failures in the region. The market and policy failures were attributable to the misconception that natural resources of the Amazon Basin are inexhaustible which leads to the unsustainable use of those resources. The lack of knowledge was associated with inadequate training in best land use practices resulting in the failure to adopt techniques for soil and chemical use in the agriculture and mining industries that make these activities more profitable and less environmentally damaging. Training in best land use practices must be included in the basin-wide management plan. Finally, poverty is common in the Amazon Basin and results in the significant dependence of people living in the region on the exploitation of natural resources in order to sustain their livelihoods. The Amazon Basin is one of the last frontiers and a land of opportunities for those that do not have good perspectives in their homelands. The poverty-environmental degradation cycle probably represents the largest challenge for the future administration of this region.

The two most promising projects developed to address these root causes aimed to collate and disseminate information and to implement a fisheries management programme in the Madeira Basin. Information is the key requirement in order to implement actions to ensure sustainable use of water resources. The Governments must be well

informed about the ecology, economy, socio-economy, hydrology, meteorology, agriculture and other important aspects related to water and land use in the Basin. This action could be implemented in three ways: (i) research, to obtain more and new information; (ii) search, to gather existing information; and (iii) dissemination, to transmit information to the target audience. The purpose of this project is to integrate the different countries and stakeholders that support research, databases, and social organisations, in the field of water resources and environmental management in the Madeira Basin. This project will represent a first step to develop and implement a basin-wide management programme involving the three countries. This action complies with directives of the Amazon Cooperation Treaty (ACT) and will be the basis for the constitution of a Commission or International Committee of the Madeira River Basin. All three countries possess research programmes and database systems to monitor problems and manage water resources sustainably, but these programmes are not integrated. The implementation of an integrated information system might improve the prediction of floods and the implementation of mechanisms for pollution control. Also, the scientific community within these countries could work in association with the information system to develop joint research projects in the aquatic sciences.

The impetus for establishing a sustainable development programme for fishing activities in the Madeira Basin is the great economic potential of fish stocks and the importance of connections between the upper and lower parts of rivers to enable fish migration. This project aims to gather fisheries projects and organisations in order to achieve sustainable fishing practices and exploitation of unidentified opportunities. In addition, the project should strive to raise awareness among fishermen and stakeholders of how their activities affect and, in turn, are affected by the health of the environment of the Basin, thus transforming them into one of the primary agents monitoring and enforcing the sustainable development programme. In the Amazon Basin, some efforts have been made to integrate fisheries management, mainly to manage the stocks of large migratory catfish. Experiences gained from these efforts could be incorporated directly into a sustainable fisheries development programme for the Madeira Basin. The selection of this project was based on the fact that the fishery supports thousands of direct and indirect jobs and, as a consequence, the adequate management of the fish stocks in the region is more important from a social perspective than an economic one. Considering the fact that large migratory catfish spawn in the Andean headwaters of the Basin and mature in the estuary and in the lower Amazon reaches, the geographic area in which this project would be implemented is enormous. The protection of the spawning areas of these species is essential for the fishery in the entire Amazon Basin. The efficiency of the project is high

because the economic feedback resulting from larger fish stocks is relatively fast. In addition, the equity considerations are also positive because the development programme for fishing activities would directly affect both professional and amateur fishermen, as well as the consumer markets in the largest cities. Furthermore, considering the increase in the number of conflicts between fishermen during recent decades, the political feasibility of the project must be addressed. The necessity of implementing a fishing ordinance to manage fish stocks in the region has been recognised by both professional fishermen and by artisanal fisherman living in riparian communities. In some cases, it is impossible to find an equitable solution for a conflict and it is necessary to make a decision that could be unfavourable to one party. If this is done, the political feasibility of the project can be threatened. However, if the decision is not taken, the conflict may intensify and become uncontrollable, potentially threatening the project once again. Unfortunately, despite having the necessary scientific capacity, the implementation of this project is prevented by inadequate financial resources in each of the three countries that share the Madeira Basin.