

Socioeconomic Root Causes of Biodiversity Loss in Madagascar

Authors

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Abstract

In 2000 and 2001 a root cause analysis was conducted for the Spiny Forest Ecoregion in Madagascar, identifying the local level root causes of biodiversity loss in the ecoregion as well as the policy and institutional issues at the national and international levels that contribute to them. Most of the research was conducted in and around Tulear and Fort Dauphin. Findings will be used to develop a strategic action plan for the ecoregion.

The direct threats to biodiversity loss in the ecoregion are forest clearing, land conversion, and habitat alteration. Root causes include demand for wood as a primary source of fuel for rural and urban populations, limited technical support to farmers, and the tying of land ownership to forest clearing. The current situation of deforestation, heavy land use, poverty and urban expansion is exacerbated by population growth and in-migration. In the regional government, lack of both management skills and training to execute programs and enforce laws is compounded by uncomplimentary and uncoordinated national policies. The deregulation of the agriculture sector—including the reduction of export taxes on all agricultural commodities, the elimination of cheap urban food policies in the late 1990s, and currency devaluation—contributed to increased agricultural production and exports, further driving deforestation.

Recommendations include the establishment of formal land tenure rights; enhancement of agricultural extension services; improved market access and economic development for agricultural crops and alternative forest products, including medicinal plants; and increased access to micro-credit by the poor. Avenues for promotion of linkages between the ministries that oversee the environment and economic and social development are identified.

Key Words: ecoregion, spiny forest, Madagascar, economics, biodiversity loss, root cause

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The Issue

The Spiny Forest Ecoregion in southwestern Madagascar, one of the World Wide Fund for Nature (WWF) priority ecoregions, includes some of the biologically richest drylands on Earth. Native plants (*didieraceae* and *euphorbia*) have uniquely adapted to the extremely arid climate and poor soil conditions. Ring-tailed and sifaka lemurs (*Lemur catta* and *Propithecus v. verreauxi*), terrestrial tortoises (*Geochelone radiata* and *Pyxis arachnoides*), and several birds, reptiles, and amphibians are endemic to this ecoregion.

Over the last decade these natural areas have been exposed to various pressures, most stemming from human activity. With a human population of over 1.7 million (INSTAT 1993) concentrated in the urban areas of Toliara, Fort Dauphin, and the emerging towns of Beloha, Ampanihy, and Tsihombe (figure 1), the ecoregion is one of the poorest areas on the island of Madagascar. It is estimated that 88 percent of the population in the ecoregion lives below the national minimum per capita annual income (equivalent to US\$38 in 2003) as defined by the World Bank (1999), and that 79 percent live in extreme poverty. The population is heavily reliant on natural resources for its livelihood, practicing agricultural and pastoral activities, as well as harvesting natural resources for subsistence and commercial purposes. Less than 3.2 percent of the remaining natural habitat in the ecoregion is currently included in the country's network of protected areas.

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Because of their unique biodiversity and the threats they face, the Spiny Forests have been identified as priority biodiversity conservation zones by WWF, Conservation International and the Madagascar National Parks Service.

WWF Ecoregion Conservation Approach

WWF defines an ecoregion as a relatively large parcel of land or water that harbors a characteristic set of species, communities, dynamics, and environmental conditions. Ecoregions therefore stretch over administrative and political boundaries. The WWF ecoregion approach aims at 1) ensuring the representation of biodiversity; 2) ensuring the viability of key species populations; 3) maintaining the key ecological factors that sustain life; and 4) maintaining blocks of natural habitats that are large enough to ensure resilience to large-scale disturbances. Ecoregion-based conservation is characterized by a larger spatial scale than protected areas, and by a longer time frame—with a conservation vision of 25 to 50 years.

In 1998 WWF initiated an ecoregion-based conservation program for the Spiny Forests Ecoregion of Madagascar. A series of rapid biological assessments was undertaken across all major blocks of natural habitat in the ecoregion to assess conservation needs, potential threats, and opportunities for conservation. In 2000, a more thorough analysis of the biodiversity of the ecoregion identified a network of nine priority areas for conservation that became the cornerstone of WWF's work in the region.

To be effective and sustainable, the conservation program's partnerships, strategies, and interventions need to address the deeper political and institutional settings that affect biodiversity conservation in Madagascar. A detailed and comprehensive threat analysis was conducted to identify the root causes of biodiversity loss around the target areas.

The Root Causes Methodology

The methodology adopted for this study was modelled after the WWF Macroeconomics Program Office's Root Causes of Biodiversity Loss Framework (Stedman-Edwards 1998), which includes the following steps: 1) identification of direct pressures on natural resources and their socioeconomic root causes at the local (micro level), meso (communal, regional, provincial) and macro (national and

international) levels, thereby highlighting key causal chains from one level to another; 2) identification of future social, economic, and political trends that may affect biodiversity conservation, based on development plans and projections at various levels; 3) development of a conceptual model to represent the linkages between biodiversity targets and the root causes at different levels, and the linkages between levels; and 4) development of recommendations to address the identified root causes of biodiversity loss at various levels. The root causes methodology is designed to give a holistic picture of biodiversity and the intricate socioeconomic factors that affect its conservation.

Findings

Local Level Root Causes--The spiny forest has experienced some of the highest deforestation in Madagascar over the past decade. Forest loss translates into reduced availability of habitat for wildlife, and reduced availability of essential natural resources such as wood and medicinal plants for the local population. The loss of forest cover has led to decreased rainfall and loss of humidity, increasing the frequency of drought, and putting further pressure on farmers to produce enough food for consumption and income generation.

One of the primary causes of forest loss throughout the Spiny Forest Ecoregion is the demand for wood as a primary source of fuel for rural and urban populations. Rural inhabitants cut the forests to provide charcoal, fuelwood, and construction wood for their own consumption, and for sale in urban centers and large towns. Firewood is a major source of fuel for most households and the cutting of wood for cooking is a significant cause of environment degradation (EIU 2000). Over 90 percent of Madagascar's urban population uses charcoal and firewood for energy in its homes. The sale of wood and charcoal provides a key source of income to the poor rural population; wood products are brought directly to town centers by wagon, or more often are sold roadside for a small percentage of the selling price in the urban centers.

Rural populations also exploit forests for the harvest of non-timber products such as honey. The collection of both wood and non-wood products is often unsustainable; a whole tree may be felled during honey collection, the honey removed and the tree wood left unused. Along the coast, canoe builders often utilize only the center portion of felled trees, leaving the remaining portions in the forest unused.

Although wood and other forest product collection puts tremendous pressure on the forests, maize cropping is the main threat to forest loss. Higher prices for maize, demand for maize exports, and low input requirements have provided the impetus for increased production and land clearing. The practice of slash and burn agriculture, coupled with poor quality soils, results in fields being abandoned and standing forests being cut for new crop land every two to three years. Rural populations are consequently moving further into previously forested land and away from existing communities, services, and roads, exacerbating rural poverty. Ultimately poor roads, lack of transportation, and weak links to market leave the rural populations insecure in their ability to participate in the local economy. Increasingly there are signs that this insecurity is leading many farmers to switch most of their effort from cash crops to the production of food for their own communities.

Keeping livestock is an important component of rural livelihoods, and forests and abandoned cropland are used for grazing. Increasing the size of the herd is a symbol of prestige, and income generated from the sale of agricultural crops is often used to buy more cattle. Production costs for this activity are low since household members take care of tending the herds. Overgrazing has degraded the forest understory, and repeated burning of pastureland has left only those species unsuitable for feed.

At the moment there is very little investment in the land and only limited support for improving farming techniques; only 1.5 percent of small farmers have access to credit. While there is a lack of formal land tenure, a license sold illegally from the local forest authority to remove the forest and convert it to agricultural land is considered by the rural population to equal land title rights. The incentive of land ownership and the tying of ownership to forest clearing have furthered deforestation.

Lack of local economic development and the difficulty of getting goods to town centers, coupled with low inputs for production of maize and lack of policing, means there is little incentive for favoring forest protection and conservation. Deforestation is often seen as the only means to survival, as it is directly linked to income generation through agricultural production and land ownership.

The current situation of deforestation, heavy land use, poverty and urban expansion is exacerbated by pressure from population growth and in-migration. A 22 percent increase in the human population in the ecoregion in the last six years has been driven largely by migration.

Regional Level Root Causes--At the regional government level, a lack of management skills and training in program execution and law enforcement is compounded by national level policies that are neither coordinated nor complementary. In some areas policies are in place that simultaneously attempt to promote both development and environmental protection. From 1997 to 2002, the Environmental Program tried to manage and organize these policies in five regions through Regional Development Committees, but bringing together the different representatives was difficult. There are also great inequities between urban and rural programs. The lack of health, education, and other public services at the local level serves to further exacerbate poverty.

Although a decentralization of government services and decision making is underway, it has yet to be seen how increased revenue to the regions will be utilized. Before decentralization, local authority control over spending equaled just 0.5 percent of GDP, and a large percentage of the income generated from export products from the regions went to the centralized government in the capital.

National/International Level Root Causes--National and international level forces, often out of the control of local resource users, have heavily influenced patterns of resource use in the Spiny Forest. Over the last decade, the government has instituted a number of reform programs in response to the requirements attached to loan agreements with the International Monetary Fund (IMF), World Bank (WB), and European Union (EU). The deregulation of the agriculture sector (including the reduction of export taxes on all agricultural commodities), the elimination of cheap urban food policies in the late 1990s, and currency devaluation have meant higher prices for agricultural products and increased agricultural production and exports. Maize exports from Toliara increased from 12 million Malagasy Francs in 1991 to 10 billion Malagasy Francs in 1997. Devaluation and liberalization, coupled with the low inputs required for maize production, have been drivers behind increased deforestation.

The greatest amount of deforestation has taken place in areas managed under the jurisdiction of the Forest Administration (DEF), which receives very little funding. This situation contrasts with that of ANGAP; this government body manages protected areas (national parks and reserves), and has a much larger budget. DEF budget cuts have led to weakened enforcement of the forestry regulation system, unchecked illegal harvesting, and internal corruption. In 1995, regular monitoring of logging and charcoal

permits was restricted to large-scale exploitation, ignoring smaller scale logging and leaving little incentive for small-scale rural farmers to adhere to forest protection and conservation regulations.

Structural adjustment programs for stabilization resulted in public expenditure compression, which further reduced the funds available for government outlays. Reduced government spending has jeopardized enforcement and monitoring of existing environmental legislation. This can be seen at the local level in terms of lack of service delivery and compliance; a mere 5 percent of all investors comply with environmental impact assessment requirements.

International trade liberalization has stimulated activity by both artisanal fishermen and industrial operators. However, European, Russian and Japanese boats take much of the potential offshore catch. Commercial offshore prawn fishing and traditional river fishing are now both in decline from overfishing, but modern seawater prawn farms, traditional fish farming in rice paddies and artisanal sea fishing are doing well. Prawns accounted for 80 percent of seafood export revenue in 1997.

Lack of coherence between the Ministries has led to inconsistent government policies. In 2000, 10 zones for tourism and industrial production were identified for lease and infrastructure development. These plans have, however, come into conflict with conservation priority sites designated by the Ministry of Environment and its implementing agency, the National Office for the Environment, which has conservation objectives and development projects of its own. This lack of policy coherence has led to inefficient management at the regional and local levels and has ultimately delayed the delivery of services and project implementation on the ground.

The World Bank's 1997 Country Assistance Strategy (CAS) for Madagascar attempted to tackle widespread poverty by encouraging broad-based economic growth, led by significantly higher levels of foreign investment. The core strategies were aimed at creating a business-friendly climate by unleashing market forces, improving public finances, and emphasizing the delivery of public goods and services to the poor. In many ways national efforts at market stimulation have never reached the rural communities in the Spiny Forest Ecoregion. In spite of efforts over the past 15 years to boost the agricultural sector, performance has remained low.

Trends, Threats, and Opportunities in Key Sectors

By borrowing from international financial institutions such as the World Bank, IMF and EU, Madagascar is required to adhere to certain policy reform measures, including: maintaining economic growth through government expenditure reduction and privatization; encouraging privatization; increasing agricultural production; increasing labor intensive industry and services; investing in support for the poor; making government more efficient and closer through the devolved provincial authorities; and establishing efficient revenue collection. Madagascar has also qualified for debt relief under the Highly Indebted Poor Country (HIPC) initiative and is now scheduled to receive final loan disbursement under the IMF's poverty reduction and growth facility. In connection with qualification for debt relief under HIPC, the government is required to develop a national poverty reduction strategy (PRSP) that focuses on improvements in the areas of health, education, social services delivery, water and sanitation, rural development and protection of the environment, and improved governance to address poverty alleviation.

The IMF is also concerned with strengthening tax revenue and continued liberalization of trade. Much of the economy remains informal and beyond the reach of the tax authorities, and the formal sector carries the burden of providing most tax revenue. In structural terms the focus is on regulation and transparency with the aim of curbing corruption and promoting competition in the provision of services. Involvement in regional trade liberalization is also encouraged.

The EU, World Bank, and IMF have identified tourism, mining, manufacturing, and agriculture as the sectors having potential for achieving high economic growth for the medium and long term; tourism is estimated to grow at an average rate of 15 percent per year, agriculture at an annual rate of 5 percent, and mining from 3 to 5 percent (EIU 2000).

The government plans to create an atmosphere favorable to private sector investment and will do this by liberalizing the movement of capital, reducing administrative constraints, improving access to land, establishing more secure land tenure rights, and improving road networks.

Tourism--The tourism industry is identified as underexploited and has the potential to more than double during the next 10 years. An investor friendly environment includes measures to provide access to land for development of infrastructure to accommodate a 10 to 15 percent increase in tourists per year. Applicants are expected to be internationally established hotel chains.

The spiny forest region is currently the first destination for nature-based tourism in Madagascar, with two-thirds of visitors coming to Madagascar for ecotourism, and another one-fourth coming for beach holidays. Marketing has been minimal, but the recent establishment of direct air links from Asia has opened new opportunities. Authorities have taken a number of steps to encourage tourism and bring down travel costs. A national tourism development committee and a tourism agency were established in 1991, and in 1995 the laws governing the sector were overhauled. Liberalization of the internal and regional air routes in 1994 opened up the local travel market to four new carriers. The long-haul air routes were also liberalized; the privatization of Air Madagascar could introduce further competition to the airline market, bringing prices down. There has been investment in both tourism infrastructure and staff training for improved services (EIU 2000).

Ten zones for tourism and industrial production have been identified and land will be leased and infrastructure developed, but there is the risk that informal land ownership will be disrupted by the assignment of commercial zones. The World Bank would like the government to give its own guarantees against interference by any third party and competing property claims, even in those originating in local governments (World Bank 1999).

Investment in ecotourism may be dubious in that its ability to reach the poor population and benefit development may be limited. In reality not all of the forested lands are priority sites for protection and conservation, thereby limiting the ability of ecotourism to provide incentive for controlling logging and forest clearing and delivering real benefits to the poor.

Mining--The exploitation of titanium sand, nickel, and cobalt could eventually double the size of the mining sector, and there is also the potential for exploitation of precious and semi-precious gems, gold, chrome ores, and quartz, as well as graphite, mica and marble at a smaller scale. The government strategy consists of the application of mining codes that promote large mines through changes in investment laws; developing small-scale mining with respect for the environment; and eradicating illicit trade and exploitation (World Bank 1999). A new mining code was approved in 1999, the objective of which was to reduce the existing mining application backlog by 80 percent. This is expected to create conditions for transparent allocation of mining licenses, providing the public sector with a more predictable business environment in mining activities (EIU 2000).

The new mining code is consistent with existing environmental regulations, but these should be reviewed along with enforcement mechanisms. Large-scale mines should be examined for their direct and indirect impacts on environmental and human health.

Manufacturing--Madagascar's eligibility in the Africa Bill initiative should assist in the growth of this sector, which includes activities from garment making to information processing. There has been increased success with the growth of textiles and other industries due to the new U.S. Africa Growth and Opportunities Act. The growth in this sector also offers opportunities for agriculture as it uses raw materials produced in the Malagasy farm sector (EIU 2000).

Fishing and Agriculture--Increased agricultural production is key to economic growth and poverty reduction in Madagascar, and fish exports are an increasingly important source of foreign currency and an underexploited resource. Improvement of the performance of the shrimp aquaculture industry will be addressed through shrimp fishing licenses which will also provide tax revenue for the state. Guidance for enhancing the sector will be taken from the Rural Development Action Plan (PADR) and the involvement of the Rural Development Working Groups in each region. The proposed allocation of fishing licenses is designed to counteract the current incentive framework, and should provide a better incentive for sustainable exploitation by clarifying property rights (EIU 2000). The government must define an allocation system particular to Madagascar's conditions, taking into account traditional fishermen, local participation, and fair competition for those firms that may receive foreign subsidies. Madagascar is being considered as a pilot country on which the Forum for Sustainable Fisheries (a coalition of multilateral agencies, bilateral donors, and NGOs) may focus to develop a dynamic and sustainable fisheries sector. Since 2002, WWF has been involved in supporting the establishment of sustainable shrimp farming and shrimp fisheries systems.

In terms of agriculture, the government is now focusing on land security in rural areas and supporting labor organization. The government plans to increase funding and development of income-generating agricultural practices, specifically short-cycle breeding and aquaculture. Increased agricultural research and rural credit is important as only 1.5 percent of small farmers have access to credit and a mere 5 percent of total lending goes to agriculture (World Bank 1999).

In addition to supporting small farmers, the World Bank is pushing for investor incentives to ensure easier exportation, which is expected to encourage the settlement of large scale farms. This would encourage dense populations to concentrate in high-potential areas, making infrastructure costs less prohibitive.

There may be danger in increasing large scale land holdings, as it may lead to increased landless laborers and exploitation by large scale owners where management may be far removed from the site. In addition, attention should be paid to export-oriented crops that rely heavily on imported inputs, such as petroleum-based products that respond dramatically to fluctuating global market prices. Training and information dissemination in the use of inputs that can pose health risks—such as those associated with pesticides and herbicide use—is essential.

Agriculture “underperformance” is seen as a major cause of widespread rural poverty. Methods of agricultural intensification and extension must take into account environmental considerations as well as the impacts on the rural societies currently involved in small scale agricultural production (EIU 2000).

Infrastructure--Economic growth and poverty alleviation are impeded by basic economic infrastructure (EIU 2000). Possible improvements include adoption of a transportation policy in rural areas, rehabilitation of roads, the rehabilitation and construction of ports, and long-term maintenance to establish security and stability of market links. A port proposed by Rio Tinto Mine and the World Bank could benefit the developing industries of tourism, sisal, seafood and meat, and could reduce the costs of imported construction goods and other products in Taolanaro. The impact of the proposed port on the traditional fishing communities and the estuary will need to be investigated, and access by industries other than the Rio Tinto Mine must be guaranteed.

Upgrading and expanding infrastructure has been prioritized for meeting the infrastructure and support service needs of the 10 new industrial and tourism zones. This development strategy should be monitored for its potential to allow access to previously unexploited areas and the impacts on resource degradation, migration and social disruption.

Recommendations

Establishing Formal Land Tenure Rights--Land tenure reform is a primary objective of the World Bank and EU. Any efforts at reform must be coupled with education on formal versus informal and legitimate versus illegitimate land rights. Sensitivity must be paid to the fact that many rural inhabitants perceive that they already have land ownership from the purchase of permits, many of which were distributed illegally. In addition, land tenure reform must be coupled with agriculture extension.

Land tenure rights need to be extended to forested as well as non-forested land, and services provided for sustainable cultivation and sale of non-forest products. Monitoring and compliance for land ownership should take place and be accountable to users with sanctions put in place. There must be a system to ensure the financial sustainability of the programs that monitor and enforce existing forest and forest resource laws.

Agricultural Extension--Agricultural extension services need to be enhanced to provide information to rural farmers on better crop production and soil conservation. Work can be coordinated with agriculture donors and operators to develop more ecologically and economically sustainable uses for land production. SOPAGRI (Société de Production Agricole) should be encouraged to integrate crops other than maize into their collection and export scheme. Quality control, marketing and processing for country-wide food consumption needs to be improved to reduce reliance on food imports. Improvements of irrigation and water networks are needed, as only 16 percent of arable land is irrigated. The agriculture sector has the potential to provide raw materials for industrial products. The industrial sector has been successful and has the potential to take advantage of the limited import liberalization clauses of the new U.S. Africa Growth and Opportunities Act. This can in turn increase demand for the agricultural sector to produce primary inputs.

Improved Market Access and Economic Development--Better market access for agricultural crops and alternative forest products should be coupled with major investment in infrastructure, market outlets, and means of transport for the rural communities. National government strategies should also be coupled with regional and local capacity development. Efforts should be made to influence current development policies to this effect, including the Poverty Reduction Strategy Paper (PRSP) and the World Bank's Country Assistance Strategy (CAS). The Regional Development Committee (CRD) can be another avenue through which information and education on the market for goods could be provided. The Rural

Development Working Group (GTDR) can provide information, education and communication regarding efforts to attract the private sector. GTDR can also be mobilized to identify income-generating activities and the CRD used to link environment considerations with investment strategies for the region.

Micro-credit--Many Malagasy are outside of micro-credit networks which are vital for grassroots development and poverty reduction. The introduction of credit schemes to rural populations is important for investment, and should be pursued by the national government in conjunction with land tenure policies and agriculture extension practices. In addition, local networks organizing micro-financing and providing loans should be supported.

These strategies need to be coupled with enforcement of existing environmental laws and forest protection, and incentives for increased agricultural production need to be assessed for perverse incentives inducing forest clearing and further land degradation. Money must be allocated to the DEF to ensure capacity development and adequate pay for forest officers, as well as the ability to address corruption. The government should be encouraged to view the DEF as being responsible for environmental conservation along with ANGAP. In addition, sanctions must be levied on violators of forest and park laws.

Increased government capacity--The national government should be encouraged to transfer funds and trained personnel from the central government in order to empower local councils. This should improve with the recent decentralization. Delivery of grassroots services could prove popular with donors, and may also help tax collection if people see their payments resulting in direct services. Programs like the existing provision to municipalities of budgets for reforestation should be encouraged.

National policies and their coordination--There must be greater outreach and education explaining the relationship between economic policies and environmental degradation. Coordination of the various ministries must be facilitated to dispel the perception that environmental problems are only the problems of the Environment Ministry.

The Poverty Reduction Strategy can be used to promote linkages between the ministries overseeing the environment and economy, to encourage support of rural development and sustainability. Work at the national level should also focus on programs linking poverty alleviation with environmental protection, including the Sectorial Transport Programme, the National Programme for Support to the

Private Sector, the National Population Policy for Economic and Social Development, the National Policy for the Promotion of Women, and the Environment Programme.

The national energy policy must move away from reliance on firewood, and opportunities to finance plants fuelled by solar power or bagasse should be pursued. A program to deliver alternative cooking fuels should be encouraged; a subsidy on kerosene could lower demands on fuelwood. Plans to reduce fuelwood consumption would need to be coupled with alternative income generation in those rural communities whose primary source of income is wood and charcoal sales.

Use of Study Results

Figure 2 illustrates the various socioeconomic causes of biodiversity loss and the linkages between them. These results were also summarized and shared with the donor community and with decision-makers in the key sectors of agriculture, tourism and the environment.

WWF used the study recommendations to design interventions at various levels and to mobilize partnerships to implement these interventions.

Local level interventions include:

- supporting local stewardship of forests and natural resources by facilitating forest management transfer contracts between the State and communities neighboring priority conservation areas;
- helping integrate environmental issues in local and communal development plans and helping introduce spatial zoning for development and conservation in such plans.

Communal and regional level interventions include:

- partnering with PADR executing agencies and programs to provide sustainable alternatives to natural resource exploitation in target communities. This includes agricultural extension and the introduction of revenue generating activities such as small scale businesses;
- mobilizing support to reinforce communal and regional structures and the ability to design and implement development plans;
- developing an energy strategy for the Spiny Forest Ecoregion.

National and international level interventions include:

- more in-depth study of the linkages between trade liberalization, rural poverty and the environment with a special emphasis on the case of maize exportation, and the creation of a National Advisory Committee to help influence trade policies in favor of the environment and rural development;
- creation of and participation in a joint Environment Programme-PADR committee to ensure coherence and synergy between the rural development and environmental sectors;
- creation of and participation in a joint forests/mining committee to facilitate dialogue between the two sectors, and to develop mechanisms for conflict resolution in areas of both high biodiversity and high mining potential. These joint committees are playing a key role in the implementation of Madagascar's recent commitment to triple its protected area coverage over the next five years.

Conclusions

The analysis of the root causes of biodiversity loss in the Spiny Forest has provided the basis of a 15-year Ecoregion Action Plan that identifies the strategies, actions, partners and means necessary to ensure effective and sustainable conservation of the ecoregion's biodiversity. The results of the study have been very useful in fostering dialogue with other sectors and raising their awareness of the potential environmental and social costs of their actions, and will eventually inform them on how these actions can be more sustainable.

The study has helped us gain a better understanding of the complex dynamics among which our work is taking place, and has helped us make more informed decisions on how to act. It must be stressed that the value of such a study heavily relies on the level of specificity that can be achieved; a root cause analysis should ideally start from the analysis of specific biodiversity targets (key species or habitats) in specific sites so that the higher level causes and subsequent interventions can be better adapted and targeted and hence be more responsive.

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