REPORT ON SECTIONS 118 AND 119 OF THE FOREIGN ASSISTANCE ACT

1. Introduction

1.1 Peru is among the twelve most biologically diverse countries in the world. It also is the country with the fourth largest area of humid tropical forest.[1] Yet habitat destruction, contamination, over-exploitation and exotic species threaten its biodiversity and tropical forests. The impediments to reducing these threats are embedded in the structure of Peru's economy, society and politics. Success in eliminating, reducing or mitigating these impediments will thus require multiple, well planned, effective actions.[2] The Government of Peru and many Peruvian citizens, however, are committed to acting to conserve and sustainably manage their country's biodiversity and tropical forests.[3]

1.2 In 2001, USAID/Peru prepared its "Country Strategic Plan for 2002-2006".[4] Sections 118 and 119 of the Foreign Assistance Act require each USAID Mission to report to the U.S. Congress on the potential impact of its Strategic Plan on its host country's biodiversity and tropical forests. The present report is intended to provide the basis for USAID/Peru to comply with this requirement.

1.3 The report is divided into seven sections. After this introductory section, Section 2 summarizes the characteristics of Peru's biodiversity and tropical forests. Section 3 describes the four principal threats to their conservation and sustainable management. Section 4 describes and analyzes six impediments to the elimination or reduction of those threats. Section 5 compares the actions required to reduce, eliminate or mitigate these impediments with the actions proposed in the Country Strategic Plan, FY2002-FY2006. Section 6 discusses potential environmental issues raised by some of the actions proposed in the Country Strategic Plan. Section 7 briefly recapitulates the report and draws some general conclusions regarding the impact of the Country Strategic Plan on Peru's biodiversity and tropical forests.

1.4 Two documents that have been prepared (in Spanish) by the Cuanto Institute, a Peruvian environmental NGO, El Medio Ambiente en el Perú, Ano 2000 and the State of the Environment Report for 2001, provide the basis for the report.[5] It also draws on

[1] Cuanto Institute, 2001, Chapter 9.

[2] In this report, the term threat refers to the direct causes of the loss of biodiversity and tropical forests. The term impediment refers to the barriers to the reduction or elimination of these threats. The term action refers to specific activities designed to remove, reduce, or mitigate impediments.

[3] The many national laws and regulations and international environmental treaties of which it is a signatory indicate this commitment of the Government of Peru. The commitment of many Peruvians has been shown in the establishment of many environmental NGOs and in the results of opinion surveys.

[4] USAID/Peru. 2001.

[5] Cuanto Institute, 2000 and Cuanto Institute, 2001 (Draft Chapters 9 – 13). The second document was scheduled to be completed and published in December 2001 but only the drafts of Chapters 9 through 13 were available for the preparation of the present report. USAID/Peru provided financing for both reports.

information derived from other reports and from consultations with Cuanto Institute staff, Peruvian experts and USAID/Peru staff.

2. Description of Peru's Biodiversity and Tropical Forests

2.1 Peru is a country with megadiversity, a term used to distinguish a high concentration of biodiversity and species endemism. The term biodiversity refers to biological variability at the ecosystem, species and gene levels. The term endemism refers to species that occur only within a defined area. Peru has a great variety of ecosystems, although they can be classified according to a number of different sets of criteria.[6] Its identified species include 17,144 plants, 2,000 fish, 1,736 birds, 332 amphibians, 460 mammals, 365 reptiles, and over 16,000 invertebrates. In most of these groups, many more species remain to be identified. Species endemic to Peru number 6,288. Peru's domesticated and wild plants and animals contain a great store of genetic variability.[7]

2.2 Broadly used, the term tropical forest refers to all the forest types that occur in the tropics. More narrowly, it refers to the forest types of the tropical humid lowlands. Peru's large areas of humid tropical forests provide the habitat for much of Peru's biodiversity. However, Peru also has many other forest and non-forest ecosystems, each with its own range of species and genetic biodiversity.

2.3 Much remains to be learned about Peru's biodiversity, endemism and tropical forests. The structure and function of few of Peru's ecosystems have been thoroughly studied. Many geographic areas lack complete floral and fauna inventories and thorough studies of endemism.[8] Little is known about the species numbers and endemism of the more inconspicuous groups of organisms, such as invertebrates, bacteria, and arthropods or the genetic diversity of natural populations of plants and animals.[9] The following sections, however, summarize some of what is known about Peru's biodiversity at the ecosystem, species and gene levels.

Peru's Ecosystem Biodiversity

2.4 Peru is located on the western central coast of South America, between the latitudes 00° 01' 48" S and 18° 21' 03" S. It is bordered by Ecuador and Colombia to the north, Brazil to the east, Bolivia and Chile to the south, and the Pacific Ocean to the west. Its terrestrial area of over 128 million hectares makes it the third largest country in South America. Including its marine waters, Peru has four Geographic Regions.[10] It has ten

[6] INRENA. 1997, p. 71, Table 4.2 lists seven different ways to classify Peru's landscape.
[7] CONAM, 2001, p. 24
[8] INRENA. 1997, pp. 88 & 122
[9] Cuanto Institute, 2001and INRENA, 1997 contain little information about gene level biodiversity of wild, natural populations. They both focus on the genetic diversity of domesticated plants and animals.
[10] INRENA, 1997, pp. 57-62

Ecoregions[11], each with one or more Ecosystems.[12] Some of the Ecoregions occur in more than one Geographic Region.[13]

Marine Geographic Region

2.5 The Marine Geographic Region occupies about 37 million hectares, corresponding to the area of marine sovereignty claimed by Peru in a band 200 miles wide off its coast.[14]

2.6 The climatic event of El Niño plays an important role in the climate of the Marine Geographic Region. El Niño events occur at periods from 3 to 7 years when the ocean off the northern and central Peruvian coast becomes unusually warm. After an El Niño event, the ocean waters become colder than usual. The El Niño event causes large variations in the populations and distributions of the species of marine organisms found in the Marine Geographic Region.[15]

2.7 The Marine Geographic Region includes two ecoregions: the *Peruvian Current Ecoregion* and the *Tropical Ocean Ecoregion*. The *Equatorial Front*, an area of great diversity of marine organisms, occurs at the boundary between the two ecoregions, at about 6° S latitude.[16]

The Peruvian Current Ecoregion [17]

2.8 The Peruvian Current Ecoregion flows north along most of the Peruvian coast and contains three currents:

- The Cold Coastal Current flows from the south to the north, usually within 60 miles of the coast. It has low temperatures, between 15 and 18 C, and salinity between 34.9 and 35.1 percent.
- The Temperate Current of the Sub Antarctica Region flows out of the northern border of the oceans surrounding Antarctica at a depth of 50 to 150 m. Its temperatures are less than 15 C and its salinity is less than 34.8 percent.

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[11] This report utilizes the Ecoregion system of classification because that is the system that was used in Low et. al., 1993, INRENA, 1997, and Cuanto Institute, 2000. The descriptions of the Ecoregions are adapted from these documents.

[12] Topographic features characterize a Geographic Region. Ecological characteristics define an Ecoregion. Vegetative formations are the simplest way to describe Ecosystems, although an ecosystem includes more than just the main plant species.

[13] The Ecoregions do not fit neatly into the three terrestrial Geographic Regions. For example, the boundary between the Coastal Region and the Highland Region does not necessarily coincide exactly with the boundary between the Dry Equatorial Forest Ecoregion and the Andean Steppe Ecoregion.

[14] INRENA, 1997, p. 57 says that the area of the Marine Geographic Region is “370 km2”. This must be a mistake, because on p. 58 it says that the area of the Coastal Region is “136,370 km.2”. Yet the coast is only “40 to 80 km. wide", while the Marine Geographic Region is "200 miles wide". The figure of 37 million hectares, therefore, is derived from supposing that “370km2” was meant to be “370,000 km2”.

[15] Cuanto Institute, 2000, pp. 113-125

[16] INRENA, 1997, p. 149

[17] Ibid.

- The Intermediate Antarctica Current lies below 600 to 700 m and has very low salinity.

2.9 The upwelling of these currents' cold, nutrient-rich waters off the southern and central Peruvian coast stimulates the florescence of extremely high concentrations of plankton, which support large populations of anchovies. The anchovies are the food base for one of the world's highest concentrations of fish, marine mammal and seabird populations.[18]

Tropical Ocean Ecoregion

2.10 The Tropical Ocean Ecoregion occupies a small area off Peru's northwest coast.[19] Within this ecoregion, five currents flow down the Peruvian coast from the north and northwest:

- The Superficial Tropical Current has temperatures above 25 ° C and salinity less than 33.8 percent.
- The Superficial Subtropical Current has variable temperatures, ranging from 15 to 26 ° C and salinity over 35.1 percent.
- The Equatorial Superficial Current has temperatures between 22 and 25 C and salinity of 24.0 to 34.8 percent.
- The Submerged Equatorial Current flows at 50 to 300 m below the surface. Its temperature is from 13 to 15 ° C and its salinity 35.1 to 34.9 percent.
- The Deep Equatorial Current flows at 150 to 700 m below the surface. Its salinity is 34.0 to 39.9 percent.

2.11 In spite of its relatively small area, species diversity is much higher in the Tropical Current Ecoregion than in the Peruvian Current Ecoregion although the total population of marine organisms is much lower.[20]

[18] INRENA. 1997, p. 167 quotes Dr. Roger Revelle, Director of the Scripps Institute, as saying that the Peruvian Coastal Current "…is situated in the most fertile area of the world and that it is the most important physical and biological phenomenon of the earth".
[19] Ibid., p.211, Diagram 4.
[20] Ibid., p.167 notes that the higher species diversity of the Tropical Ocean Ecoregion might partially be a result of more scientific investigation.

Table 1. Summary Description of Peru's Geographic Regions, Ecoregions, Ecosystems [21]

Geographic Region	Ecoregion	Ecosystems	Summary Description
Marine	Peruvian Current	Various currents	Cold, nutrient rich, high populations, less diversity
	Tropical Current	Various currents	Warm, nutrient poor, lower populations, high diversity
Coastal Plain	Pacific Desert/ Hills	Coastal Hills	On hills up to 700 masl. Very low rainfall/Moisture from mists supports desert vegetation.
		Tillandsia Form.	On extremely dry flat desert but moisture from mists supports growth of bromeliads.
	Dry Equatorial Forest[22]	"Algarrobos"	Prosopis pallida forest
		"Hualtaco" Forest	Forests dominated by "hualtaco", Lonopterygium huasango, a commercial timber tree.
		Mangrove Forests	In the estuaries of the Tumbes and Zarumilla Rivers on the northern coast
		Scrub Forests	In the northern foothills/ 200-1000 masl/300-650mm/yr rainfall/Canopy 4-5 m.
		Low Deciduous Forests.	In the central/southern foothills/400-1,000mm/yr rainfall/many epiphytes
	Pacific Tropical Forest	Pacific Tropical	Northern Peru. 1,200 mm/yr. rainfall/20-25m canopy height
Highlands	Puna	Andean Pastures	Above 3,800 masl/150-600 mm/yr rainfall. 19,000,000 has. Severe degradation.
		Tolares.	Southern regions/Temperatures 3-6°C/200-500 mm/yr rainfall. Thorny bushes predominate.
	Andean Steppe	Brushlands	Western Andes/1,500-3,800 masl/125-1500mm/yr rainfall/8 million has./many cacti.
		Quinuales	3,000-4,500 masl/main plant is "quinual" (Polylepsis, sp)/43,000 has in southern departments.
	Paramo.	Paramo	Small area at 3,500 and 4,500 masl in northern Peru. Up to 600 mm/yr of precipitation.
Amazon Basin	"Selva Alta"	Upper Montane	
		Podocarpus Forest	Moister locations in Selva Alta 1,800-3,500 masl/153,000 has mostly in Cajamarca.
		Lower Montane	600-1,400 masl. Temperatures 17-25°C. 1,600-4,000 mm/yr.
	"Selva Baja".	Riverain Forest	Beside rivers/20-25 m. canopy height/3,250,000 has/higher sites cultivated by local people.
		Swamp Forests/ Aguajales"	Near confluence of Tigre & Pastaza rivers and many smaller areas. 6,300,000 has.
		Terrace Forest	Alluvial terraces/8,000,000 has./Fertile soils for agriculture/canopy height 30-45 m.
		Upland Forest	On old terraces/26,000,000 has./35-40 m canopy height. Many tree species.
		Bamboo Forest	1,500,000 ha of Merostachis and Guadua bamboo genera.
	Chaco savanna	Chaco savanna	In Pampas del Rio Health in Madere de Dios Department. Mauritia flexuosa palm.

[21] Based on Low, 1993, pp.3-15 and Cuanto Institute, 2000, pp. 48-9
[22] Some of the ecosystems of the Coastal Geographic Region also cross into the Highland Geographic Region.

Coastal Plain Geographic Region

2.12 The Coastal Plain Region is from 40 to 80 km wide and occupies over 13 million hectares, about 11 % of Peru's terrestrial area.[23]

2.13 Average annual temperatures on the coastal plain are between 16° C and 24° C. Temperatures are cooler during the winter months, June to September, and warmer during the summer months, December through March. Average annual precipitation in the lower elevations of the southern and central coastal plain is less than 100 mm/yr. However, during the winter months there is an almost continuous mist, known as "garúa", which keeps the atmospheric humidity high and the level of solar radiation low. Rainfall increases in the northern coastal plain and at higher elevations. During an El Niño event, torrential rains fall on the central and northern Peruvian coast during a period of 12 to 18 months. After an El Niño event, rainfall generally decreases and drought affects northern Peru.

2.14 The Coastal Plain Geographic Region has three ecoregions: the *Pacific Desert and Hills, Dry Equatorial Forest* and the *Pacific Tropical Forest.*

Pacific Desert and Hills Ecoregion

2.15 The Pacific Desert and Hills Ecoregion occurs on the southern and central Peruvian coast, where the soils are frequently saline and calcareous. Some of the 53 valleys that open on to the coastal plain, however, have very fertile soils. Irrigated agriculture in these valleys can be extremely productive.

2.16 The main ecosystems are the *Coastal Hills* and the *Tillandsia Formations*.

- *Coastal Hills*: On the southern coastal plain constant ocean winds have formed hills up to 700 m high. Enough moisture from the "garúa" condenses on these hills' sea-facing slopes to support desert vegetation, dominated by Carica candicans, Capparis prisca and Prosopis pallida, and Acacia macrocanthus.

- *Tillandsia Formations*: The Tillandsia Formations occur on the flat desert along the southern and central Peruvian coast. They consist of bromeliads of the genus Tillandsia.

Dry Equatorial Forest Ecoregion

2.17 The Dry Equatorial Forest ecoregion occurs on the northern coast, where relief is flat at lower elevations and very steep at higher elevations. Soils are mainly sands, loams and clay loams.

[23] Ibid., p.58

2.18 The principal ecosystems are *Algarrobales, Hualtaco Forests, Mangrove Forests, Scrub Forests*, and *Deciduous Forests.*

- *Algarrobales:* The "algarrobales" ecosystem occurs on about 3 million hectares of the northern Peruvian coast. Its flora includes species of the genera Capparis, Parkinsonia and Acacia spp., but the tree Prosopis pallida dominants. Its nutritious seeds provide food for humans and livestock and its wood makes excellent charcoal.

- *Hualtaco Forests:* The Hualtcaco Forest ecosystem occurs on the border between Tumbes and Piura Departments. The commercially valuable tree species, "hualtaco", Lonopterygium huasango is the dominant species.

- *Mangrove Forests:* Mangrove forests, composed of Rhizophora mangle, R. harrisoniac, Avicennia germinans, A. nitida, Laguncularia racemosa, and Conocarpus erectus, grow at the mouths of the Tumbes and Zarumilla Rivers in Tumbes Department. The mangrove forest stabilizes the shoreline and provides habitat for coastal aquatic fauna.

- *Scrub Forests*: The Scrub Forest ecosystem occurs on about 480,000 hectares in the Andean foothills, between 200 and 1,00 masl[24], in northern Peru. The height of the forest's canopy is 4 to 5m. Dominant woody genera are Caesalpinea, Lozopterygium, Tabebuia, Capparis, Eryoteca, Chorisia, Cordia and Acacia.

- *Deciduous Forests:* The Deciduous Forest ecosystem occurs on the lower Andean slopes. Typical woody species are Eryoteca discolor, Ceiba pentandra, Bursera sp. Epiphytes of the genera Tillandsia completely cover the branches of many of the trees.

Pacific Tropical Forest Ecoregion

2.19 The Pacific Tropical Forest Ecoregion occurs on a small area in the northern Department of Tumbes. It is the southernmost extension of the western Andes humid tropical forest. Rainfall, however, rarely exceeds 1,200 mm/yr., except during an El Niño event. Mean maximum temperatures are around 25° C. The only ecosystem in this Ecoregion is the *Pacific Tropical Forest* ecosystem, which corresponds to the area of the Ecoregion itself. The forest has a canopy height of 20 to 25 meters and a very high diversity of species. Timber trees include Cedrela odorata and Cordia alliadora.

Highland Geographic Region

2.20 The Highland Geographic Region, also known as the "Sierra", lies to the east of the coastal plain. It covers over 39 million hectares, 30 percent of Peru's area. Topography is extremely varied, with high, flat plains, deep valleys and snow-covered peaks.

[24] masl: meters above sea level

2.21 Amazon and coastal air masses both influence the climate of the Sierra Region. Average annual precipitation is about 700 mm and average annual temperature about 15° C. Local topography and altitude, however, greatly influence site-specific climates in the Highland Geographic Region. At higher elevations, the average precipitation may be as low as 450 mm/yr. and the average annual temperature as low as 9° C.

2.22 The four Ecoregions of the Highland Geographic Region are the *Andean Steppe*, *Puna, High Andean Pastures,* and *Paramo.*

Andean Steppe Ecoregion

2.23 The Andean Steppe Ecoregion is extremely mountainous. Its soils are frequently shallow and stony, but may be fertile in the valley bottoms.

2.24 The principal ecosystems a within this ecoregion are the *Brushland* and *Quinuales.*

- *Brushland*: The Brushland ecosystem occurs between 1,500 and 3,800 masl. Its typical plant species are the bushes and small trees Cerus candelaris; Carica candicans; Armatocereus sp, Salix sp.; Alnus sp.; Schinus molle, Sambucus peruviana and Opuntia ficus.

- *Quinuales*: The Quinuales ecosystem occurs between 3,000 and 4,500 masl. and is named after its dominant tree, the "quinual", (Polylepsis, sp).

Puna Ecoregion

2.25 The Puna Ecoregion occurs in the southern Highlands at elevations over 3,800 masl. The Puna's topography is generally flat or gently rolling. Soils have a black, organic surface layer that overlies unconsolidated volcanic ash. Nights are very cold but days can be quite warm. Some of Peru's major rivers originate in the Puna's many lakes.

2.26 The principal ecosystems of the Puna Ecoregion are the *High Andean Pastures* and the *Tolares*.

- *High Andean Pastures*: The High Andean Pastures cover about 19 million hectares of the highest elevations of the Andean steppe. The original vegetation mostly consisted of herbs of the genera Festuca, Calamagrostis, Poa, Bromus and Stipa. Sheep have overgrazed most of this ecosystem.

- *Tolares:* The Tolares ecosystem occurs in the southern part of the Puna Ecoregion, where temperatures are lower and rainfall is less than further north. Several thorny species of bushes, locally called "tola", of the genera Parastrephia and Baccharis, predominate.

Paramo Ecoregion

2.27 The Paramo Ecoregion occurs in a relatively small area at 3,500 and 4,500 masl in the headwaters of the Chinchipe, Quiroz and Huancabamba rivers in northern Peru. It is similar to, but more humid than, the Puna Ecoregion. Except for isolated patches of trees, in the genera Polylepis, Alchimilla, and Escallonia, its vegetation is mostly herbaceous.

Amazon Geographic Region

2.28 The Amazon Geographic Region occupies the eastern part of the country, covering over 75 million hectares, or about 59 percent of Peru.

2.29 Humid air masses from the eastern Amazon Basin are the main influence on the climate. Annual rainfall, although generally above 2,500 mm/yr., is not uniform. Rainfall increases with higher elevations and decreases towards the south, where a dry season of up to three months occurs. Temperatures in the lower areas are usually in the upper 20's but decline with increasing elevation.

2.30 The Amazon Geographic Region's two principal ecoregions are the *"Selva Alta"* and the *"Selva Baja"*.

"Selva Alta" Ecoregion

2.31 The "Selva Alta" ecosystem, also known as the "Yungas", occurs along the steep eastern slopes of the Andes above the Amazon plain, between 500 and 3,800 masl. Topography in this ecoregion greatly influences precipitation patterns; some easterly exposed slopes, for example, may receive as much as 8,000mm/yr. of rainfall. Areas lying in a rain shadow, however, may have much less precipitation. Soil types include newly formed, fertile and old, infertile soils. Biodiversity and endemism in this ecosystem is extremely high. Many plant and animal species have a very restricted distribution.

2.32 Ecosystems of the "Selva Alta" are the *Upper Montane Forest*, *Lower Montane Forest*, and *Podocarpus Forest.*

- *Upper Montane Forest:* The Upper Montane Forest occurs between 1,800 and 3,800 masl. It frequently covers shallow soils on steep slopes with dense vegetation composed of mosses, lichens, bromeliads and climbing plants as well as short trees of the genera Myrcia, Clusia, Alnus, Piper, Polylepis, Gynoxis, Weimania, Ocotea, and Eugenia.

- *Lower Montane Forest*: The Lower Montane Forest occurs between 600 and 1,400 masl. Originally, it covered much of the Central Selva, Pichis, Palcazu, Satipo, Chancamayo and Huallaga Valleys. Levels of biodiversity and endemism are very high. The forest forms a closed canopy with tree heights of up to 30 m. and many

lianas and epiphytes. As many as 50 plant species may grow per hectare. Among the commercial tree genera are Aniba, Ocotea, Perea, Nectandra, Cedrela, Virola and Chorisia.

- *Podocarpus Forests*: The podocarpus forest ecosystem, composed of several species of the genera Podocarpus, occurs mostly in the Department of Cajamarca, at elevations between 1,800 and 3,500 masl, and covers about 153,000 hectares.

"Selva Baja" Ecoregion

2.33 The "Selva Baja" is Peru's largest ecoregion, covering about 45 million hectares. It lies between 100 and 600 masl in the east and northeast. Much of the ecoregion is flat, although occasional hills rise up to 500 meters. Standing water is common. This ecoregion is the most biologically diverse in Peru.

2.34 The ecosystems of the "Selva Baja" are the *Riverain Forest, Swamp Forest and "Aguajales, Terrace Forest, Upland Forest*, and *Bamboo Forests*.

- *Riverain Forest:* The Riverain Forest ecosystem, covering about 3.2 million hectares , borders the main rivers. Depending on the site, its vegetation can be savanna-like or dense forest. Higher sites frequently have fertile soils, often cultivated periodically by indigenous peoples. Although pioneer heliophytes, such as Cecropia sp, Ficus anthelminthica, Guarea sp., Cumala sp. and Calophyllum sp., quickly colonize abandoned agricultural clearings, most tree species that occur in this ecosystem do not grow particularly fast.

- *Swamp Forest and "Aguajales*": The Swamp Forest and "Aguajales" ecosystems occur on about 6.3 million hectares near the Maranon, Ucayali, Tigre and Pastaza Rivers. The "Aguajales" are dominated by the "aguaje" palm, Mauritia flexuosa. Associated species include Ficus sp. Virola sp., Guarea sp., Euterpe spp and Lessenia spp.

- *Terrace Forest:* The Terrace Forest ecosystem occurs on about 8 million hectares of the level to slightly rolling land on the alluvial terraces of large rivers. Its fertile soils offer the best possibility in the "Selva Baja" for sustainable agriculture. Typical tree species include Hura crepitans, Guarea sp., Bertholletia sp., Cedrelinga catanaeformis, Ocotea sp., and Pourouma sp.

- *Upland Forests:* The Upland Forest is the most extensive ecosystem in the "Selva Baja", covering about 26 million hectares. It occurs on old terraces and hills, where soils are generally quite infertile. Plant species diversity is extremely high. The most valuable timber trees are Cedrelinga catanaeformis, Cedrela odorata, Swietenia macrophylla, and Protium sp.

- *Bamboo Forests:* Dense bamboo forests occupy about 1.5 million hectares in the "Selva Baja" Like the Upland Forest ecosystem, this ecosystem tends to occur on old terraces and hills.

Palm Savanna Ecoregion

2.35 The palm savanna ecoregion occurs in a small area of southern Peru, in Madre de Dios Department. It is an outlier of the savannas of Bolivia, Paraguay and Brazil and its principal plant species is the palm Mauritia flexuosa. The only ecosystem in this ecoregion is the Palm Savanna ecosystem itself.

Peru's Species Diversity

Plants

2.36 Peru has 17,144 species of identified flowering plants, in 2,458 genera and 224 families.[25] This is the fourth largest number of identified flowering plants of any country in South America and the ninth largest number of any country in the world. The families with the most species diversity are the Asteraceae, Orchidaceae and Piperaceae. The eastern side of the Andes has more flowering plant diversity than the western side. More than 300 species of trees per hectare have been recorded at Yanamono in the Amazon.[26] Thirty-one percent of Peru's flowering plants, or 5,354 species, are endemic.[27]

2.37 Peru has approximately 1,000 species of non-flowering plants, such as ferns, licopodios, and equistos in 16 families. The highest variety and number of non-flowering plants occurs in the "Selva Alta" Ecoregion.[28]

Birds

2.38 Birds are the most completely studied group of Peruvian fauna.[29] Identified bird species number 1,710, in 88 families. The greatest number of species occurs in the "Selva Baja" Ecoregion, where 895 species have been reported. The fewest species are found in the Puna Ecoregion. Many bird species, especially those that inhabit the western slopes of the Andes, have very restricted distributions.[30] There are 112 species of endemic bird species in Peru.[31] The Peruvian Marine ecoregions provide refuges for many species of migrant birds from the Northern Hemisphere.[32]

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[25] Cuanto Institute, 2001, Chapter 9.
[26] Ibid., Chapter 11
[27] Ibid., Chapter 9
[28] INRENA, 1997, p. 117
[29] Ibid., p.100
[30] Ibid., p. 101, Table 4.3.1
[31] Cuanto Institute, 2001, Chapter 9, Table 9.3
[32] Instituto Nacional de Estadistica e Infomatica, 2000. p. 92

Table 2. Number, Orders, Families, Genera and Species of Birds by Ecoregion

Ecoregion[33]	Order	Family	Genera	Species	Restrict.
Peru	20	88	587	1705	959
Marine and Shore	10	39	98	175	91
Arid Tropical	17	48	190	245	64
Arid Subtropics	14	40	117	151	22
Arid Temperate	11	30	85	133	2
Humid Subtropical Temperate	11	32	101	143	8
Puna	13	34	82	128	39
Humid Temperate	13	39	144	250	94
Humid Subtropical	14	44	189	292	74
High Humid Tropical	13	43	214	305	55
Humid Tropical	17	65	435	895	510

Source: INRENA, 1997, p. 101, Table 4.3.1

Mammals

2.39 Peru has 460 identified terrestrial and marine mammal species, in 49 families, and 196 genera. Sixty-seven percent of the mammal species are rodents or bats; bat species represent 35 percent of the mammals of Peru, with 164 species in 55 genera and 8 families. Twenty-four rodent species are endemic to Peru. About 30 mammal species are endemic to the eastern "Selva Alta". Seven species are endemic to the western coast and Andean foothills. The largest number of endemic species, however, occurs in the "Selva Baja" Ecoregion. [34]

Table 3. Numbers of Orders, Families and Species of Mammals in Peru

Orders	Families	Species
Marsupialia	2	29
Xenarthra	4	13
Insectivora	1	1
Chiroptera	8	152
Primates	3	32
Carnivora	7	35
Cetacea	7	30
Sirenia	1	1
Perissodactyla	1	2
Artiodactyla	3	12
Rodentia	12	152
Lagomorpha	1	1
Total	50	460

Source: INRENA, 1997, p. 103, Table 4.3.1.f.

2.40 The diversity of ecological niches created by the convergence of cold and warm currents in the Marine Geographic Region supports a high diversity of marine mammal species. Thirty-one species of whales live in or migrate through Peruvian coastal waters. Of these, however, only one species is endemic, the *Mesoplodon peruvianus*, the "ballena de pico Peruana". [35]

[33] This table uses a somewhat different classification of ecoregions.
[34] Cuanto Institute, 2001, Chapter 9
[35] Ibid., Chapter 9

Amphibians

2.41 Peru has 315 identified species of amphibians, 125 of which are endemic. Sixty new species of amphibians have been identified since 1985. About 30 percent of the amphibian species are restricted in their range to only one reported site. The largest number of amphibian species occurs in the "Selva Alto" and "Selva Baja".[36]

Table 4. Number of Orders, Families, Genera and Species of Amphibians in Peru by Ecoregion

Ecoregion	Order	Family	Genera	Species	Restrict.
Peru	3	132	48	315	264
Coastal Desert	1	2	2	3	1
Dry Ecuatorial Forest	1	2	4	4	2
Tropical Pacific Forest	1	4	7	7	3
Andean Steppe	1	3	3	13	4
Puna	1	3	7	27	19
Paramo	1	3	7	11	8
"Selva Alta"	3	8	26	131	97
"Selva Baja"	3	13	44	167	130
Palm Savanna	1	1	4	5	0

Source: INRENA, 1997, p. 99, Table 4.3.1.c

Reptiles

2.42 Peru has 365 identified reptile species, of which 98 are endemic. Although the largest number of reptile species occurs in the "Selva Baja" ecoregion, most of the endemic species live in the Pacific Desert and Dry Equatorial Forest ecoregions. Over 80 percent of the reptile species have restricted ranges.

Table 5. Number of Reptiles in Peru by Order, Family, Genera, and Species

Ecoregion	Order	Family	Genera	Species	Restrict.
Peru	3	27	120	365	301
Ocean	2	3	5	5	0
Coastal Desert	1	8	22	44	32
Dry Equatorial Forest	2	11	22	39	19
Tropical Pacific Forest	3	5	6	6	2
Andean Steppe	1	6	16	25	17
Puna	1	2	5	14	11
Paramo	0	0	0	0	0
"Selva Alta"	2	13	41	93	58
"Selva Baja"	3	21	43	189	162
Palm Savana	1	1	1	1	0

Source: INRENA, 1997, p. 100, Table 4.3.1.d.

Freshwater Fishes [37]

2.43 Peru has 900 identified freshwater fish species, although the total number may be over 1,200. The number of freshwater fishes differs greatly between Peru's three principal drainage areas: the Pacific Coast, the Amazon Basin and Lake Titicaca Basin. The Pacific Watershed has only 37 fish species and 30 of these live in the Tumbes River,

[36] Ibid., Chapter 9
[37] INRENA, 1997, Vol. I, pp. 95-97

in northern Peru. Fish diversity decreases south of the Piura River. In the southern Moquegua River, for example, there are only three fish species. There are two endemic fish species in the Tumbes River and one in the Piura River.

2.44 In Lake Titicaca there are 39 native species and 1 introduced species (Odonthestes bonariensis or "pejerry") of fish. Thirty-three of the species are endemic, belonging to only one genera, *Orestira*..

2.45 The Amazon Basin has 855 fish species, in 323 genera and 45 families. Species variety and fish abundance within and between the region's rivers varies considerably, depending on nutrient availability. The upper reaches of the Marañon River, for example, which carry little sediment and are nutrient poor, have relatively few fish species and low fish populations. The lower Marañon River, which has more sediments and nutrients, supports high fish populations and over 200 fish species. The Alto Ucayali River has 150 species of fish, mostly relatively small, while the Ucayali River has over 300 species, including some species, such as the "paiche", *Arapaima gigas*, that grow to a very large size. In the Madre de Dios River 120 species of fish have been identified. Little information has been collected regarding the fish populations of the Napo River.[38]

Table 6. Number of Fishes by Order, Family, Genera and Species in Peru by Basin

Basin	Orders	Families	Genera	Species
Peru	16	57	346	866
Pacific Basin	6	16	26	37
Titicaca Basin	2	4	4	39
Amazon Basin	14	45	323	744
High Andes Lakes/Rivers	2	3	3	22

Source: INRENA, 1997, p. 97, Table 4.3.1.b.

Invertebrates [39]

2.46 Knowledge of invertebrate species in Peru is far from complete since probably only about 20 percent of the total number of species have been scientifically described and identified. Of the identified species, 10,800 are insects, 3,000 are arachnids, 1,030 are mollusks, and 512 are crustaceans.

Peru's Genetic Diversity

2.47 An important element of Peru's biodiversity is the genetic diversity contained in its species of living organisms. Peru is a world center for domestic plants and animals that have become useful to humans. Some of the domesticated plants, such as the potato and tomato, have spread around the world and have become economically important; their wild relatives contain important reserves of genetic variety. Other of Peru's domesticated flora and fauna, including "amaranto", "chirimoyo", "cocona", "kiwicha", "lucumo", "olluco", "quinua", "rocoto", "tarwi", and "tomate de arbol", are less well known internationally, although they are important foods in Peru. Peruvian farmers, for

[38] ibid., pp. 97-102
[39] ibid., p. 103

example, cultivate more than 30 genetically distinct varieties of "quinua", each one adapted to a local ecotype.[40]

2.48 Genetic diversity must also be great in many species of wild organisms. Comparatively little, however, is known about the genetic diversity of undomesticated species of plants and animals.[41]

Threatened and endangered species

2.49 In 1999, the Peruvian government promulgated an official list of threatened species. The list included 222 species of terrestrial and aquatic vertebrates, including 73 mammals, 86 birds, 44 reptiles and 19 amphibians. Eighty-one of the endangered species are aquatic.[42]

National System of Natural Protected Areas [43]

2.50 In 1990, Peru established the National System of Natural Protected Areas (SINANPE). SINANPE includes 17.3 million hectares, thirteen percent of Peru's total area. It is administered by the National Institute for Natural Resources (INRENA), with cooperation from national and international development agencies and environmental NGOs. SINANPE includes 53 separate areas, including National Parks (9), National Reserves (9), National Sanctuaries (6), Historical Sanctuaries (4), Protective Forests (6), Communal Reserves (2), Hunting Territories (2), Landscape Reserves (1) and Reserved Zones (14). Thirty-eight priority zones for conservation of biological diversity have been identified in Peru. Of these, SINANPE adequately protects 11, partially protects six, and does not protect 21. Financing for SINANPE comes from public funds and from the National Fund for Natural Protected Areas (FONANPE), which receives Peruvian government and international donations.

3. Threats to conservation and sustainable management of Peru's biodiversity and tropical forest

3.1 The four principal threats to Peru's tropical forests and biodiversity are (i) habitat loss and fragmentation; (ii) over-exploitation; (iii) contamination; and (iv) exotic species. [44] The following paragraphs summarize the character and scope of these threats in Peru.

Habitat Fragmentation

3.2 Habitat fragmentation, the greatest threat to Peru's biodiversity and tropical forests, has two components: (i) reduction of the total amount of a habitat type and (ii)

[40] ibid., pp. 227-8
[41] INRENA, 1997, p. 227-8 discusses genetic diversity but does not provide any information on the genetic diversity of wild populations of flora and fauna.
[42] Instituto Cuanto, 2000, p.40
[43] ibid. p. 222, Table 12.1
[44] Cuanto Institute, 2001, Chapter 10 and Meffe, Gary & Ronald Carroll, 1997, pp. 148-9.

division of the remaining habitat into smaller, more isolated patches. Habitat fragmentation causes local species extinction, shifts in species composition and a change in abundance patterns in favor of weedy species. A reduction in total population may affect a species' genetic stability and evolution. The pattern and scale of habitat fragmentation determines its impact on biodiversity.[45]

3.3 Deforestation is the most widespread cause of habitat fragmentation in Peru. The last study of deforestation in Peru, prepared in 1996 by INRENA, included only the "Selva Alta" y "Selva Baja" Ecoregions. It concluded that the original forest cover in the "Selva Alta" and "Sevla Baja" was 75.5 million hectares and that by 1990, 6.9 million hectares, or about 9 percent of this area had been deforested. Sixty percent of the deforestation had occurred in the "Selva Alta and 40 percent in the "Selva Baja. [46]

3.4 Deforestation can be temporary or permanent. Temporary deforestation generally occurs as a stage of shifting agriculture. Crops are grown, usually by local people not agricultural colonists, on a small patch of land that has been cleared of forest. Clearing, however, usually leaves stumps and seeds of the native vegetation in the soil. When weed and insect populations become too large, and the soil loses most of its fertility, the patch is abandoned and cultivation is moved to another part of the forest. The abandoned land begins to be covered again with native vegetation and forest can often develop again. In Peru, this type of temporary deforestation occurs most commonly in the "Selva Baja".

3.5 Another type of deforestation results from a decision to change permanently land use. Agricultural colonists clear forest with the intention of changing the land use permanently to agriculture and pasture. About 1 million hectares of forest in the "Selva Alta" have been cleared for the cultivation of coca.[47]. Roads and trails left by logging operations and seismic lines cut during exploration for petroleum frequently provide the colonists the means to penetrate the forest.[48] Most of the permanent deforestation has occurred in the "Selva Alta" although some permanent clearing for pasture is also occurring in the "Selva Baja".[49]

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[45] Meffe, Gary K & C. Ronald Carroll. 1997, pp. 230; 269-278.

[46] INRENA. 1996. This study has serious deficiencies: (1) It is out-of-date, since it is based on data from the 1980s. (2) It does not define the term "deforestation" and states no criteria for classifying its data points as "deforested" or not. (3) It extrapolates its study of deforestation in the Amazon Ecoregion to the whole country, without stating any justification for doing so. (4) it says that 80 % of the deforested area is "abandoned" and 20 % is in "production", with 6 % of that in "rotation", but does not define these terms. In short, the INRENA study provides little guide to the location, extent and character of deforestation taking place in Peru. There is, however, no other study of deforestation in Peru. Cuanto Institute, 2001, mostly bases its discussion of deforestation on the INRENA study.

[47] Cuanto Institue, 2001, Chapter 10. The study does not provide the source for this estimate of deforestation accelerated by coca production.

[48] Portilla, Alfredo. Per. com. 200. Petroleos del Peru, for example, has cut thousands of kilometers of seismic lines near the Tigre and Pastaza rivers in northern Peru. Similarly, Occidental Petroleum has cleared 1,863 km of seismic lines through its 100,000 ha concession in the Ucayali River valley.

[49] Cuanto Institute, 2001 is contradictory regarding what happens to the deforested areas when they are abandoned. Thus in Chapter 10, Section 3, the Cuanto Institute study says that "…after a few years, most of the [deforested] land is converted into pasture". Yet on the same page, it also says that "…80% of the

3.6 Placer gold mining Peruvian Amazon rivers has also destroyed about 15,000 ha of riverside vegetation.[50]

3.7 Deforestation is also occurring in some of Peru's other ecoregions. For example, only about 5,000 ha of the original 28,000 ha of mangrove forest remain in the estuaries of the Tumbes and Illo Rivers on the northwest coast, due to clearing for the construction of shrimp ponds.[51] Likewise on the northwest coast, a large part of the "Algarrobos" forest has been cleared to create pasture and produce firewood.[52] Probably permanent deforestation is occurring in other types of Peruvian forest.[53]

3.8 Not all habitat fragmentation in Peru involves deforestation. Coastal cities, for example, have expanded across the natural and agricultural landscapes of the coastal desert. Over-grazing by sheep has changed the species composition of the herbaceous plants of the Puna and Paramo ecosystems. Probably other types of habitat fragmentation are occurring, although they have not been studied.[54]

Over-exploitation

3.9 Over-exploitation of the environment's resources is a second principal threat to Peru's biodiversity and tropical forests. Commercial over-exploitation of wild living resources, such as fishes, whales, commercial timber trees, wildlife and wild medicinal plants, for example, may severely reduce their populations. Reduced population levels reduce the diversity of a species' gene pool, lowering it adaptability to environmental change or competition, and thus increasing the risk of species extinction.[55] Sometimes population reduction may be a side effect of a commercial activity, as when sea turtles, dolphins or seabirds are caught inadvertently in drift nets or marine trawls.[56]

3.10 Logging as generally carried out in Peru is a form of over-exploitation of Peru's forests. Peruvian logging operations generally remove only one tree for every four hectares, since less than 50 tree species have commercial value and these occur infrequently in the forest.[57] Even such low volume, selective extraction, however, may significantly affect the forest's biodiversity. Especially in highly species diverse humid tropical forests, the silvical characteristics of the exploited species rarely are well known. Therefore, the requirements of soil conditions, temperature, moisture and light for successful regeneration are for the most part not known. Peruvian foresters do not have

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deforested area are now in a state of brush, "purmas" or secondary forest; the other 20% are in very low levels of production…"

[50] Cuanto Institute, 2001, Chapter 10, Section 3

[51] Ibid., p. 47

[52] INRENA, 1997, Vol. I, p. 128

[53] The documents consulted for this report do not discuss deforestation in other forested ecosystems. Attention appears to have been focused on deforestation in the "Selva Alta" and "Selva Baja", although even there the data is over a decade old.

[54] Inference

[55] Meffe, Gary K. and DC. Ronald Carroll. 1997, 203-231

[56] Ibid., p. 149

[57] Cuanto Institute, 2001, Chapter 10

the basis, therefore, for making silvicultural prescriptions that are successful in regenerating the exploited tree species.

3.11 Mahogany is the most studied case of a commercial species in Peru becoming rare through over-exploitation. Until recently, the Peruvian timber industry has concentrated on removing large mahogany trees from primary forest. Although the silvics and silviculture of mahogany are well known compared to other commercial tree species of Peru's humid tropical forest, no effective silvicultural measures were taken during or after logging to assure its regeneration.[58] The population of mahogany trees in Peru, therefore, has decreased.[59]

3.12 There are many other examples of over-exploitation of plant and animals. In and around the Pacaya-Samiria National Reserve the area of "moriche" palms has decreased because people cut the whole plant down rather than just harvesting the ripe fruit. River turtle eggs are taken in great numbers from river beaches in the "Selva Baja". Over-hunting of large monkeys, some bird and ungulate species also is occurring.[60] In 2000, 438,000 kilos of "una de gato" were extracted from natural forests without technical control.[61]

3.13 Over-exploitation has severely affected the populations of some Peruvian marine organisms. For example, over-exploitation during the 1960's, combined with the impact of warm water temperatures during the 1971-2 El Niño, drastically reduced anchovy populations. Until the mid-1990's these anchovy populations remained abnormally low. The low anchovy population caused a sharp decline in the populations of some species of sea birds. The population of "guaneras', for example, declined from over 24 million in 1955 to only 2 million individuals in 1972.[62]

3.14 When whaling stations were built in 1950 at Pisco and Paita on the southern coast, whales were overexploited and their populations declined drastically. Elimination of whaling allowed whale populations to rebound in the 1980's. Similarly, over-hunting reduced sea lion populations on the Peruvian coast from about 500,000 in the 1930's, to about 40,000 by 1970. [63]

3.15 Over-exploitation probably has caused a decline of other species of Peruvian animals. Peru's Amazon population, for example, consumes approximately 60,000 tons of river fish per year.[64] Manatees are being over-hunted in the Pacaya-Samira National

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[58] Mahogany is probably the tree species from the tropical humid forest whose silvics and silviculture has been most studied.
[59] Stern, Peggy. 2001. per. com.
[60] PiP, 2001, p. 10
[61] Instituto Cuanto, 2001, Chapter 12, Table 12.7; in 2001 D.S. 014-2001-AG established the requirement for a management plan in order to produce "una de gato".
[62] Cuanto Institute, 2000, p. 41
[63] Ibid., p. 42
[64] Cuanto Institute, 2001, Chapter 10. The discussion in this section, however, does not draw any specific conclusions about the threat that commercial fishing in the Amazon rivers represents to its fish biodiversity.

Reserve.[65] Likewise, logging crews and migrant farmers frequently rely on wild meat as an important source of food. Their hunting probably significantly affects the populations of some game animals.[66] Hunting by native communities in the Manu Reserve has been shown to have a significant impact on game animal populations.[67] Over-exploitation for licit or illicit commerce in live and dead wild plants and animals also threatens Peru's biodiversity. Commercially traded live organisms include parrots, monkeys, boa constrictors, butterflies, insects, seeds, cactuses and orchids. Parts of dead organisms that are traded illicitly included armadillo and turtle shells, skins of various wild animals, feathers, and teeth.[68]

3.16 Over-exploitation of non-living natural resources can also threaten biodiversity and tropical forests. Changes in the patterns and volumes of water flow in rivers, for example, may modify habitat conditions and affect populations of aquatic plants and animals. The flow of the Rimac River, for instance, has been almost entirely diverted to Lima's water supply. Lima, furthermore, plans to augment its water supply with water from rivers whose water now flows to the east of the Andes. Such changes in water flows are likely to cause negative impacts on fresh and oceanic biodiversity. [69]

Contamination

3.17 Contamination is the third major threat to Peru's biodiversity and tropical forests. Contaminants may be synthetic substances or natural substances, such as animal wastes or discarded fibers that are released into the environment. Contaminants can directly kill living organisms and affect ecosystem functioning or evolutionary processes. Although it may be easier to notice and measure the negative impacts on biological diversity of large, concentrated, releases of contaminates into the environment, small but repeated contamination at sites scattered over large areas may also cause significant negative impacts on biological diversity.

3.18 Artisanal and industrial mining occurs in many parts of Peru. Gold mining, for example, involves directly or indirectly 30 percent of Peru's Amazonic population.[70] Industrial mining concessions in southeast Peru, in the watersheds of the Inambari, Tambopata, Colorado, Manu, Alto Madre de Dios and Heath covered 711,389 hectares in 2000.[71] Both types of mining frequently contaminate Peru's water and soil with such chemicals as cyanide, mercury, chrome, lead, manganese, iron, cadmium, copper, zinc,

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[65] PiP, 2001, p.9

[66] Inference. Neither the Cunato Institute, 2001 or INRENA, 1997, evaluate the impact on wild game of logging crews and colonists.

[67] PiP, 2001. A study of the impact of hunting by native peoples in the Manu Biosphere Reserve compared the populations of on 14 species of animals within and outside of hunting areas. It found that hunting impact was much stronger on primates than on birds. For example, within the hunting area the density of Ateles sp was 2 or 3 individuales /km2. Outside of the hunting area the populations of Ateles sp was 15 to 28 individuales/km2.

[68] Cuanto Institute, 2001, Chapter 10, Table 10.11

[69] Cuanto Institute, 2000, p. 77

[70] Cuanto Institute, 2001, Chapter 10

[71] Ibid.

arsenic and cyanide.[72] Abandoned mines, such as those at Matilde and Miluni near Lake Titicaca, may continue to contaminate long after they are closed down.[73] Some of the many large, industrial mines that are located on the western flank of the Peruvian Andes contaminate the rivers that cross the coastal plain into the Pacific Ocean.[74] Gravel mining in river bottoms, a common source for road building operations in lowland humid forest areas, may cause severe sedimentation, with impacts on aquatic biodiversity.[75]

3.19 Industrial processes frequently release contaminants into Peru's aquatic environments. Between Chimbote and Paracas, for example, on the central Peruvian coast, 82 fishmeal and fish oil plants release 58,086,400 m3/yr of contaminated water, 4,324,096 m3/yr of fish blood, and 9,513,023 m3/yr of "agua de cola" into the nearby ocean. These contaminants lower dissolved oxygen levels and raise the pH of the ocean water, thus affecting the variety and populations of marine organisms.[76]

3.20 Coca leaf processing causes widespread contamination of water in the "High Selva" ecoregion. A 1986 study found that to produce 400 tons of PBC in the Upper Huallaga Valley required 57 million liters of kerosene, 32 million liters of sulfuric acid, 17 tons of calcium, 16 tons of live calcium, 6 million liters of acetone, and 6 million liters of tolueno. After their use, these chemicals were disposed of directly into water bodies, directly affecting terrestrial and aquatic biodiversity.[77]

3.21 Population centers throughout Peru release chemical and microbiological contaminants into the ocean. Given the high concentration of population on the coast, in cities such as Paita, Chimbote, Supe, Pisco and Ilo, a large percentage of these contaminants enter the ocean.[78] The sewage system of Lima, for example, discharges 20 m3/sec of untreated waste water into Callao and Miraflores bays, representing an estimated 126,000 tons/year of biochemical oxygen demand.[79] All the principal highland cities also discharge untreated sewage into rivers and lakes.[80] The city of Puna, for example, contaminates Lake Titicaca, affecting its unique species of aquatic organisms.[81] The cumulative negative impacts on biodiversity, although mostly unstudied, are probably severe.[82]

3.22 Petroleum production frequently causes contamination of water and soil. In 1993, for example, 5,000 barrels of oil were spilled at kilometer 320 of the North Peruvian Pipeline; part of the oil entered the Apaga and Yuruc Rivers. In 1994, 5,000 barrels of residual petroleum were spilled into the Amazon River at the Petro Peru port. A rupture

[72] Cuanto Institute, 2000, p. 73, Table 6.1
[73] Ibid., p. 60
[74] Ibid., p. 72
[75] Inference
[76] Cuanto Institute, 2001, Chapter 10. This chapter does not provide qualitative or quantitative information on the effect of such contamination on aquatic biodiversity.
[77] Cuanto Institute, 2001, Chapter 10
[78] Cuanto Institute, 2000, p. 74, Figure 6.3
[79] Ibid., p.78
[80] Ibid., p.13
[81] INRENA, 1997, p. 222-3
[82] Inference

in 1994 of one kilometer of the Nor-Peruano Pipeline resulted in 24,000 barrels of oil entering the Maranon River. In 2000, 16,800 barrels of oil were spilled from the Nor-Peruano pipeline in Amazonas Department. The oil industry, moreover, daily releases cognate water from production wells that have a high content of heavy metals. Both oil and cognate waters alter the physical-chemical characteristics of the water into which they are released in ways that can affect aquatic biodiversity.[83]

3.23 Agricultural production may significantly contaminate the terrestrial and aquatic ecosystems with chemicals. The use of the Rimac River water for human consumption is severely restricted due to its contamination with nitrates, derived from inorganic fertilizers used on the farmlands surrounding Lima. Some proportion of the contaminating chemicals ends up in the Peruvian coastal waters. For example, a study of a coastal fish, Mugil cephalus, which is commonly used for human consumption in Pisco, found that it contained pp-DDE.[84]

3.24 According to a recent study made by the International Potato Center, farmers in only three provinces of the Department of Cajamarca apply 13 fungicides and 10 insecticides to their potato crops. Between 85 and 90 percent of these pesticides may not even reach the organisms that they are intended to control. They, however, do enter terrestrial and aquatic ecosystems, where they almost certainly affect biological diversity and ecosystem functions as well as pose a threat to human health.[85] In addition, non-technical use of pesticides changes evolutionary processes by selectively increasing the relative reproduction rates of more resistant varieties of target populations. They may also eliminate organisms that benefit agricultural production.

3.25 Sedimentation is a form of contamination of water bodies that may affect biodiversity. Severe soil erosion affects approximately 8 million hectares of Peru, especially at elevations between 1,500 masl and 3,700 masl. in the Highlands Geographic Region.[86] Soil erosion may directly affect biodiversity through the impact of sediments on aquatic biodiversity. However, little data specifically links sedimentation with loss of biodiversity in Peru.[87]

Exotic species

3.26 Exotic species are a fourth threat to Peru's biodiversity. Exotic species are species that have been introduced into areas beyond their native ranges. There are many examples of how such introductions can devastate native ecosystems and species. Exotic

[83] Cuanto Institute, 2001., Table No. 10.3
[84] INRENA, p. 176
[85] Cuanto Institute, 2000 p. 84
[86] Sociedad National del Ambiente, 1999, p.39
[87] Note that neither of the two Cuanto Institute "State of the Environment Reports" , the INRENA "Esutdio Nacional de la Diversidad Biologica", nor the Peru: Natural Resource Assessment: 1993 Update", mention or discuss sedimentation of water bodies as a result of soil erosion as a threat to species diversity. Soil erosion, therefore, although certainly a serious environmental problem in Peru, has been considered more as a negative environmental impact of deforestation and poor land use practices than as a cause of biodiversity loss or degradation.

plant and animal species may out-compete native organisms for food and space. They may also change or reduce the habitat or food available to indigenous species. The population of the native species may therefore decline. Exotic species may also directly affect the growth of a native species when, for example, an introduced disease or insect attacks and kills a native plant or animal. Exotic species may also use the natural habitat in such a way as to cause its degradation and decline in populations of some species.[88]

3.27 Very little information is available regarding the impact of exotic species on Peru's biodiversity. Sheep, cows, donkeys, horses, pigs, wheat, barley and many other now common plants and animals were purposefully introduced to Peru after the Spanish conquest. Some exotic crops are now grown on a large scale. Over 700,000 ha of irrigated agriculture, for example, now occupy areas of the Pacific Geographic Region, mostly planted to introduced species such as rice; these hectares have replaced natural vegetation and native crops.[89] Cattle and sheep grazing in the Puna have favored some floral species over others.[90]

3.28 The pace of accidental introduction and spread of exotic species probably has increased during the last decades, along with augmented regional and international travel and commerce.[91] Tilapia, introduced in the Department of Loreto with the intention of increasing local food supplies, for example, has escaped from fishponds and is now found in local rivers, where it may be competing with native fish species.[92] The Asian shrimp species *Macrobrachyum sp.* has escaped from shrimp ponds on the northwest Peruvian coast, and now competes with the native shrimp, *Chryphos sp.*[93] The magnitude of the threat from the introduction of exotic species to Peru's biodiversity and tropical forests, however, has not been adequately evaluated.

4. Impediments to reducing the threats to Peru's tropical forests and biodiversity

4.1 There are six principal impediments to reducing the threats to Peru's tropical forests and biodiversity: (i) population growth and migration; (ii) widespread poverty; (iii) government policies; (iv) market failures and weaknesses; (v) inadequate environmental management knowledge and capability; and (vi) lack of public awareness and support for conservation and management of tropical forests and biodiversity.

Population growth and migration

4.2 The demand of larger human populations for the products and services of the environment negatively affects biodiversity and tropical forests. Larger human populations require more goods and services, such as water, food, and fuel, most of

[88] Meefe, Gary K. & C. Ronald Carroll, 1997, p. 149; pp. 245-7
[89], Cuanto Institute, 2000, p. 12, 16
[90] Low et. al., 1993., p. 98
[91] Inference
[92] Portilla, Alfredo. Per. comm., 2001
[93] Ibid.

which must be extracted or produced from the environment. Soils must produce more food. More water must be diverted from rivers to urban and agricultural areas. Oil, and other sources of energy, must be found, extracted, and transported.

4.3 The population of Peru has grown from about seven million in 1940 to over 25 million in 2001.[94] This larger population requires more food. An expansion of the total area of land under cultivation or pasture has been one way to increase the food supply. Such expansion, however, frequently has stimulated the conversion of natural landscapes to agricultural landscapes. For example, in the 1980's, 233,000 hectares of natural vegetation were cleared in the Central Huallaga and Lower Mayo Valleys for conversion to agricultural use. Partial evaluations made in 1983 and 1986 indicated that in the valley agricultural production increased 76 % between 1980 and 1988.[95]

4.4 Extensive soil erosion, caused mostly by poor agricultural practices, indirectly affects Peru's biodiversity and tropical forests by lowering crop yields. Rural people who are dependent on subsistence or commercial agriculture therefore have less food and cash income available. Consequently, they become poorer. The result is increased migration, either to urban areas, where the increased population contributes to contamination of natural ecosystems, or to other rural areas, where colonists may contribute to habitat fragmentation through deforestation.[96]

4.5 The growth in population of urban centers also can cause habitat loss. In 1940, for example, most of the Peruvian coast had a population of less than 20 inhabitants per km ^{2}. In 2000, by contrast, the central and northern coast had a population density of 236 inhabitants per km ^{2}.[97] The coastal cities of Lima, Tumbes, Piura and Tacna have all expanded in area as their populations have grown. The population of Lima, for example, grows by approximately 200,000 people per year. Consequently, Lima has been expanding in area over surrounding agricultural land at a rate of six percent every year. [98]

4.6 Even if the total population was not to grow, internal migration would cause impacts on Peru's biodiversity and tropical forests. Rural highland people, for example, have migrated to the "Selva Alta" and the "Selva Baja" where they caused habitat fragmentation through deforestation. The deforestation in the Upper Huallaga Valley was accompanied by the settlement of 3,500 colonists.[99] Similarly, rural people have moved into urban coastal areas, where they create more wastes that are discharged into aquatic ecosystems.[100]

Widespread Poverty

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[95] Low, F. et. al., 1993, p.45
[96] USAID, 1994, p 6.
[97] Cuanto Institute, 2000, p. 12
[98] Ibid., p. 77
[99] Low, F. et. al., 1993, p. 45
[100] Cuanto Institute, 2000, p. 69-82

4.7 Poverty impedes people's ability to conserve and manage biodiversity and tropical forests, frequently forcing them to take a short-term perspective and use the environment in unsustainable ways.[101] Poverty also stimulates migration, as poor people move in order to find opportunities to earn more income.

4.8 Poverty is Peru's most widespread and intractable problem. Peru in 1999 had a per capita income of $2,065. Income distribution in Peru, however, is extremely skewed and the majority of the population has an income of less than US$460 per year. Between 1999 and 2001, moreover, the level of poverty increased from 50.7 to 54.4 percent of the population and the percentage of "extremely poor" Peruvians leveled off at an estimated 14.8 percent. The daily per capita expenditures of the "extremely poor" in 2000 were only $0.72. This is insufficient to buy the minimum daily calories and nutrients to stay healthy and productive. In 2001, the number of poor Peruvians was increasing by 75,000 per year.[102]

Government policies

4.9 Some government policies cause significant impediments to reducing the threats to Peru's biodiversity and tropical forests. It is a policy decision, for example, to give less priority to protection and conservation of biodiversity and tropical forests than to other concerns. Peruvian government leaders frequently do not give high priority to the conservation of biodiversity and tropical forests. That the Peruvian government, for example, has sometimes chosen to allow oil exploration within national natural protected areas, an indication that it at times assigns higher priority to oil production than to protection of biodiversity and tropical forests.[103]

4.10 Government policy decisions frequently rely on conclusions drawn from analyses of the national economic accounts. Peru's national accounts, however, do not include the environmental costs of destruction and loss of biological diversity and tropical forests. The production of timber, for example, enters on the positive side of the national accounts; it thus is counted as a contribution to the Net National Product. The loss of environmental services due to logging or deforestation, however, does not enter on the negative side of the accounts. The national accounts therefore give a false basis upon which to make policy decisions.[104]

4.11 The government's funding decisions also reflect its leaders' policy priorities. The Institute for Natural Resources (INRENA), for example, has the legal mandate to regulate the use of natural resources in all of Peru. INRENA, however, is a relatively small, under-staffed and under-budgeted government entity. It does not have sufficient public funding, for example, to finance all the necessary park guards at one of Peru's most

[101] USAID/Peru, 2001, p. 76
[102] Ibid., p. 43
[103] Portilla, Alfredo. Per. comm. 2001
[104] Cuanto Institute, 2001, Chapter 10; note, however, that Peru does have an Integrated System of Environmental Accounting and Economy, as described in INEI, 2000, p.157

biologically important protected areas, the Pacaya Samiria National Reserve.[105] By contrast, the Ministry of Mines, with no greater responsibilities, is a well-staffed, well-financed ministry.[106] Again, this choice indicates that the national government's priorities place mining over conservation of biodiversity and tropical forests.

4.12 Some Peruvian government policies involve subsidies that encourage habitat destruction, over-exploitation and contamination. The government, for example, does not charge farmers the full price of the irrigation water that it provides to them. Farmers who receive subsidized irrigation water use more of it than they would if it cost more. Consequently, the irrigation systems withdraw more water from natural water bodies. The environmental impact of water withdrawals is proportionately greater. [107]

4.13 Government failure to enforce effectively environmental and natural resource regulations is a policy decision to subsidize those who exploit natural resources or discharge contaminants into the environment. Peru has many environmental laws and regulations.[108] If it is not necessary to comply with them, however, the cost of doing so can be removed from financial calculations. Consequently, the costs of an economic activity go down and the net income goes up. Moreover, the higher level of profit draws more investment into the activity, increasing its negative environmental impacts.

4.14 For example, the government does not assign sufficient resources to effectively control access to public forestlands and enforce land use regulations. This has stimulated habitat loss and over-exploitation. Logging companies and migrant farmers remove timber trees and eliminate forest, for example, without having to incorporate payment for the environmental costs of doing so in their financial calculations. Similarly, petroleum companies generally are allowed to explore for and produce oil without paying compensation for the negative environmental impacts these activities cause. In both cases, reduced costs increase the financial incentive for habitat destruction and over exploitation.

4.15 In Peru, the state has reserved to itself all rights over forest resources. Article 6 of Law No 26821, “Ley Organica para el Aprovechamiento Sostenible de los Recursos Naturales” says “The State has sovereignty over the use of natural resources”. Law No 27308, “Ley Forestal y de Fauna Silvestre”, divides up all of Peru’s forests among a number of different categories. All the categories, however, assign the state control over forested land. There is no category of privately managed forests. This policy creates a tremendous disincentive for private landowners to protect and manage the forest on their land. Landowners, with essentially no private rights to the forest resources on their land, have an incentive to destroy the forest. By doing so, they gain control over their property, since non-forest land uses are less regulated by the government.[109]

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[105] Portilla, Alfredo. Per. comm. 2001
[106] Ibid.
[107] Cuanto Institute, Chapter 10
[108] The laws include the Organic Law for the Use of Natural Resources, Law for Conservation and Sustainable Use of Biological Diversity, Law for the National System of Environmental Impact, and the Law for Forestry and Wildlife.
[109] Randall, Alan, 1987, pp. 154-162

Market Failures and Weaknesses

4.16 Low prices and unstable markets for biodiversity and tropical forest products and services impede conservation and management of Peru's biodiversity and tropical forests. Markets for forest environmental services, such as protection of biodiversity, production of oxygen, sequestration of carbon, purification of water, amelioration of microclimates and protection and formation of soil, are incipient in Peru.[110] People who convert forest to non-forest uses, exploit wildlife for sale, or contaminate water, therefore, do not pay the costs of loss or degradation of these environmental services. Nor do those who protect biodiversity and tropical forests receive a financial benefit.

4.17 Furthermore, products from Peru's tropical forests and biodiversity that do have markets generally have a relatively low market value. Two reasons for the low market value are overabundance and difficulty of extraction. Since so much of Peru is covered with forest, there is no shortage of forest products. Their value in the forest is therefore low and landowners receive little for the forest products in the forest on their land. Difficulty of access to the forest lowers the in-forest value of forest products by raising extraction and transportation costs. Thus rarely can the financial returns from forest management for wood products compete with the returns from agriculture or livestock, even on soils that have been classified as suitable only for production of forest products.[111]

Inadequate environmental management

4.18 Lack of scientific knowledge is one cause of inadequate environmental management in Peru. Peru does not systematically collect basic scientific information about its biodiversity and tropical forests. There are no national or regional biological surveys. Peruvian universities finance very little research on biodiversity or tropical forests. Although foreign universities and international agencies do finance some scientific research on biodiversity and tropical forests, such research tends to be short-term and frequently inaccessible to Peruvians.[112]

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[110] Cuanto Institute, 2001, Chapter 12, discusses the markets for environmental services, including biological diversity, carbon sequestration and storage, ecotourism, scenic beauty, and water purification. Peru does receive international funding to support the protection of its natural areas. The only example of commercial sale of ecosystem services mentioned in the Chapter, however, has to do with ecotourism. Given the current international interest in the subject, it is likely that private sector initiatives are underway in Peru, as in other countries, to trade or sell carbon credits based on reforestation or forest protection projects.

[111] Southgate, D. 1998. P. 62. This publication provides the following information on the cost of transporting one cubic meter of wood from the Peruvian varzea forests the distance of 100 kilometers: "…$30.02, using a track; $7.94 with a barge; and just $1.02 when logs are rafted". The conclusion is that "…with transportation costs this low and with standing timber as abundant as (reported) ….stumpage values in a free and competitive market are unlikely to rise very high, even in the most favorably located várzea forests".

[112] Maria Luisa del Rio, per. com., 2001.

4.19 Peru also lacks sufficient institutional capacity for converting scientific information into management technologies. Silvicultural practices, for example, should be based on autoecological knowledge of the tree species to be regenerated yet little such technical knowledge has been developed by Peru's universities.

4.20 Ineffective environmental management also results from public and private institutions that lack trained personnel and sufficient budgets. Effective conservation and management of biodiversity and tropical forests requires professionals, technicians and workers who are trained to analyze natural resource management problems and make correct management decisions. These personnel, moreover, must be working in sufficient numbers and in the right place in field situations in order to apply their capabilities. Peruvian universities do not graduate sufficient numbers of environmental management specialists. Difficult living conditions in most parts of Peru, moreover, discourage professionals from permanently living in or near to the natural areas that require their professional capabilities.[113]

4.21 An incomplete and ineffective legal, regulatory and normative framework contributes to inadequate environmental management. Authorities are necessary to set standards, promote pollution prevention in industry and create incentives for improving industrial environmental performance. Legislation is required to assure that natural resources are fully costed and therefore efficiently used. Strengthened regulations regarding public access to environmental information are necessary, as are regulations to define judicial mechanisms for environmental management. [114]

4.22 An essential part of environmental management is a capability for enforcing regulations. Many of the institutions responsible for regulating, controlling and enforcing Peru's environmental laws and regulations do not have sufficient qualified personnel, equipment or operating budgets to be effective. Most local governments also lack the capability to analyze the environmental consequences of development investments.[115]

Lack of public support

4.23 The Peruvian public gives a lower priority to conservation and management of biodiversity and tropical forests than to such immediate problems as unemployment, poverty and income. Environmental contamination was named a principal concern by only 4.8 percent of Peruvians in a survey made in 1998. By contrast, 67 percent named employment, poverty and income as their principal concerns.[116] These percentages indicate that most Peruvians support their political leaders' decisions, described above, to give lower priority to conservation and management of biodiversity and forests than to other goals.

[113] Romero. Per. com., 2001
[114] USAID/Peru, 2001, p. 81
[115] Ibid., p. 81
[116] Cuanto Institute, no date, p. 5.

5. Comparison of actions needed to achieve conservation and sustainable management of Peru's forests and biodiversity with USAID/Peru proposed actions

5.1 This section compares the actions that are required to reduce, eliminate or mitigate the impediments to conservation and sustainable management of Peru's biodiversity and tropical forests with the actions proposed in USAID's Strategic Plan FY2002-FY2006.

5.2 The USAID/Peru "Country Strategic Plan FY2002-FY2006" states its goal as "Promote the expansion of sustainable opportunities for improved quality of life of Peruvians through democratic institutions and processes". It establishes four Strategic Objectives and three Special Objectives, as follow:

- Strategic Objective 1: *Democratic processes and institutions strengthened in critical areas.*
- Strategic Objective 2: *Increased economic opportunities for the poor in selected economic corridors*.
- Strategic Objective 3: *Improved health for Peruvians at high risk.*
- Strategic Objective 4*: Strengthened environmental management to address priority problems*
- Special Objective 5*: Sustained reduction of illicit drug crops in target areas of Peru*
- Special Objective 6: *Expanded opportunities for girls' quality basic education in targeted rural areas*.
- Special Objective 7: *Improved quality of life of Peruvians along the Peru-Ecuador border target areas*.

In the following discussion, the term SO is used to refer to the set of actions that is described in the USAID/Peru Strategic Plan FY2002-2006.

Actions to reduce or mitigate population growth and migration

Action 1: Increase family planning programs

5.3 Family planning programs will slow population growth rates among target populations. In Peru, family planning programs have been successful in reducing population growth rates. Ninety-six percent of married women of reproductive age in Peru are now knowledgeable about modern family planning methods. In 1996, 57 percent of them used modern or traditional family planning methods. Previous Peruvian family planning programs contributed to a reduction of the Peruvian fertility rate from 4.0 to 3.5 children per family between 1992 and 1996.[117]

[117] USAID/Peru, 2001, p. 58

- SO3 will improve and increase reproductive health and family planning services on a national scale.[118]

Action 2: Increase availability of user-paid health and education services

5.4 Increased availability of health and education services can reduce population growth rates and internal migration when couples have to pay for health care and education for their children. When couples have to pay themselves for their childrens' health care and education, they will frequently choose to have fewer children and population growth rates may decline. In addition, availability of health services will decrease infant mortality and, therefore, some couples may decide to have fewer children. Some couples choose to migrate in order to provide their children with better health and education services. If these services are made more widely available in the areas of migration, the rate of migration may be reduced.[119]

- SO3 is supporting greater cost recovery thru policy reform and through a project to strengthen private sector health institutions.
- Under SO4, the Urban Environmental Health Service and Hygiene Behavior Activity will improve environmental health services in targeted communities.
- SO6 will increase educational opportunities for girls.
- Under SO4 the America's Fund of Peru will finance projects to increase child survival and well being.
- Under SO4 the Urban Environmental Health Service and Hygiene Behavior Activity is promoting policies that will facilitate improved urban health conditions.

Action 3: Support land use planning and zoning and creation of additional protected natural areas.

5.5 The impact of population growth and migration on biodiversity and tropical forests could be mitigated through the designation of biologically important areas as off-limits to urban expansion or colonization. These areas could become additional protected areas, such as parks and reserves, where colonization and deforestation would be prohibited.

- A joint SO5 and SO5 program in coca growing areas, will identify and prioritize the remaining large blocks of high conservation value forest, develop land use change patterns analysis, and identify areas with potential for conservation and natural resources management.

Actions to reduce rural poverty

5.6 A reduction in poverty levels in Peru is the overall aim of the Government of Peru, USAID/Peru and many public and private, national and international institutions. A full discussion of the many actions required to reduce rural poverty in Peru is beyond

[118] Ibid., p. 64
[119] USAID/Peru. 2001, p. 58.

the scope of this report. Some actions to reduce poverty, however, that directly concern biodiversity and tropical forests, are discussed.

Action 4: *Support the development and application of management practices that will increase the sustainable production of natural resource products.*

5.7 Biodiversity and tropical forests themselves can contribute to the reduction of rural poverty. They provide raw materials, such as wood, fibers, medicines, and game, to rural people for their own use or for sale. Increased productivity in the management of these resources can, therefore, increase profits and reduce rural poverty. Forests, for example, can be managed to increase production of wood and non-wood products.

- The America's Fund will finance projects that will improve management practices for tropical forests and biodiversity.
- The joint SO5 and SO5 program in coca growing areas will promote forest management and community forest management projects.
- Under SO4, the BIOFOR and SENREM projects and the new STEM activity will support more productive forest management.

Action 5: Create markets for environmental services provided by biodiversity and tropical forests.

5.8 Biodiversity and tropical forests contribute environmental services to the economy. The water that flows out of a forested watershed, for example, may be used for irrigated agriculture, industrial processes or human consumption. Birds, insects and predators that live in natural vegetation may help to control pests in nearby agricultural areas. Deterioration in the quality or quantity of these types of environmental services could make poverty reduction more difficult. The commercialization of environmental services may provide a source of income for some rural people.

- SO4, under the BIOFOR activity, will utilize the results of 14 economic case studies for the valorization of environmental services provided by forests and biodiversity;

Action 6: Establish more stable and profitable markets for commercial natural resource products.

5.9 Improvements in the markets for natural resource products will raise the incomes of rural people and reduce rural poverty. Such improvements can consist of both better and more stable prices.

- SO2 and SO5 in the Highlands and "Selva Alta" regions will promote market development for natural resource products.

Action 7: Support measures to increase agricultural productivity.

5.10 Since many rural people live mostly from agriculture, the level of agricultural productivity greatly affects their level of income. Increased agricultural productivity would thus tend to reduce rural poverty. Increasing agricultural productivity involves support for agricultural research, technology development, agricultural education and extension and the adequate provision of agricultural inputs, such as improved seeds, livestock, equipment and chemicals.

- SO5 will provide technical assistance to increase agricultural productivity in coca growing regions of the "Selva Alta".

Action 8: Improve markets for agricultural products.

5.11 The prices that rural people receive for agricultural products greatly affect their incomes. Better prices, if accompanied by greater net profit, will thus reduce poverty.

- SO2 is improving markets for agricultural products in ten priority economic corridors.
- SO5 seeks to improve markets for agricultural products from the coca growing regions.

Action 9: Improve infrastructure for agricultural production and marketing.

5.12 The provision of adequate infrastructure, such as roads and post-harvest treatment facilities, reduces production and marketing costs for agricultural products and improves their quality upon reaching the market. The cost of transportation can be reduced through the provision of better means of transportation, by road, water or air, especially for export products.

- SO5 will provide improved infrastructure in coca growing regions.

Action 10: Increase off-farm employment opportunities.

5.13 Off-farm employment opportunities can reduce rural poverty. Industry and tourism, for example, often offer more remunerative employment than subsistence agriculture.

- SO2 will increase off-farm employment opportunities in selected corridors of the Highland, "Selva Alta" and "Selva Baja" regions.

Action 11: Improve educational opportunities in rural areas.

5.14 Education widens the range of employment opportunities available to rural people.

- SO6 will improve educational opportunities for girl's in rural areas.
- SO7 will improve educational infrastructure in the northern frontier region.

Actions to improve environmental policies

Action 11: Support measures to create responsive democratic governments.

5.15 Democratic governments, at the national and local levels, are likely to give high priority in their policy decisions to long-term public welfare. Conservation and management of biodiversity and tropical forests are in the long-term public interest. In a responsive, functioning democracy, therefore, policy measures that would contribute to overcoming impediments to reducing the threats to Peru's biodiversity and tropical forests would thus be likely to receive increased political support.

- SO1 will help the Peruvian government at all levels to become more responsive to the concerns of the Peruvian citizenry including conservation and management of biodiversity and tropical forests.
- SO4 will increase knowledge of decision-makers and citizens on environmental issues and mitigation alternatives.

Action 12: Increase institutional capability for policy research concerning biodiversity and tropical forests.

5.16 One component of more effective democracy is an objective decision-making process, based on accurate analyses of alternatives. To prepare such analyses requires solvent, well-staffed policy research institutions.

- SO4 under SENREM provides technical assistance and training to the National Environmental Council (CONAM), the Ministries of Industry, Tourism, Integration and International Trade (MITINCI) and Fisheries (MIPE) and the National Environmental Society to strengthen their capacity to identify and solve environmental problems
- SO4 supports the Cuanto Institute and the Peruvian Society for Environmental Law in the preparation of environmental policy analyses.
- SO4 will strengthen the national policy framework through technical assistance to address important deficiencies in the national policy framework.
- SO4 will support development and testing of a system whereby lessons learned in the process of applying policies at the local level are fed back to the national level to identify problem areas
- SO4 will finance policy studies necessary to improve the national policy framework.
- SO4, under an America's Fund grant, will support provision by the Peruvian Society for Environmental Law (SPDA) of technical assistance on policy.

Action 13: Include the costs of the exploitation and degradation of biodiversity and tropical forests in the national accounts.

5.17 Unless environmental costs are included in national accounts, they will not be considered in the policy decisions of governmental and economic leaders.

- SO4 could support the studies, policy analyses and education that this action would require.

Action 14: Support measures to eliminate subsidies to private enterprise that stimulate over-exploitation of natural resources and contamination of natural ecosystems.

5.18 Until private enterprises are forced to pay the full, unsubsidized costs associated with their exploitation of biodiversity and tropical forests and disposal of wastes into the environment they will be receiving a public subsidy. The cost of such subsidies is borne by the public in the form of environmental degradation or an uneconomic rate of resource exploitation.

- SO4, under SENREM, supports policy research studies related to oil exploitation in protected areas, concessions for exploitation of natural resources and individual transferable fishing quotas.

Action 15: Provide adequate financing for the institutions responsible for protection and management of publicly owned natural resources.

5.19 Adequate financing is a prerequisite for effective conservation and management of biodiversity and tropical forests and enforcement of environmental regulations by the responsible government institutions.

- SO4, under the Parks-in-Peril Program (PiP) and other programs, will provide financial support for the management of national natural protected areas.

Action 16: Transfer a portion of the public forest areas to private ownership.

5.20 Increased private rights and responsibilities in biodiversity and tropical forests would create additional incentives for their conservation and management and reduce the areas of "uncontrolled access" to publicly owned land.

- One forest conservation area is now under private management. SO4 and SO5 plan to support the private management of a large new national park and other areas as appropriate.
- SO4 and SO5 support the private management of tropical production forests through the award of long-term concessions.

Action 17: Revise the present Forestry Law to include private rights in biodiversity and tropical forests.

5.21 The creation of private property rights in forest resources would increase the incentive for landowners to protect and manage the forest on their properties and decrease the incentive for them to eliminate forest cover.

- The USAID/Peru Strategic Plan does not specifically include this action. The role of private ownership of forest resources, however, could be analyzed under SO4 policy related activities.

Actions to improve markets

Action 18: Establish stable, profitable markets for forest and biodiversity products.

5.22 People will be more likely choose to conserve and manage biodiversity and forests if they receive a higher net income from doing so than from converting forestland to agriculture and livestock use. One way to increase the net income that landowners receive from the forest on their land is to establish stable and profitable markets for forest and biodiversity products.

- SOs 2 and 5 both will reduce market impediments to the profitable sale of products from biodiversity and tropical forests.
- SO2 will expand access to business development services and credit for small enterprises, including those utilizing biodiversity and tropical forests products
- SO4, under the BIOFOR activity makes grants to local NGOs in the buffer zones of natural protected areas for the development of sustainable economic activities.
- SO4, under the PiP program, will support a model climate change project that will put into practice the new forestry law by demonstrating that environmental service provision can abate threats and provide resources for conservation action.
- SO4 and SO5 will support a range of certified timber and non-timber forest products.

Action 18: Adequately staff, equip and finance existing protected areas.

5.23 Restricting the supply of biodiversity and tropical forest products would raise their market value. The Peruvian government could restrict supply of forest products by effectively stopping their extraction from existing protected areas. In order to make such restrictions effective the government would have to control access to the protected areas by increasing their staff. As of 1997, for example, only 30 of the areas in SINANPE were staffed and many of these had only one or two people without adequate equipment or other resources.[120]

- Under the Parks-in-Peril Program (PiP) financing will be provided for the management of national protected areas.

Action 19: Create and adequately staff, finance and equip additional national protected areas.

5.24 As noted in paragraph 2.50, not all of Peru's range of biodiversity has been protected within the boundaries of national protected areas. The national government could still declare additional natural protected areas. If adequately staffed, financed and

[120] INRENA, 1997, Vol. III., p. 84

equipped, these additional areas could serve both to restrict the extraction of forest products and to protect more completely Peru's range of biodiversity.

- SO4, under the BIOFOR and PiP programs, supports the establishment of the Apurimac-Amboro Biological Corridor, running from central Peru to southeastern Bolivia
- SO4, under BIOFOR, supports the management of the Paracas National Reserve.
- SO4, under BIOFOR, supports the participatory preparation of master plans for the Pacay-Samiria National Reserve and the Tingo Maria National Park.
- SO4, under the BIOFOR activity, supports land use zoning.
- SO4, under BIOFOR, supports the creation of new units of the National System of Natural Protected Areas covering 10 million hectares.
- SO4, under BIOFOR, supported economic and ecological zoning in the Department of Madre de Dios on 8.5 million hectares of mostly tropical lowland forest;
- SO4 and SO5 will support the management of additional protected areas under their joint environmental program.

Actions to improve environmental management

Action 20: Support scientific research on Peru's biodiversity and tropical forests

5.25 Effective policies and management technologies for Peru's biodiversity and tropical forests depend on adequate scientific knowledge. To prescribe silvicultural practices for the regeneration of a timber species, for example, it is necessary to know the silvical characteristics of that species. Likewise, to set harvest limits for commercial marine organisms, the factors influencing their rate of reproduction must be known. Scientific research is thus an essential basis for overcoming the impediment of inadequate environmental management of Peru's biodiversity and tropical forests.

- SO4 does not specifically discuss the need for scientific research on Peru's biodiversity and tropical forests. Nor does it provide financing for basic scientific research on biodiversity and tropical forests.

Action 21: Support development of management technologies for Peru's biodiversity and tropical forests.

5.26 The results of scientific research on biodiversity and tropical forests must be transformed into management technologies. For example, once the silvical requirements for the regeneration of a given timber tree species are known, it is necessary to develop techniques to create the conditions that meet those silvical requirements. Likewise, once the reproductive rates of marine organisms have been established, techniques must be developed to harvest commercially valuable marine organisms in such a way as to assure the conditions for reproduction.

- SO4, under SENREM, finances 22 demonstration projects with local NGOs, including 8 for agroforestry and forest management and 3 for management of the organisms in natural water bodies, including fish and shellfish;
- SO4, under SENREM, supports the development of techniques for reducing the amounts of pump water and other residues discharged in the Bay of Paracas by the fishmeal industry.
- Under the Parks-in-Peril (PiP) program environmental management will be supported at the Paracas and Pacaya Samiria National Reserves.
- SO4, under BIOFOR, finances 12 grants for demonstration projects in forest management, fisheries, non-timber forest products, terrestrial fauna and ecotourism.
- SO4 under its new STEM Activity and SO4 and SO5 under the joint environmental agenda will support innovative and replicable natural resource management practices.

Action 21: Support training of forestry and other environmental management professionals and technicians

5.27 Effective environmental management requires sufficient trained environmental management professionals and technicians in the fields of forestry, soil conservation, natural resource economics, and fisheries who are trained to manage and administer natural resources, as distinct from carrying out scientific research.

- SO4, through BIOFOR and follow on activities, is implementing a comprehensive training program for protected area guards.

Action 22: Establish an adequate legal, regulatory and normative framework for the management and conservation of Peru's biodiversity and tropical forests.

5.28 An adequate legal, regulatory and normative framework provides the basis for conservation and sustainable management of Peru's biodiversity and tropical forests.

- SO4 emphasizes the development of a national policy legal framework through many of its activities, including SENREM, BIOFOR and future activities.
- The joint SO4 and SO5 program will provide support to the Ministry of Transportation and Communication' s Environmental Unit in the design and approval of impact assessment guidelines and regulations.
- SO4, under BIOFOR, has provided technical assistance to INRENA for the preparation of a new Forestry Law and its regulations; both were approved in 2000
- The joint SO4 and SO5 program will support INRENA in improving regulatory legislation at its implementation and decision making levels.
- SO4, under BIOFOR, provided technical assistance to help INRENA prepare regulations for the National Law for Protected Areas.
- SO4, under the BIOFOR activity, has contributed to the establishment of voluntary forest management certification standards;

Actions to increase public support

Action 23: Increase public support for conservation and management of Peru's biodiversity and tropical forests

5.29 Actions to increase the public support for conservation and management of biodiversity and tropical forests underlie all the efforts to overcome the impediments, especially in a functioning democracy.

- SO4 will support increased environmental awareness, understanding and demand for environmental issues and solutions, involving public and private decision-makers.
- SO4 will support an environmental communication program for the Peruvian public in general.
- The joint SO4 and SO5 program will also support actions to increase public support for conservation of biodiversity and tropical forests.
- SO7 will include environmental education in its programs for girl's education.

The PiP programs include environmental communication activities.

6. Potential Environmental Issues Related to the Activities Proposed under the USAID/Peru Strategic Plan 2002-2006

6.1 USAID/Peru's Strategic Plan 2002-2006 includes a wide range of proposed activities. Many of these activities, as discussed in the previous section, will assist Peru to improve the conservation and management of its biodiversity and tropical forests. Some of the proposed actions, however, also have the potential to cause negative impacts on Peru's biodiversity and tropical forests. Such potential negative impacts should be identified by the procedures specified in the USAID Environmental Regulations contained in Section 216 of the Foreign Assistance Act. If the negative impacts are judged significant, then an Environmental Assessment is required. The Environmental Assessment analyzes in detail the potential environmental impacts of the proposed action, specifies actions to mitigate those negative impacts, and designs monitoring procedures to evaluate the effectiveness of the mitigation measures.

6.2 Although the present document cannot substitute for the procedures for environmental review, assessment, mitigation and monitoring specified in USAID's Environmental Regulations, this section does identify some potential environmental issues concerning Peru's biological diversity and tropical forests that could be raised by the actions proposed in the USAID/Peru's Strategic Plan 2002-2006. These potentially significant environmental issues concern: (i) increased road construction and rehabilitation; (ii) increased contamination from productive activities; (iii) unsafe disposal of medical wastes; (iv) lack of incentives for private forest protection and management (v) increased area placed in state protected areas; and (vi) negative environmental impacts of alternative development programs.[121]

[121] No attempt was made in the preparation of this report to review or evaluate environmental assessment documents that may have been prepared for USAID/Peru activities.

Issue 1: Increased road construction and rehabilitation

6.3 SO1 and other SOs will work to make national, regional and local governments more democratic and more effective and, therefore, more responsive to citizen concerns, especially in municipal governments. Increased road access is a principal citizen concern in Peru, especially at the level of the local governments. As local governments become more responsive, therefore, they may become more effective in building or improving local roads. Care should be taken to also promote actions to mitigate potential negative environmental impact from this renewed sense of empowerment.

6.4 SO4 is cognizant of this responsibility, yet other SOs should be made aware that they share this responsibility.

Issue 2: Increased contamination from productive activities

6.5 SO2 and SO7 will increase economic opportunities for the poor in selected economic corridors and in the northern frontier respectively. They include activities to improve access to and participation in markets, increase availability of micro finance for small enterprises, and improved the policy environment for economic growth. The aim of all these measures is to reduce poverty through increasing production in the selected corridors and along the northern frontier.

6.6 Increased production of almost any product carries with it the potential for increased use of natural resources and increased release of contaminating materials into the environment. If, for example, SO2 were to promote the increased production of leather through its credit or marketing programs, it would also be stimulating increased use of tanning chemicals, which might be disposed of into the environment. If SO2 did not provide for the introduction of clean production processes and mitigation measures, it would be a cause of increased environmental contamination. If tanning were to be carried out by many small, dispersed enterprises, the cumulative negative environmental impacts could be significant, for example, on aquatic biodiversity.

6.7 Although individual enterprises might release only small quantities of contaminating substances into the environment their cumulative negative impacts could be large and spread over a wide geographic areas. For example, a successful micro-credit program would finance a large number of small enterprises. Each one of these could be relatively small. However, each one might contribute to an increased demand for forest products or discharge contaminants into the environment. The cumulative negative environmental impacts on tropical forests or biodiversity of a micro-credit program might become significant.

6.8 Mitigation measures for SO2 could include (i) the establishment of standard environmental assessment procedures in programs, such as microcredit lending facilities, to stimulate economic activity in the selected economic corridors; (ii) provision of technical training to small enterprises in the reduction of negative environmental impacts; and (iii) promotion of production of and markets for environmentally certified products.

6.9 SO4, and other SOs do include activities that correspond to some of these mitigation measures. These activities, however, may not address the specific negative environmental impacts that may be the result of increased production due to SO2.

Issue 3: Unsafe Disposal of Medical Wastes

6.10 SO3 will support the construction and operation of health clinics. Health clinics administrators are sometimes careless in their disposal of used medical supplies, particularly used needles. If not properly disposed of, such medical wastes can contaminate water sources or directly infect other humans, especially children.

6.11 A mitigation measure for this potential negative environmental impact is to require that all health clinics facilities that receive USAID/Peru support safely dispose of their medical wastes, following procedures that have been tested and approved by international health organizations.

Issue 4: Lack of incentives for private forest protection and management

6.12 The Forestry Law that was approved in 2000, with technical support from SO4, continues the Peruvian tradition of giving the government extensive legal powers over forest use and management, even on private property. To the extent that the government is successful in enforcing the provisions of the Forestry Law, the less power the landowner will have over the management of the forest on his property. Landowners without power to manage the forests on their properties are unlikely to take much interest in them. Since the government does not claim power over the management of non-forested land, many landowners are likely to find ways to eliminate the forest on their properties and thus largely free themselves from government interference and oversight. The disincentive for private forest management in the Forestry Law, therefore, could be a stimulus for deforestation.

6.13 There are two possible mitigation measures for this potential negative impact of the Forestry Law. The first would be to attempt to increase state control over forests on private properties to prevent deforestation. Given the limited financial resources of almost all parts of the Peruvian government, this mitigation is not likely to be effective. The alternative mitigation would be to revise the Forestry Law to provide incentives rather than disincentive for private forest management, by loosening state control and increasing state assistance for private forest management and protection. This could be an effective incentive for private landowners to manage and conserve the forests on their properties, as has been demonstrated in many other countries of the world, especially the United States.

6.14 The Strategic Plan does not discuss the role of incentives for the conservation and management of private forests. The planning documents for the Peru Parks-in-Peril program does discuss the role of private protected areas and includes activities to support

them.[122] These protected areas, however, are not large nor are they established for producing forest products.

Issue 5: Increased Area Placed in Government Controlled Natural Protected Areas

6.15 SO4 includes measures to increase the area of state protected areas. Negative impacts on biological diversity and tropical forests could result from increasing the area of land in nominal government control, without providing the means for effective state control and management. Such areas, rather than being protected, can become open to uncontrolled access and exploitation. Logging, mining and agricultural colonization, for example, could take place in such areas more easily than on private lands, where an owner has a personal interest in controlling land use and keeping out invaders. By contrast, people occupying areas under nominal state control, have no long-term interests, since they cannot receive property rights. The result of declaring large areas under state control, when the government does not have the means to exert such control, could be accelerated conversion and degradation of tropical forests and biodiversity rather than their protection. In addition, the inclusion of additional large areas in the government-controlled categories could draw resources away from the existing protected areas.

6.16 Mitigation measures for this potential negative impact could include: matching of resources available for protection and management of protected areas with the area placed in natural area categories and additional attention to the role of private ownership or private management of forests in Peru.

6.17 The risks involved in designating large additional areas of protected government land are not thoroughly discussed in the Strategic Plan or most of the other documents consulted for the preparation of this report. The Parks-in-Peril documentation for Peru, however, does include plans to support private protected areas. Also, SO4 could support analyses of the comparative effectiveness of declaring additional large areas in government controlled categories of protection or transferring more areas to private ownership.

Issue 6: Negative Environmental Impacts of Alternative Development Programs

6.18 SO5 involves the sustained reduction of illicit drug crops in target areas through “alternative development” programs. The environmental benefits of reducing coca production will be great. Coca cultivation will no longer stimulate deforestation in the "Selva Alta" and coca leaf processing will no longer result in chemical contamination of water bodies. Alternative development activities, however, can cause negative impacts on biodiversity and tropical forests. For example, the construction and rehabilitation of roads, including the building of bridges across large rivers, can open new areas of primary forest to the process of logging and colonization, causing deforestation. The

[122] PiP, 2001,

introduction of new crops and better markets could stimulate the increased non-technical, unsafe use of agricultural chemicals, causing contamination of water bodies, with impacts on aquatic organisms. If SO5 imports new species or varieties of plants or animals, it could introduce harmful exotic species.

6.19 Mitigation measures for such negative impacts can be effective in reducing the negative impacts and augmenting the positive impacts of alternative development on biological diversity and tropical forests. Alternative development programs, however, sometimes give such mitigation measures short shrift. Environmental assessment and mitigation measures, for example, are often given a relatively small percentage of the overall budget assigned to such programs and are relegated to second-level consideration in project planning and administration.

6.20 Additional mitigation measures for SO5 could include: (i) the assignment of larger financial resources for the environmental assessment, mitigation and monitoring components of alternative development programs; (ii) the implementation of a natural resource protection and management program in the alternative development areas; (iii) greater administrative attention to the environmental programs on the part of CONTRADROGAS and USAID/Peru officials.

6.21 SO5 does include a program of environmental assessment and mitigation. For example, CONTRADROGAS, with the help of USAID/Peru has designed and implemented an environmental assessment and monitoring program, which is being used as a model by the Ministry of Transportation. In addition, SO4 and SO5 have developed a joint environmental program based on the need to mitigate any harmful impacts of the ADP.

7. Conclusions

7.1 Peru is one of the world's most important countries for the conservation and sustainable management of biodiversity and tropical forests. These are threatened, however, by (i) habitat fragmentation, (ii) over-exploitation, (iii) contamination and (iv) exotic species.

7.2 The principal impediments to eliminating, reducing or mitigating these threats are (ii) population growth and migration; (ii) widespread poverty; (iii) government policies; (iv) market failures and weaknesses; (v) inadequate environmental management knowledge and capability; and (vi) lack of public awareness and support for conservation and management of tropical forests and biodiversity.

7.3 All seven of the Strategic and Special Objectives in USAID/Peru's "Country Strategic Plan for Peru, FY2002-FY2006" will contribute to removing these impediments.

- SO1 includes actions that will make the Peruvian government more responsive to citizen concern about loss of biodiversity and tropical forests.

- SO2 will reduce rural and urban poverty, thus reducing population growth rates and migration.
- SO3 will promote family planning and improve health, contributing to slower population growth rates and higher rural incomes.
- SO4, the environmental SO, will support Peru's government and private environmental institutions to undertake a wide array of actions to strengthen environmental management systems with a focus on establishing an adequate national policy legal framework, developing and applying environmental policies and practices and increasing environmental awareness, understanding and demand.
- SO5 will reduce coca production in the "Selva Alta" region. By doing so it will reduce the geographically extensive negative impacts on biodiversity and tropical forests caused by the deforestation and chemical contamination associated with coca cultivation. In addition, SO5 will reduce poverty and improve health, promote improved management practices for tropical forests, improve markets for forest and agricultural products, finance land use planning exercises, and carry out environmental communication programs in the coca growing regions.
- SO6 will include environmental education in the curriculum of girl's education in selected schools.
- SO7 will improve income, health conditions, and markets in the northern frontier region.

7.4 The Strategic Plan, however, does raise some potentially significant environmental issues. These are (i) increased road construction and rehabilitation due to more responsive local governments; (ii) increased contamination resulting from augmented productive activities; (iii) unsafe disposal of medical wastes from an increased number of health clinics; (iv) lack of incentives for private forest management and conservation; (v) increased area placed in state protected areas without increased state resources for protection and management; and (vi) negative environmental impacts of alternative development programs. If USAID/Peru judges these issues to be significant, they should be addressed fully and systematically utilizing the procedures provided for in USAID Environmental Regulations.

7.5 Overall, however, USAID/Peru "Country Strategic Plan FY02-06" responds well to the United States Congress' concern about loss of tropical forests and biodiversity as expressed in Sections 118 and 119 of the Foreign Assistance Act.

Table . Threats, Impediments, Required Actions, USAID/Peru Actions and Mitigation Measures

Threats	Impediments	Required Actions	USAID/Peru Actions	Mitigation Measures
Habitat Fragmentation Over-exploitation Contamination Exotic Species	1. Population growth and migration	1. Increase family planning	SO3	Disposal of medical supplies
		2. Improve health and education	SO3, SO7, AF	Safe disposal of medical supplies
		3. Reduce poverty	SO2, SO5,AF, PiP	Evaluate/mitigate/monitor negative impacts of productive processes
	2. Poverty	4. Increase forest productivity	SO4, AF	
		5. Increase agricultural productivity	SO5	Evaluate/mitigate/monitor negative impacts of increasing agricultural productivity (Agrochemicals, exotic species)
		6. Increase off-farm employment	SO2	Evaluate/mitigate/monitor negative impacts of productive processes (contamination, source of raw materials, safety, etc)
		7. Improve markets for forest products	SO4, SO5	Evaluate/mitigate/monitor potential negative impacts of increased demand for forest products
		8. Increase educational opportunities	SO6, SO5	
	3. Policy	9. Support private forest ownership	PiP,	Accompany private forests with technical assistance & education programs
		10. Make government more democratic	SO1	Include environmental education/analysis within democratic processes
		11. Improve decision-making processes	SO1	Environmental training for government officials
		12. Support policy research	SO4, AF	none
		13. Charge full environmental costs	SO4	none
		14. Remove government subsidies	SO4	none
		15. Control access to protected areas	SO4, PiP	none
		16. Establish additional protected areas	SO4	Policy studies
		17. Support private forest ownership	Nothing specific	none
	4. Environmental management knowledge/ capability	18. Support research and technology dev.	none	none
		19. Train environmental professionals	No formal training	none
		20. Strengthen institutions	SO4	none
		21. Enforce regulations	SO4, PiP	none
		22. Control introduction of exotic species	Nothing specific	none
	5. Public awareness/support.	23. Support environmental education	SO4 , SO6,SO7, PiP	none

References Cited

Consejo Nacional del Ambiente. 2001. Estrategia nacional sobre diversidad biologica. 138 pp.

Development Resources, Inc. 2000. Evaluation of USAID/Peru strategic objective 4 program and framework.

Hanrahan, Michael, et. al. 1995. Environmental and natural resource management in Peru: a strategy for USAID/Peru assistance. 85 pp.

Instituto Cuanto. 2001. "State of the environment report", Chapters 10-13 (in Draft), no page numbers.

Instituto Cuanto, 2000. El medio ambiente en el Peru, Ano 2000. 370 pp.

Instituto Nacional de Estadistica e Informatica. 2000. Peru: Estadisticas del medio ambiente, 2000. 206 pp.

Instituto Nacional de Recursos Naturals (INRENA). 1997. Estudio nacional de la diversidad biologica. Vol. I. 407 pp.

Instituto Nacional de Recursos Naturales y Sociedad Peruano de Derecho Ambiental. 2001. Compendio de legislacion forestal y de fauna silvestre. 212 pp.

Low, Frank,et. al. 1993. Peru: natural resources assessment, 1993 update. 129 pp.

Meffe, Gary K. and C. Ronald Carroll. 1997. Principles of conservation biology. Sinauer Associates, Inc. Sunderland, Mass. 130 pp.

Parks-in-Peril. 2000. Initial Site Workplan, Pacaya-Samiria National Reserve. 58 pp.

Instituto Nacional de Recursos Naturales (INRENA). 1996. Monitoreo de la deforestacion en la amazonia Peruana. 35 pp.

Instituto Cuanto and USAID/Peru. 1998. Resumen: encuesta nacional de medio ambiente. 52 pp.

Randal, Allan. 1987. Resource economics. John Wiley & Son, New York. 434 pp.

Southgate, D. 1998. Tropical forest conservation. an economic assessment of the alternatives in Latin America. New York: Oxford University Press.

USAID/Peru. 1995. Environmental and natural resource management in Peru: a strategy for USAID/Peru assistance. 99 pp.

USAID/Peru/Fondo de las Americas. 2001. Informe de actividades, 2000, 19 pp.

USAID/Peru. 2001. Country strategic plan for Peru FY 2002-FY 2006. 178 pp. plus Annexes