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Reinventing the Well

Approaches to Minimizing the Environmental and Social Impact of Oil Development in the Tropics

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Volume 2/1997

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Cover: Using helicopters for transportation during oil exploration activities can reduce the expense and environmental impact of the operation, and eliminate the need to build a road. ©Jorgen Thomsen, 1996.

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MISSION STATEMENT

With the explosion of our planet's population and the radical conversion of natural lands for living space, farming land, and waste disposal, the ecosystems that have traditionally supported human societies are severely stressed. Ultimately at risk are the air we breathe, the water we drink, the soils and seas that feed us, and the living creatures that give us fibers, medicines, and countless other products.

Conservation International (CI) believes that the earth's natural heritage must be maintained if future generations are to thrive spiritually, culturally, and economically. Our mission is to conserve the earth's living natural heritage, our global biodiversity, and to demonstrate that human societies are able to live harmoniously with nature.

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FOREWORD

Oil companies are entering the planet's richest ecosystems in their continuing quest to satisfy the world's growing demand for energy. In the next decade, more than 80 percent of new oil development will take place in the humid tropics, home to most of the world's biological diversity. This expansion has already caused extensive, often severe, environmental and social disruption and has stimulated a growing international awareness of the impacts of oil development in the tropics. ■ Conservation International understands that biodiversity conservation inherently takes place in the context of economic development. Our task, and that of our partners throughout the world, is to ensure that global biological wealth is not eroded in the process of development. Conservation International takes the view that certain forms of natural resource extraction can co-exist with biodiversity conservation. *Reinventing the Well* examines the case of oil development, addressing the conditions under which it can be appropriate in given tropical ecosystems and outlining tools to minimize environmental and social impacts where it does proceed.

Conservation International has worked for a decade in many of the tropical ecosystems targeted for oil development. While we acknowledge the importance of oil revenues for many countries, we have seen first-hand the environmental and social destruction that can result from poorly managed extraction. However, we have also seen that oil development can co-exist with conservation and be responsive to the needs of local communities when careful planning and consultation are undertaken and superior technologies and best practices are employed.

Oil development anywhere entails great environmental and social risks. In national parks, it should never occur. In other circumstances, where its social impact on indigenous people or local communities would be highly destructive, it is also inappropriate. In many other cases, it may be environmentally and socially acceptable provided best practices are applied. Each situation is unique, and decisions about whether and how to proceed with oil development must be based on the informed participation of governments, oil companies, local communities, and other stakeholders.

Reinventing the Well is the product of a Task Force Conservation International developed to help our partners address these issues in the ecosystems where they are active. As a part of our Policy Paper series, it is a "hands on" document intended to be used as a practical tool to help the full range of stakeholders make informed decisions about oil development. The authors of this paper have tried to synthesize the disparate experiences of oil companies, government agencies, and non-governmental organizations (NGOs) working to improve the environmental and social performance of oil operations in the tropics. While the paper does not represent a definitive set of guidelines, its recommendations offer a useful framework for thinking about whether and how oil development should proceed in sensitive ecosystems.

Peter Seligmann, Chairman and CEO
Ian Bowles, Vice President, Conservation Policy

CONSERVATION INTERNATIONAL, WASHINGTON, DC

EXECUTIVE SUMMARY

This report offers recommendations for minimizing the environmental and social impacts of oil exploration and production in tropical ecosystems. It examines the often devastating environmental and social impacts that have resulted from oil development in the tropics and offers a series of "best practices," including technologies, management practices and policies, to address and mitigate these impacts. The paper concludes with an overview of legislative and contractual mechanisms that can be used to ensure enforcement and implementation of these best practices. ■ The paper provides an introduction to the issues and impacts associated with exploration and development in the tropics, and is meant to be a useful guide for corporations, governments, indigenous groups, and NGOs. We offer a series of specific recommendations that we believe represent current "best practices." This list should not be considered definitive, however, as technology and knowledge are constantly evolving. Rather, our recommendations comprise a minimum standard that should be followed. The paper is structured so that the first two sections on environmental and social issues may be more useful to companies and governments seeking guidance on specific practices and technologies, while the last section on legal issues may be more relevant for governments and indigenous groups seeking to establish and defend legal rights and standards.

The New Frontier for Oil Development

Oil exploration and development is proceeding at a rapid pace in the humid tropics. This expansion into the tropics is fueled by a continuing global reliance on oil to meet rising energy needs, as well as the growing need for foreign exchange in many oil-rich developing nations. While this paper focuses on development in the Latin American tropics, its lessons and recommendations can be useful for any tropical forest area under pressure from oil development.

Although oil development in any region is risky, carrying the potential for severe environmental damages and social disruption, tropical areas are particularly vulnerable. Because of the high correlation between areas of high biodiversity and geologic formations that contain hydrocarbons, many of the areas targeted for oil development directly overlap with sensitive and threatened ecosystems. Many of these areas are also home to indigenous populations, some of which have had little or no contact with the outside world. Finally, these countries often have relatively young bureaucracies and environmental management systems that may lack the capacity to thoroughly implement and enforce effective environmental and social safeguards.

For all the reasons mentioned above, oil operations in tropical areas should be improved and monitored to minimize impacts on both natural and cultural surroundings. With the proper safeguards and using advanced technologies and community-relations practices, oil operations can be more benign in a tropical forest than other land-use options, such as cattle ranching, agriculture, logging or mining.

Nevertheless, there are situations in which oil development should not proceed, because the environmental and social costs will simply be too great. An important principle for any nation, not just those in the tropics, is the prohibition of oil and other resource development projects within national parks. Parks and reserves that have been designated for the conservation and maintenance of biological diversity in an undisturbed state should under no circumstances be subject to large-scale infrastructure development and resource extraction. An exception to this rule may occur if a concession for oil activity was granted prior to the designation of a protected area. In all cases, the government should require that the operating company work closely with environmental experts and local and national authorities to ensure that best practices are followed, that the impacts of the oil operation do not extend beyond project boundaries, and that the land is fully restored and returned to protected area status upon completion of the project. Extreme caution should also be used when deciding whether to explore in an area that is home to isolated indigenous people. The effects of contact and development on these people can be devastating and even deadly, and oil operations should avoid these areas.

Environmental Impacts and Best Practices

Until recently, oil operations in tropical rain forests have largely depended on technology and practices that, while effective in certain ecological surroundings, have proven ill-suited to the environmentally fragile ecosystems of the humid tropics. Severe, direct environmental impacts, including land-clearing, air pollution, water contamination, soil erosion, sedimentation, and disturbance of wildlife and habitats, have resulted. Perhaps even more threatening are the indirect impacts, including colonization and extensive deforestation, that result from the opening of access into the forest via roads and pipeline paths.

To avoid repeating these mistakes, the oil industry and local and national governments must incorporate a whole new set of ecological and social parameters into their thinking about oil projects. In many cases, the technology to minimize the environmental impacts of an operation exists and has already been implemented in the field. Frequently, all that is needed is an application of old models to new places, or a rethinking of traditional operating procedures. In this section, we provide an overview of both existing and experimental technologies and practices that can help to minimize the environmental impact of oil projects. In general, the operating company should use the most advanced and efficient technology, unless it can convincingly demonstrate why a certain technology or practice would not work.

Social Impacts and Best Practices

While many technological and management innovations have been successful at reducing the environmental "footprint" of oil development, less has been done to respond to the social challenges facing oil operations. Yet, just as it is important for companies and governments to assume responsibility for mitigating environmental impacts, it is equally necessary that they address social issues in their management and oversight activities. Social problems at oil operations often result from mishandled contact with indigenous groups, some of whom have had little or no contact with the outside world. The spread of diseases to which indigenous people have no immunity, disruption of traditional hierarchies and social structures, and an increasing dependence on outside aid can destroy long-established and healthy societies. Even in towns and communities that are already integrated into the local economy, traditional lands and production systems can be deeply affected by the presence of an oil operation.

Social issues are often beyond the expertise and experience of project developers, who are usually trained as engineers or environmental managers. Thus, it is important for anthropologists and other social scientists to work with companies and local people to identify social impacts, determine community needs, and formalize two-way communications. In addition, it is extremely important to work with other oil and resource extraction companies in the area to standardize policies about interaction with local communities. This section of the paper discusses the social impacts associated with oil and other infrastructure development projects and lays out a series of general policies and corporate practices necessary for a successful community relations strategy.

Legal Mechanisms to Promote Best Practices

The potential for extensive and irreversible environmental and social damage from oil development projects is particularly acute in developing countries with inadequate regulatory frameworks or weak environmental and social legislation. In order to ensure that the conservation of their vast biological wealth and the well-being of their citizens is not sacrificed at the expense of short-term development, developing countries need to implement progressive legislation that is supported by strong institutional capacity and innovative funding mechanisms. In addition, individual oil contracts should supplement statutory requirements, reaffirm the company's obligation to comply with all applicable environmental and socio-cultural regulations, and require companies to follow best practices for oil development at all times. Oil development contracts should also fill gaps in legislation and set additional requirements for particular projects in especially sensitive areas.

Conrad Reining

Land-clearing along pipeline path, Petén, Guatemala.

In this section, the report offers a series of suggestions and examples of the best ways to create and enforce effective petroleum legislation and to draft contracts to ensure the proper implementation of environmental and social best practices.

Recommendations

In each section of the paper, we lay out a series of recommendations for technologies, practices and policies. The following is a summary of general principles that guide each individual recommendation. While these principles, and the recommendations listed throughout the report, are not exhaustive, they represent a useful summary of the existing literature and experiences surrounding oil exploration and development in the tropics.

- *Conduct preliminary impact assessments.*
  Early evaluation of the potential environmental and social impacts of a proposed project can allow project planners to determine where and how to best mitigate these impacts. In some cases the expected environmental and social costs may be so great that the best option is to forego development altogether. It is important to determine this before any exploration activities begin.

- *Involve local stakeholders throughout an operation.*
  An operating company should establish a formal mechanism for consultation and communication with local communities, governments, NGOs and other stakeholders. These groups should be consulted and involved in planning, data collection, review of project documents and monitoring.

- *Ensure a proper level of environmental awareness and expertise among workers.*
  The most effective protection programs will be worthless if workers and management do not understand and commit to environmental principles. Environmental experts should be included as part of the planning team from design to remediation, and all project workers should be educated on environmental issues.

- *Minimize the area of impact.*
  An oil operation should leave as little imprint upon the land as possible. This goal can be achieved by minimizing and eliminating roads, using helicopters, reducing the land area needed for base camps and other facilities, and cutting the size of drill sites with directional drilling from cluster platforms.

- *Use extreme caution when there is a potential for contact with isolated indigenous groups.*
  Whenever possible, workers should avoid contact with groups that have had little or no involvement with the outside world. This policy is extremely important to prevent the spread of deadly illnesses among these groups and to avoid the potential disruption of long-established social and production systems.

- *Tailor compensation schemes to specific communities.*
  By working with local communities and cultural experts, companies can determine the best way to compensate communities for the use of the land or individuals for work at the project site. In many cases, community-based compensation may be the best way to avoid severely impacting local economies and family structures.

- *Conduct environmental and social monitoring and evaluation programs during every phase of an operation.*
  These programs should assess the impacts of project activities on the surrounding ecosystem, cultures and economies. Monitoring can also determine whether environmental and social programs instituted by the company are having the desired effect, and suggest alternatives if they are not.

- *Return the project site to its pre-operations condition.*
  When an oil project finishes, a company should institute complete remediation procedures to reseed and revegetate affected land areas. All facilities and equipment should be broken down and removed from the site, and roads and stream crossings should be taken up and the soil loosened to promote regeneration.

- *Enact a comprehensive legislative framework of environmental and social regulation.*
  Conservation efforts require legislative and administrative support at every level of governance, from constitutional provisions and national environmental policies, to more specific sectoral legislation and agency rules and regulations.

- *Allow oil development activities only after a thorough bidding and permitting process.*
  Government agencies should screen bids for oil contracts using environmental criteria as an essential factor. Bids should be publicly available, and citizen groups should be allowed to comment on the relative merits of each proposal.

Courtesy Mobil Oil Corporation

Oil-rich tropical countries are beginning to carve up their biologically rich areas for oil development. This map is a recent depiction of the current concessions that have either been allocated or awarded for development in Peru.

- *Structure oil contracts to provide for maximum government and citizen group supervision.*
  Companies must be required to keep the government fully updated on the status of an oil development project. In addition, local communities must be fully informed of the scope of the project, of the potential threats and measures that have been taken to minimize these threats, and of the recourse available to them in the event companies ultimately cause environmental damage.

- *Establish civil and criminal liability for companies and the officers responsible for supervising and implementing oil projects.*
  In addition to imposing heavy fines on companies that do not comply with environmental law, establishing criminal liability for corporate officers who are grossly negligent in performing their duties acts as a significant deterrent against environmental damage.

- *Include funding mechanisms to offset environmental damage in any legislation regulating oil company activities.*
  Performance bonds and mitigation trust funds controlled by citizen groups or local governments, as well as environmental insurance policies, should be prerequisites to oil development projects. Governments should also study the feasibility of tax incentives to promote conservation measures.

- *Require companies to conduct comprehensive studies of land tenure patterns for any operations in areas where there are competing land tenure systems.*
  Companies that will be working on lands where ownership patterns are unclear should make a concerted effort to work with the government to clarify the situation as fully as possible. Regardless of legal title, the rights of all local residents should be respected.

INTRODUCTION

In their search for new reservoirs of oil and gas to meet the continuing global demand for fossil fuels, energy producers are expanding their operations into some of the world's last undisturbed ecosystems. This expansion has led to extensive, often severe, environmental and social damages, accompanied by a growing international awareness about the environmental and social costs of oil exploration and development. International campaigns by networks of local, national and global stakeholders have caused oil companies and national governments to rethink their development practices and begin to internalize the environmental and social costs associated with their operations. In some cases, increased public pressure has led oil companies to abandon highly valuable concessions, while in others, companies have concentrated their efforts on ways to strike a balance between financially viable operations and ecological and social needs within their concession sites.

This paper focuses on oil exploration and development activities in the humid tropics—the next big frontier for oil operations. Companies have already begun to move into these areas, and it is estimated that a significant percentage of new oil development in the next 10 years will take place in the humid tropics. The tropical areas targeted by these operations hold not only large stores of oil, but are also frequently undeveloped and remote, located in or near important and sensitive ecosystems, and often inhabited by marginalized local people. Because geologic formations containing hydrocarbons are often found in areas of high biodiversity, many of these operations overlap with the biodiversity "hotspots" in which Conservation International works.[1] (See Figure 1.1)

Although oil exploration and development is expanding throughout the tropics, we focus in this paper on the activity and impacts in the Neotropics ("New World" tropics), which include South America, Mesoamerica and the Caribbean. A regionwide move toward privatization of some aspects of Latin American state oil industries, which were nationalized in the 1970s and 1980s, growing liberalization of markets, and contractual incentives for foreign investment, make this region a prime target for oil exploration and development. In addition, many of the ecosystems most directly threatened by oil development in coming years are in Latin America. The threats and problems associated with uncontrolled and unmonitored oil activities in Latin America can be applied to similar situations in other areas of the world, and the suggested best practices discussed here can be useful at other tropical oil operations. In fact, several of our examples of best practices and innovative technologies are taken from operations outside of Latin America.

The Neotropics are an important area for biodiversity conservation. No matter how priorities for conservation are set, the Neotropics emerge as among the biologically richest spots on Earth. Of the 12 "megadiversity"[2] countries that harbor the majority of the world's biological diversity, five are found in Latin America: Brazil, Colombia, Ecuador, Mexico, and Peru. Several Neotropical regions are also listed as "hotspots," including the eastern slopes of the tropical Andes, the Atlantic Forest region of Brazil, the Chocó region of Colombia, the Pacific slope forests of Ecuador and the forests of Mesoamerica.

The Neotropics also hold an enormous absolute competitive advantage in ecological resources.[3] Although the region occupies only 16 percent of the planet's land surface and is home to only 8 percent of its human population,
it supports a very high percentage of terrestrial and freshwater species. This ranges from a low of 27 percent of the world's mammal species to 37 percent of reptile species, 43 percent of bird species and 47 percent of amphibian species. The region is also home to more than half of the world's insect species.[4] Flowering plant diversity is especially high, with an estimated 34 percent of the global species total in the Neotropics. And 67 percent of all tropical rain forest is found in the Neotropics, 36 percent of it in Brazil alone.

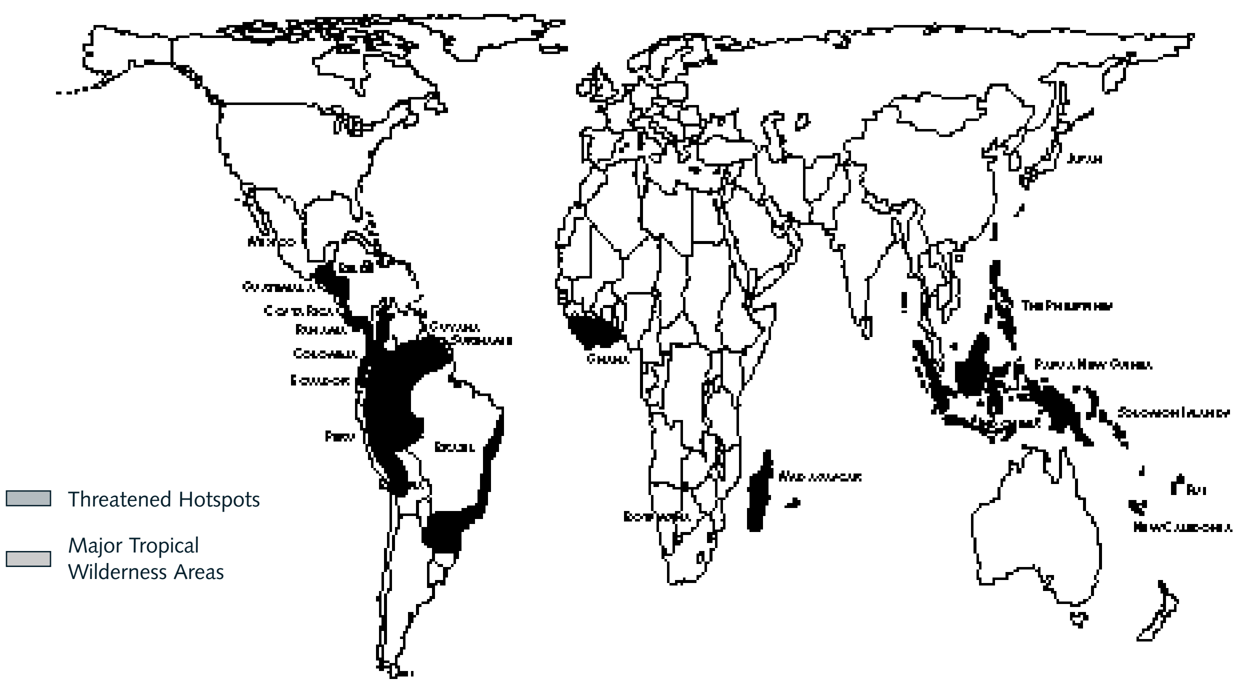
Although Conservation International recognizes the need for energy conservation and alternative sources of fuel, we also acknowledge the important and inevitable role that oil and gas will continue to play in the global energy mix for many years to come. The oil business is one of the largest economic entities in the world today, generating economic activity of more than $1 billion daily.[5] In 1976, oil and gas accounted for about 60 percent of energy demand worldwide. Two decades later, in 1994, this proportion remained steady, at 60.1 percent, despite energy crises, rising energy prices and other economic factors that should have inspired a movement away from oil and gas.[6] At the same time, a growing number of developing countries have begun to depend on oil revenues as an important source of desperately needed foreign exchange and investment.

Conservation International seeks to find ways for conservation and economic development to co-exist, to demonstrate that human societies can thrive while remaining in harmony with the natural world. Although past oil exploration and production activities have caused huge environmental and social impacts, technological developments and innovative thinking both within and outside the industry show that these damages can be minimized, mitigated, and sometimes eliminated if companies make a firm commitment to reducing their impact on the environment and local people.

Continued access to oil reservoirs in tropical countries will, in many cases, depend on the perception, by governmental and non-governmental organizations, that companies are committed to good environmental and social practices. International oil companies also have to answer to stockholders and customers, as well as financial institutions, which are beginning to place more emphasis on environmental management when approving loans.[7] Frequently, this international perception depends upon more than the actions of any one company. Even if most companies are operating with clean records, it only takes one large oil spill or a major conflict with local groups to harm the reputation of the entire industry. As the actions and problems of one company may reflect on the industry as a whole, synthesizing experiences and lessons can be an important first step toward improving the environmental and social record and image of the entire industry.

This paper reviews the environmental and social impacts of past oil exploration and development, as well as new technologies and management practices that

FIGURE 1.1: BIODIVERSITY "HOTSPOTS" IN WHICH CONSERVATION INTERNATIONAL WORKS



promise to improve both the performance and profitability of oil exploration and production operations in the tropics. Although many companies have begun to experiment with new approaches to oil development in sensitive ecosystems, there is still very little sharing of information among them. Experiences and institutional knowledge are rarely disseminated, and may be lost when an employee moves on to another job or company. Similarly, although environmental management plans and governmental regulations frequently refer to "international standards," there is not a true consensus on what these standards should be or what methods and technologies should be used to meet them.

Several important documents lay out useful general guidelines and recommendations for oil operations in the tropics.[8] These documents have been valuable guides for understanding the complex environmental issues surrounding oil exploration and production in tropical forests. However, there are few, if any, generally accepted standards or guidelines for dealing with the social impacts of oil exploration and development. Social impacts can be equally devastating and have been much less thoroughly documented or addressed than environmental impacts.

It is our hope that this paper will begin a process of gathering and analyzing the disparate experiences and general principles circulating within the industry. This document is intended for practical use by planners in the oil industry, governments and non-governmental organizations, who seek to design improved oil exploration and production paradigms that minimize impact on both the natural environment and local people.

We begin our discussion of oil activities in the tropics in Section 2, with a look at the factors that are driving international oil companies to expand into these areas, including liberalization of markets, privatization of state-run oil industries, economic and legal incentives, and a need for foreign capital. Sections 3 and 4 examine the environmental damage and social disruption that may result from oil operations and offer a series of best practices—including technology, environmental planning, and community management—that can help to minimize or eliminate these impacts. We conclude, in Section 5, with an overview of oil legislation and contracts, which are vital for ensuring the effective implementation and enforcement of these best practices.

2. THE NEW FRONTIER

The past decade has seen a major increase in oil and gas exploration in tropical forests and river basins. The movement by developers to expand their frontiers of exploration is due in part to rising global demand for energy and a need to find younger reservoirs.[9] Perhaps the greatest contributor to the surge of exploration and development in these tropical areas, however, has been a trend toward liberalization of markets and privatization of oil and gas production. These changes make it easier and more attractive for oil companies to invest in these countries, in many cases for the first time. Inevitably, this momentum will take exploration operations further into remote and environmentally sensitive areas.[10]

We will focus our discussion in this section on Latin America, which is becoming a key player in the international oil market. Latin American oil is particularly important for the United States, which can be reached in only four days by tankers from the region. In mid-1995, Venezuela replaced Saudi Arabia as the largest supplier of oil to the United States, and recent discoveries should lead to even greater U.S. market demand going to South American producers.[11]

2.1 Liberalization and Privatization

In the past, oil development in Latin America had two distinct phases. The first, in the 1920s and 1930s, saw big international oil companies moving into the region to search for reservoirs of oil and gas. However, when more productive areas were discovered in other, more accessible parts of the world, principally the Middle East and North America, these companies moved on. It was not until the 1970s when, driven by energy crises, high prices, and demand for oil, companies began to return to the region. Interest and opportunities in Latin America declined, once again in the late 1970s as Latin American nations began to nationalize their oil operations.[12]

The latest cycle of exploration, which began in the early 1990s, has been prompted by a regionwide movement toward free market reforms and privatization of state oil sectors.[13] Although the majority of oil industries in the tropics are still at least partially state-run, many governments are beginning to understand the importance of liberalization for competitiveness. Governments are also recognizing the value of the technology, expertise, and financial resources that international oil companies offer.

Privatization has proceeded at different rates throughout Latin America, depending on the regime in power, the level of political support, and the degree of economic stability in a particular country. This movement has been led by Argentina, where the formerly state-owned gas and oil companies, Gas del Estado and Yacimientos Petroliferos Fiscales (YPF), have been entirely privatized. YPF has since bought Dallas-based Maxus Energy and is moving into China, Russia, and Venezuela. Privatization has earned Argentina's YPF more than $2.1 billion from sales of its assets since September, and privately owned companies now hold about 26.2 percent of Argentina's oil and gas acreage, including both productive and prospective fields.[14]

The liberalization process has also begun in Bolivia, although complete privatization is likely to be several years away. The Bolivian government passed a general privatization law in April 1992 and plans to privatize its major industries through a system of "capitalization."[15] (See Box 2.1) In the spring of 1996, the Bolivian government approved a revised hydrocarbon law and reached agreement with the Petroleum Workers Union to capitalize the state oil company, Yacimientos Petroliferos Fiscales Bolivianos (YPFB), despite national opposition from many sectors, including the Bolivian Workers Confederation. Under this new plan, the government would sell 50 percent ownership of YPFB and totally privatize its upstream exploration and production and transportation divisions. The government-owned part of the company will continue to sign joint ventures with private companies, both foreign and national, and manage export contracts.[16]

In December 1995, the Peruvian government announced that it would sell a number of assets currently owned by Petroleos del Peru (Petroperu), the state oil company, although complete privatization of the company would not happen within the year. Among the assets that would be up for sale are all of Petroperu's terminals, two oil fields, two refineries and a concession to build the North Peruvian pipeline.[17] (See Box 2.2) Although many within the country are opposed to privatization, the government has described it as the only way to raise the $2 billion needed to improve the facilities.[18]

In other countries, oil companies remain state-owned, but operations are being opened to foreign capital. In Ecuador, all oil is still owned, refined, transported, sold and controlled by the government. However, while most of the oil is produced by Petroecuador, the state oil com-

Box 2.1: Oil Production in Bolivia

Bolivia has been producing oil for more than 50 years, with production for much of that time controlled almost exclusively by the state-owned oil company, Yacimientos Petroliferos Fiscales Bolivianos (YPFB). YPFB annually produces 75 percent of the natural gas and 81 percent of the crude oil in Bolivia, and owns all of the pipelines and refineries in the country.[1] ■ In recent years, Bolivia has begun the privatization of its state-owned companies through a system of capitalization. This system allows a 50 percent controlling interest in government-owned companies to be sold to a private investor or "strategic partner." The remaining 50 percent is funneled into a national pension fund for Bolivia's adult population. Pension fundholders become shareholders, and the government receives no direct benefit from the sale. However, the government does retain the right to negotiate contracts and monitor implementation.[2]

YPFB is one of the many state-owned enterprises being privatized through this capitalization approach. The company will be broken down into different companies to cover five main industry activities: exploration, production, refining, transportation and marketing. Nationally owned oil fields and exploration blocks will also be divided into exploration and exploitation companies.[3] Under the 1995 hydrocarbon law, private investors may be granted concessions to explore and produce at their own risk, with the freedom to market their own production. The law also includes tax incentives to encourage investment.[4]

Although Bolivia has an estimated 200,000 square miles of sedimentary basins, only about 15 percent of these have been explored.[5] In coming years, much of the country's new energy development will involve the production and export of natural gas. The majority of recent strikes have contained a high ratio of gas, and Bolivia has exported natural gas to Argentina for more than two decades, at a rate of 200 million cubic feet per day (MMCFD). An equal amount is recycled to maintain the reservoirs, and approximately 60 MMCFD is consumed internally.[6]

This large endowment of natural gas has led Bolivia, a landlocked nation, to plan a pipeline network to export gas throughout the southern cone of South America. The proposed Bolivia-Brazil pipeline, which would run along a corridor from Santa Cruz, Bolivia, to São Paulo, Brazil, will be built at an estimated cost of $1.5 to $2 billion.[7] YPFB has also signed a joint-venture contract with BHP Power of Australia and the Chilean state oil company Empresa Nacional de Petroleo (ENAP) to build a gas pipeline to northern Chile. The primary market will be new gas-fired power plants that will be constructed in the next two to five years. Gas is due to arrive in Chile by early 1997.[8]

1. "Capitalization of YPFB: Critical for Bolivia's Growth," *Capitalization Monitor* (Washington, D.C., Embassy of Bolivia, 1996). 7.

2. "Bolivian Petroleum Privatization Taking Shape," *Oil & Gas Journal,* 7 August 1995, 44.

3. Ibid., 43.

4. *Bolivia: The Gas Hub of the Southern Cone of South America* (Washington D.C., Embassy of Bolivia, 1994), 7.

5. Ibid., 4.

6. "Bolivian Petroleum Privatization Taking Shape," 45.

7. "Capitalization of YPFB…," 13.

8. Barrie Dunstan, et. al., "Australia: BHP's $1.4 billion Power Play," *Australia Financial Review,* 20 July 1994.

pany, about 10 percent of recent production has been by private companies under contract to Petroecuador.[19] The Brazilian state oil company, Petrobras, also has been opened up to private investment. The Brazilian Congress passed a constitutional amendment in November 1995 to allow investment by private and state-owned companies in petroleum exploration, production, refining, importing and exporting projects, while still leaving Petrobras in control of these activities. The government will maintain a 51 percent share of the company.[20]

2.2 Economic and Legal Incentives

Although a free market and privatization make it easier and less risky for international oil companies to invest in Latin America, there must also be some positive incentive for them to do so. In this decade, several nations have introduced economic, legal, and contractual changes that make it much more attractive for a company to invest limited resources in Latin America.

When Latin American oil industries were nationalized, the traditional practice of offering international oil companies concessions for exploration was replaced by service contracts. (See Section 5) Under this new form of agreement, oil companies would be contractors to the government, allowed to explore and produce with the understanding that any discoveries belonged to the government. At the same time, taxes and government royalty payments increased. In many Latin American countries today, liberalization has not yet prompted a return to the concession format. However, in some places there has been, to varying degrees, movement back toward concessions, an eas-

Box 2.2: Oil Production In Peru

Although oil exploration began in Peru in the mid-nineteenth century, many foreign oil companies were discouraged from participating in the Peruvian oil industry by an uneven record of discoveries and the state-controlled economy and complex maze of petroleum laws. In 1991, the government made its first step toward privatization with Decrees 655 and 730, which lifted the industry monopoly held by the state oil company, Petroperu, and allowed other Peruvian and foreign companies the opportunity to invest in the oil industry. Decree 655 specifically permitted Petroperu to negotiate and enter into contracts with foreign oil companies to exploit oil resources.[1]

While these decrees began the privatization of the industry, the 1993 Hydrocarbons Law redesigned the playing field by altering the industry's basic operating rules. Under the new regulations, Peru guaranteed that oil prices would no longer be subsidized, but instead would rely on supply and demand conditions.[2] In addition to eliminating oil subsidies, the new hydrocarbons law created Perupetro S.A. to promote foreign oil investment and negotiate oil contracts with foreign investors, effectively removing Petro-peru from its former responsibilities. With Perupetro's creation, Petroperu assumed the same status as any other oil company operating in Peru.

Since the implementation of the Hydrocarbons Law, there has been increasing involvement by international oil companies in the Peruvian oil industry. The first contracts signed under the new law involved a $150 million dollar integrated energy project proposed by Maple Gas Corporation. Under a 20-year operating contract, Maple assumed operations of the Maquia and Aqua Caliente oil fields, formerly operated by Petroperu. In a separate 30-year operating contract, Maple agreed to develop a large natural gas field at Aguaytia.[3]

Perupetro put several blocks of rain forest land up for bid as exploration concessions in 1995. Among the oil companies that have signed contracts with Perupetro are Murphy Oil, Great Western Resources, Ltd., Quintana Minerals Corp., YPF, Mobil, Chevron, ARCO and Atlantic Resources International.[4] In the future, dozens more blocks will be offered, with Perupetro continuing to conduct the negotiations. Although its role in the industry is secure, Petroperu faces imminent privatization.[5] In December, 1995, Petroperu announced that it would sell a number of its assets. In accordance with this plan, in May 1996, Peru offered for sale its La Pampilla refinery and a production block in the northern jungle Maranon Basin, which currently produces about 25,000 b/d.[6] The refinery was sold in July for $180.5 million to a consortium led by Spain's Repsol, while the production block was sold to Pluspetrol of Argentina for $142.2 million.[7]

1. *Peru: La Tierra del Nuevo Sol* (Coral Gables, FL, LatinFinance Special Projects Ltd., September 1995), 98.

2. Ibid.

3. "Peru Action Simmering Despite Privatization Delays," *Oil & Gas Journal*, 7 August 1995, 53.

4. "Peru—Oil Exploration Contract," *Market Reports*, 21 March 1995; Peru Action Simmering…"; "Peru exploration tender draws just one bid," *Latin American Energy Alert*, 3(4).

5. "Peru—Investment Climate Statement," *Market Reports*, 21 March 1995.

6. Emery, Alex, Ten years later, Camisea deal is signed," *Platt's Oilgram News*, 74(94), 2.

7. "Peru/La Pampilla acquired," *First!*, 5 July

ing of terms for service contracts, and increased incentives for investment.

Since concession contracts were abolished in Colombia in 1974, foreign companies have been allowed to operate only under association contracts, whereby they proceed at their own risk and expense as a contractor to the state oil company, Ecopetrol.[21] However, there have recently been discussions about lowering the high tax rate on the petroleum industry, which currently stands at a discouraging 55 percent.[22]

Both Peru and Ecuador revised their hydrocarbon laws in 1993 to ease the terms of service contracts for foreign investors. In Peru, the government replaced the current service contracts with operating licenses, which give companies the right to sell what they produce and allow for royalty payments to the government, rather than up-front production splits.[23] The license contracts are offered for 30 years for oil development and 40 years for gas, including a seven-year exploration phase.[24]

Box 2.3: Oil Production in Colombia

Oil exploration began in Colombia in 1904 with the first concession agreement between the government and a private company. The state oil company, Ecopetrol, was created in 1951 to continue the exploration and exploitation of petroleum in fields that had reverted back to the government at the end of concession periods. In 1970, the entire industry was nationalized, with a decree giving Ecopetrol responsibility for carrying out official petroleum policies under the supervision of the Ministry of Mines and Energy. Ecopetrol also was authorized to administer the exploration, exploitation, refining, transportation and commercialization of hydrocarbon reserves.[1]

To date, 13 sedimentary basins, totaling 783,000 square kilometers, have been identified by seismic surveys in Colombia, although only 39 percent of these basins have actually been explored.[2] More than 1,600 exploratory wells have been drilled in Colombia, 34 percent of these between 1983 and 1993. Recent large discoveries have doubled the size of Colombia's proven reserves and allowed the nation to meet domestic needs and increase exports after nearly a decade of importing petroleum. High-quality Colombian crude is in high demand by the United States and oil has become a central component of the national economy.[3]

In 1987, Ecopetrol published a "Year 2000" development plan that proposes large private investments in all divisions of the oil and gas industries. In 1992, this plan was revised to correct unmet investment goals and the "Dynamic Adjustment Development Plan" was implemented in its place. Through this plan, investment goals are adjusted annually based on current expectations. The exploration program proposed by Ecopetrol aims to increase known reserves to maintain sufficient domestic supply and sustain the increasing level of exports contributing to the economy. However, recent huge discoveries may force Ecopetrol and other investors to concentrate on development, postponing intensive exploration plans.[4]

The government introduced another development plan, "Apertura Economica," in 1993 to encourage investment in the petroleum sector and increase economic growth by boosting efficiency and exports. These goals will be achieved by a gradual opening of the economy through privatization, a decrease in public spending, and encouragement of foreign investment by lower tariffs and deregulation.[5]

Despite continuing discoveries, increases in government taxes have somewhat slowed foreign investment in the oil industry. International oil companies contend that Colombia has threatened the future of the oil industry by increasing taxes, making it one of the most expensive places in the world to produce oil. In 1992, the government imposed a $1.20 per barrel "war tax" to finance anti-guerrilla actions. Although initially described as temporary, this tax has been extended indefinitely. Overall, the government takes about 85 percent of all petroleum revenues[6]

1. "Colombia—Oil and Gas Drilling Equipment," *Market Reports*, 21 March 1995.

2. Ibid.

3. Ecopetrol Home Page, Spring 1996.

4. "Colombia—Oil and Gas Drilling Equipment."

5. "Colombia: Special Report—Ecuador, Peru and Colombia—Nations at an Economic Crossroads," *Lloyds List*, 12 November 1993.

2.3 Need for Foreign Capital

The driving force behind the liberalization of oil markets and the push to attract international investment is the need for foreign capital in Latin American nations. Oil revenues play an important role in these developing economies, and in some countries account for a significant percentage of gross domestic product. However, although a state oil industry may be a nation's largest economic entity, many Latin American countries still cannot afford to develop their own fields and operations. In many cases, governments have funneled all the revenue from oil into other sectors, leaving little or no money for reinvestment in the oil industry.

In 1992, Venezuela derived 78.9 percent of its export earnings and 65.8 percent of government revenues from oil, which accounted for about 20.9 percent of its GDP. Yet little of this money was reinvested in Petroleos de Venezuela S.A. (PDVSA), the state oil company, which was nationalized in 1975. In the past few years, the government has realized that foreign investment in oil is the key to revitalizing PDVSA and combating low oil prices and a high foreign debt. While foreign investment had been allowed only for reviving marginal oil fields, in 1993, the Venezuelan government began to allow private capital into oil and gas exploration.[25]

PDVSA plans for $48.5 billion in investment between 1993 and 2002, nearly 20 percent of which will come from the private sector. The first joint venture with private partners, approved by the Venezuelan congress in August 1993, was the $5.6 billion Cristobal Colon Liquified Natural Gas (LNG) export project, in which three foreign partners, Shell Oil Company, Exxon Corporation and Mitsubishi Corporation, hold two-thirds equity. Two other joint venture projects, approved at the same time and totaling $4.8 billion, involve extraction and upgrading of heavy crude from the Orinoco oil belt by Conoco Inc. and a consortium led by Total. And in early 1996, PDVSA offered exploration and production rights in 10 different areas for bidding on the international market.[26]

Brazil needs an estimated $4-7 billion annually to meet its growing demand for oil and oil production, yet can provide only about $2 billion of its own money. Petrobras and the government have determined that foreign investment is the only way to maintain production and avoid a significant increase in import dependency.[27]

Ecuador is similarly dependent on oil revenues. The country's $1 billion oil industry represents about one-third of export earnings and public sector revenue, and foreign investment is desperately needed to help pay off a $12.6 billion foreign debt.[28] Ecuador needs an estimated $2 billion for exploration, development, transportation, and refining in the oil industry.[29] Seeking foreign investment, Ecuador opened its 1993 round of project bidding to international investment, awarding eight contracts, compared to 13 in all six previous rounds. In the eighth round, in the summer of 1995, Ecuador offered up for bid nine large tracts of the Oriente jungle for investors to acquire production-sharing contracts for exploration and development. Contractors are required to do a minimum amount of exploration and drill at least one wildcat well. In addition, they must connect their discoveries to the pipeline grid, and pay $100,000 per year during exploration to train Petroecuador employees and $500,000 per year for environmental mitigation.[30]

2.4 Exploration and Reserves

Table 2.1: Estimated Proven Reserves in Select Latin American Countries, January 1995

Country	Oil (1,000 bbl)	Gas (bcf)
Argentina	2,216,787	18,246
Bolivia	138,874	4,460
Brazil	3,797,000	4,852
Colombia	3,393,044	7,882
Ecuador	2,014,000	3,800
Guatemala	488,000	10
Peru	800,000	7,031
Venezuela	64,477,000	130,400

Source: International Petroleum Encyclopedia, 1995.

Increased exploration activity in the sedimentary basins of Latin America has yielded an abundance of oil discoveries, increasing the continent's overall reserves and raising hopes for future strikes. Of the approximately 63 known South American sedimentary basins, about 26 contain petroleum deposits, mostly in the sub-Andean basins. From 1914 to 1994, 135 billion barrels of oil and 258 billion cubic feet of gas were discovered in South America, and there are an estimated 75 billion barrels of oil remaining in already explored areas.[31] Past success and a few huge strikes in recent years have led state and international oil companies to step up their investigation of the vast unexplored regions of the continent.

About two-thirds of South America's known reserves are in Venezuela, which in 1995 had an estimated 64.5 billion barrels of oil and 130.4 trillion cubic feet of natural gas. Venezuela now has the largest proven reserves outside of the Middle East and the sixth largest in the world.[32] Further exploration could yield even more reserves. The El Furrial trend in the Maracaibo Basin has so far produced more than 35 million barrels of oil, and it is believed to contain at least 7-8 billion additional barrels.[33]

The biggest Latin American strike in recent years—indeed the largest discovery of oil in the Western Hemisphere in 20 years—was along the eastern foothills of the Andes in Colombia's Llanos Basin. By early 1996, this oil field, Cusiana, was already producing 185,000 barrels per day and, along with the neighboring Cupiagua field, was expected to turn out more than 500,000 barrels per day within the next several years.[34] Eventually, the two fields may yield 2-4 billion barrels of recoverable reserves.[35] Further exploration by Chevron just southwest of the Cusiana-Cupiagua complex is expected to yield another large find.[36] Until Cusiana was discovered, Colombia's largest oil deposit was the Cano Limon field, which contains about 1.1 billion barrels of reserve. The field produces 190,000 barrels per day, 36 percent of Colombia's daily
production and 15 percent of daily worldwide production for Occidental Petroleum, which operates the field.[37]

In addition to Cusiana and Cupiagua, the discovery of three more oil and gas fields in the same area could nearly triple Colombia's existing reserves. The Floreña and Pauto fields, whose discovery was announced by British Petroleum in July 1995, contain an estimated 750 million barrels of oil and 5 trillion cubic feet of gas. Floreña, Pauto, Cusiana, and Cupiagua, together with the Volcanera field, discovered by BP, Total and Triton Energy Corp., increase the estimated reserves in this region to 3 billion barrels of oil and 13 trillion cubic feet of gas.[38] In addition, a discovery by Ecopetrol at the Coporo field is expected to result in nearly 4 billion more barrels of oil reserves.[39] Approximately 60 percent of Colombia's sedimentary basins remain unexplored.[40]

The largest recent discovery in Peru is the Camisea oil and gas field, which could yield up to 11 trillion cft of gas and at least 750 million barrels of condensate.[41] In May 1996, Shell and Mobil signed a 40-year concession and service contract with the Peruvian government to drill new exploratory wells, construct a 600 MW gas-fired power plant and transmission lines, and build a 373-mile pipeline from the plant to Lima. The companies will invest nearly $3 billion in the project, including about $1 billion in the pipeline alone, while the government of Peru is expected to earn as much as $6 billion in royalties over the next 25 years.[42]

Guatemala, which is currently Central America's only oil producer, has opened its markets in recent years by eliminating restrictive legislation and bureaucratic rules for exploration contracts. The country has proven reserves

Table 2.2: Petroleum and Gas Production in Select Latin American Countries

Country	Estimated Oil Production 1994* (1,000 b/d)	Increase from 1993* (%)	Gas Production 1994** (bcf)
Argentina	656.6	11.6	512.8
Bolivia	25.6	16.9	97.6
Brazil	673.2	5.5	88.3
Colombia	456.0	0.2	143.2
Ecuador	376.8	10.8	3.0
Guatemala	7.5	8.7	n/a
Peru	130.3	3.2	38.3
Venezuela	2,463.3	5.5	691.8

Sources: *International Petroleum Encyclopedia, 1995; **Oil and Gas Journal Databook, 1995.

of about 351 million barrels and probable reserves of about 1.43 billion barrels, much of it located within the protected areas and national parks of the Petén region. The Petén, a rich tropical rain forest and wetland in northern Guatemala, is still largely unexplored, although the government has already designated exploration boundaries in much of the area. Guatemala will soon award several more blocks within the Petén subbasins through seismic option and production-sharing contracts. Current production in Guatemala is about 20,000 b/d, 80 percent of which is exported. The government hopes to eventually increase this production to 45,000 b/d.[43]

Both Argentina and Brazil are investing billions of dollars in tapping their unexplored resources. Of the 20 distinct sedimentary basins in Argentina, only five are producing oil, while the rest remain to be fully explored.[44] Proven reserves stood at 2.2 billion barrels in 1994, while projected discoveries in both active and unexplored basins are expected to yield another 5 billion barrels.[45] To increase reserves and production, YPF is planning to devote $3-3.5 billion to exploration and $10 billion to development in the next decade.[46] Petrobras, the Brazilian state oil company, has invested $2 billion in exploration and production in the Amazon region since exploration began in 1917. In the past decade, exploration for oil and natural gas has begun to focus on the 1.8 million square kilometers that have sedimentary potential in the Amazon region. Brazilian explorers are now placing a special emphasis on the deep-water area at the mouth of the Amazon, where they recently drilled the region's first horizontal well.[47]

The growing focus on the tropics as an untapped

The Phases of Oil Development

Exploration

Before any wells are drilled, oil development begins with a survey of the geology of a prospective site and the identification of potential reserves through aerial photography and geological maps. A company may also look at old seismic data conducted by other companies. By studying geological formations, including faults and anticlines, which could indicate a trapped hydrocarbon reserve, scientists are able to pinpoint where exploration activities should focus. More concentrated exploration is conducted through seismic surveys, using either the vibroseis or shot-hole method to locate reserves. With the vibroseis method, a team of trucks carries equipment that vibrates the ground for 20-30 seconds and then records and analyzes the returning sound waves depicting the underground geology. However, because the vibroseis method requires a network of roads, which are generally nonexistent in remote tropical areas, the extra expense and negative environmental impacts of building these roads often make vibroseis a poor option.

The shot-hole method also uses portable equipment to produce geologic indicators through ground vibration, but, unlike vibroseis, it does not require a road network. Here, the process involves the incremental detonation of underground explosives along a straight survey line. Like vibroseis, the waves produced by each explosion are reflected by the differing underlying strata, and the returning depictions of the underground geology are measured by a geophone.

A full-scale seismic operation in a rain forest can include as many as 400-600 workers. Each individual survey team includes about a dozen workers, who cut paths and mark locations for shot holes and geophones. Surveying lines are cleared along a straight path, often crossing rivers, valleys, hills, towns and archaeological sites. The operation may require hundreds of kilometers of trails cut to a width of one to three meters in dense rain forest. In addition, helipads must be cleared every one to three kilometers along the trails to provide landing pads for helicopters used to ferry in people and equipment.

Exploratory Drilling

If seismic studies identify favorable geologic structures, exploratory wells, known as wildcats, are drilled to confirm the findings. During this phase, a drill site must be cleared, and air, land, or water access routes are needed to transport heavy equipment to build, run and support facilities.

A traditional drill site is approximately one hectare in size. The entire site is cleared of trees and leveled to create an adequate base for the drilling rig; any removed topsoil may be set aside for replacement after drilling is completed. If the operation is supported by air, clearings will be made for helicopter pads, and if equipment is brought in by truck, a road is built. If there are no roads or infrastructure in the area, additional access routes, water supply lines, communication lines and power equipment may also be required outside the actual drill site.

A rotary drilling rig, typically about 40 meters high, is used to sink the well. The rig uses a drill string made of steel pipe and tipped with a source of oil, the world's continuing dependence on fossil fuels for energy, and newly industrializing nations' need for foreign income and investment all mean that rapidly expanding oil exploration and development in sensitive ecosystems is more or less inevitable. This activity has the potential to cause huge, irreversible damages, but proper planning and thorough implementation of environmental and social protection and mitigation can vastly reduce this impact. The following sections offer a discussion of the ways in which conventional methods of oil exploration can negatively impact both the natural environment and the lives of local peoples. In these sections, we survey new models, technologies, and management practices that oil producers are using or investigating to minimize their impact on the natural and cultural environment surrounding their operations.

drill bit that breaks through the ground to create the well. The equipment is housed in a steel support structure called a derrick, which sits on the drilling floor. Periodically, drilling must pause to allow extra lengths of pipe to be added, to replace the drill bit, or to reinforce the hole by cementing in steel casings. The drill bit must be constantly cooled by drilling mud, which also washes out rock fragments. A 1,500 meter borehole typically uses between 200,000 and 500,000 liters of drilling mud.

The base camp that houses the workers who run the drilling operations is a self-contained area. The camp includes living areas, canteen facilities, water wells, vehicle parking and maintenance, a helicopter pad, fuel storage and handling areas, and provisions for the collection, treatment, and disposal or incineration of effluent wastes and refuse.

Exploratory drilling usually lasts from one to three months. During this time, periodic tests are run to assess the potential productivity of the well. Geologists may test cuttings from the bottom of the hole or used drilling mud to see if they contain hydrocarbons. Other, more sophisticated tests use electric currents or sound waves to determine the attributes of a well. Finally, if a company wants to see a larger sample, it may take a core sample, cutting several meters of rock from the bottom of the hole.

If the well is considered to have commercial value then the workers will cement a steel casing down the entire length of the well and make several small holes, or perforations, in the sides to allow oil to seep in. To actually extract the oil, a second, smaller set of pipes called tubing is run through the well and attached to a flow and production control device on the surface. Tubing is used rather than the cemented casing because it is easier to replace if something goes wrong during operations. If the reservoir is "dry," meaning it does not contain commercial amounts of petroleum, then the well is plugged with cement and abandoned.

Development and Production

If a large reservoir is discovered, the initial exploratory well may not be enough to support profitable production. Consequently, the project will require additional production wells that can be drilled at new sites or directionally from the original borehole. Development wells are drilled in the same manner as exploratory wells but on a larger scale. When the flow of oil eventually begins to slow in a production well it may be increased through acidizing or fracturing. Acidizing involves pumping thousands of gallons of acid down the well. The acid is chemically treated so that it does not corrode the tubing of the well, but rather etches channels in the formation, allowing hydrocarbons to enter the well. In fracturing, a mixture of sand and chemicals is pumped into the well in order to increase pressure and fracture the formation. The sand remains in the new cracks, holding them open and allowing petroleum to pass into the well.

Before export, the oil is separated from gas and water at a gathering station that processes oil from several different wells. The oil must be transported from the field to the gathering station by road, pipeline, water or rail. Although small oil fields are generally serviced by a small network of roads, for larger fields, a network of pipelines is often considered a more efficient choice.

Adapted from: International Union for Conservation of Nature and Natural Resources (IUCN), *Oil Exploration in the Tropics: Guidelines for Environmental Protection* (Gland, Switzerland: IUCN Environmental Impact Assessment Services, 1991), 3-5; Ron Baker, *A Primer of Oilwell Drilling* (Austin, TX: Petroleum Extension Service: Division of Continuing Education, University of Texas at Austin, 1994), 123-152; and The Exploration & Production Forum (E&P), *Oil Industry Operating Guideline for Tropical Rainforests* (London: The E&P Forum,

3. ENVIRONMENTAL IMPACTS AND BEST PRACTICES

Large oil and gas concessions have opened up important tropical wilderness areas to development, leaving permanent environmental damage and threatening the biological diversity of these complex ecosystems. The diversity of genes and species found in the tropics have value far beyond their stores of minerals and fossil fuels. A large percentage of all manufactured pharmaceuticals are derived from plants and animals, many of which are found only in tropical rain forests. In addition, a significant portion of the world's food supply depends on only a few staple crops that require regular genetic input from wild relatives to maintain resistance to pests and diseases. Ensuring the health of these ecosystems is also vital for maintaining and regulating climate stability, soil protection, flood control, water purification, carbon sequestration and air pollutant absorption.

In addition to this irreplaceable biological diversity, rain forest ecosystems have extremely delicate, highly permeable topsoil that is particularly vulnerable to erosion and groundwater contamination; shallow root systems that are easily disturbed by human activity; endangered and unknown species; important canopy habitats; and, frequently, indigenous people.[48] While exploration and production in the tropics have opened up new markets and provided new sources of fuel and income for developing nations, they have also led to serious environmental and social costs.

Until recently, most oil operations in the tropics depended on technology and development approaches that had been tried and tested in very different ecological surroundings. However, while effective elsewhere, much of this model for oil development has proven ill-suited to the fragile environment of tropical rain forests. Because of a lack of understanding about the best way to operate in a rain forest, and an undervaluing of the rain forest environment itself, conventional petroleum operations in the tropics have frequently been marred by poor environmental planning, assessment, and management, leading to large-scale environmental and social disasters and lengthy and expensive remediation. These problems can lead to increased economic costs, social conflict and international censure. To avoid repeating the same mistakes, the oil industry must adopt a new paradigm for oil development in the tropics, including in the planning process a whole new set of ecological and social parameters.

In many cases, the technology to minimize the impacts of oil exploration and development operations exists or is in development. Frequently, it is just a matter of applying old models to new places (for instance, using the off-shore model on land) and rethinking traditional operating procedures. The following section will provide a summary of
the potential direct and indirect environmental impacts of a tropical oil operation and an overview of existing and experimental technologies and management practices that can help minimize these impacts. Several of these technologies are being implemented, developed, or studied by oil companies today. An overall guideline is that the most advanced and efficient technology should be used unless the operating company can convincingly demonstrate to the government why a technology or practice would not work for technical, geographical or geological reasons.

3.1 Environmental Roles and Responsibilities

Most of the recommendations and practices presented in this section are technologies that should be implemented by the operating company. However, in addition to corporations, both governments and local people also have roles and responsibilities in ensuring that the best technologies and management practices are used to minimize the environmental impact of oil exploration and production in their countries and communities.

3.1.1 The Role of Industry

It is extremely important for an oil company operating in the rain forest—or any other sensitive environment—to recognize and acknowledge its responsibility for understanding and addressing the potential environmental impacts of its operations. This includes accepting responsibility for the actions of all contractors and employees representing the company. In some cases companies are already integrating this philosophy into their operating procedures, while in other cases accepting this responsibility may require a complete rethinking of development strategies. To fully address this role, a company should ensure that the person or group of people ultimately responsible for all environmental assessment and mitigation is integrated into the project from the very beginning. This person or group should work closely with local people and authorities to develop the best possible environmental management strategy.

3.1.2 The Role of Governments

A single government office or agency should be responsible for overseeing and approving a company's environmental management strategy. This office should be located within the environment ministry or agency, rather than in the government department responsible for energy and mines. The government should require companies to use the best environmental technologies and practices and, with the help of local and international experts, define what these practices are. After the standards are set, the government should ensure that companies comply with these standards through oversight of activities, approval of management plans and enforcement of requirements. These issues are discussed further in Section 5.

3.1.3 The Role of Local People

Indigenous and local people should exercise their capacity to influence governments and corporations by ensuring that they are educated about the latest environmental technologies and standards to minimize environmental damage. This can be done by consulting with informed indigenous federations or other NGOs. Local communities should also work with each other, when feasible, to develop a single strategy and present a united voice to corporate and government representatives and to ensure that they are consulted and involved in all stages of planning and project design. These issues are discussed further in Section 4.

3.2 Environmental Impact Assessments

The first step for a company planning an oil operation is to complete a thorough environmental impact assessment (EIA). An EIA describes a process for closely studying the potential environmental impacts of a proposed activity before deciding whether to proceed. The EIA process includes external review, monitoring, and follow-up and should not be confused with the written environmental impact statement (EIS), which is just one product of an EIA.[49] In many countries, the national government completes this assessment. However, where this is not sufficient, due to a lack of institutional capacity, for instance, the contractor or operating company should complete its own EIA, subject to review by relevant government agencies.

The United Nations Environment Programme's (UNEP) Principles of Environmental Impact Assessment require that all EIAs should include at least: a description of the proposed activity; a description of the environment that may be affected; a description of practical alternatives; an assessment of likely and potential environmental impacts, both direct and indirect and short-term and long-term; a description and assessment of possible mitigation measures; a discussion of any uncertainties or missing information which may impact the assessment; a discussion of whether other states or countries may be affected by the activity; and a brief non-technical summary of the above.[50]

EIAs should be completed and approved by the relevant authorities before any decisions or plans are made about whether and how to proceed on a concession site. A thorough social assessment should also be conducted at this time. (See Section 4.2) Early evaluation helps to determine how and where mitigation efforts should be directed to prevent and control impacts. In some cases, it may be discovered that the potential environmental impacts and mitigation costs would make the block uneconomic to the oil company. As one company found at an operation in West Africa, "implementing proper environmental controls becomes increasingly difficult and costly to introduce as venture planning advances."[51]

An EIA process should allow sufficient time for data collection, analysis, comment and review. The first part of the assessment process is a "scoping period," involving 5-10 representatives of companies, agencies and citizens groups over a period of one or more days. This group will determine the parameters of the assessment, decide who will direct the program, and delineate a time frame for public consultation and disclosure of assessment documents.[52]

Before any exploration activity begins, a company must have an idea of the cultural and environmental issues involved in an area. A profile of the region that summarizes local history and geography, the political situation and government regulations, local communities, and ecosystem composition can offer the necessary background.[53] Assessment teams should collect baseline data on the biological features of the ecosystem, including forest composition, species populations, soil, water, geology, morphology, flora, fauna and rare or endangered species. Baseline studies should be conducted over a 12-month period to account for seasonal variations.

The main part of the EIA process is the identification of alternatives that may achieve better environmental protection while meeting the same project objectives. This should include best available technologies in siting, design, technology selection, construction techniques, and operating and maintenance procedures. If oil activity is

Box 3.1: Environmental Impacts of Oil Exploration in Ecuador

Oil development in Ecuador began in 1967, with a well drilled by a Texaco-Gulf consortium. Five years later, in 1972, Texaco and the Ecuadorian government signed a contract that gave Texaco the right to explore 400,000 ha. The company's full operation in Ecuador would eventually include 15 fields, 22 stations and 339 wells. Today, there are more than a dozen private enterprises operating along with Petroecuador, including Amoco-Mobil, ARCO, City, City-Ramrod, Elf, Maxus, Occidental, Oryx, Santa Fe, Tripetrol, and Triton.[1]

An independent consulting team, hired in September 1995 by the Congress of Ecuador to do an environmental assessment of four oil fields, estimated that it would cost about $630 million to clean up the environmental damage from oil operations in the Oriente, Ecuador's Amazon region. These costs, not accounting for social mitigation or compensation, included $600 million to reinject production water, $15 million to clean up overflowing oil pits via removal of oil, bioremediation, landfilling and reseeding, and $15 million for additional clean-up needs.[2]

In one 200,000 ha block in the Oriente, during the earlier days of exploration, seismic surveyors cut a grid of 36 three-meter-wide trails, spaced at one kilometer intervals, plus 1,368 half-hectare helipads. Total land clearing for the operation was more than 1,000 ha, and the area affected indirectly was vastly larger. Among the impacts of this land-clearing were fragmented habitats, increased erosion, disrupted hydrological patterns and facilitated migration by settlers into the forest.[3]

It has been estimated that, between 1972 and 1989, 19 billion gallons of toxic wastes were spilled into the Ecuadorian environment, approximately 4.4 million gallons per day. About 2,100-2,400 gallons of crude oil were discharged with production water every day. The temperature and salinity of water in the area was directly affected by the discharge into rivers of 4 million barrels of untreated drilling mud and 40 million barrels of toxic chemicals. Water temperatures in the area averaged 130 degrees Fahrenheit, while salinity ranged from 70,000 to 200,000 parts per million (ppm) of salt. By comparison, sea water has 35,000 ppm and freshwater in Amazon rivers averages about 7 ppm.[4]

Oil and water separation stations in the Oriente generate more than 3.2 million gallons of liquid waste each day, most of which has been discharged untreated into the environment. According to the Ecuadorian government, these stations have discharged about 20 billion gallons of production water since 1972. The separation stations also burn about 40 million cubic feet of excess gas every day, even though Ecuador is a net importer of natural gas.[5]

In addition to daily discharge, accidental spills have also caused significant environmental damage. According to the Ecuadorian government, the main Trans-Ecuadorian pipeline has spilled about 17 million gallons of oil into the environment since it became operational, leading to ruined crops, dead animals, and human health impacts.[6]

Open waste pits are another significant problem in the Oriente. Unlined pits cause liquid wastes to seep into the soils and contaminate groundwater, or overflow during heavy rains. Waste pits also pose an obvious threat to wildlife and domestic animals, which may fall into the pits and drown.[7]

The indirect effects of oil roads in Ecuador provide an example of the serious environmental disruption that can result from increased access to an undeveloped area. A 1990 report estimated that more than 500 km of oil roads led to the colonization of about 1 million ha in the Oriente. During eight years of oil development in the northern Oriente, colonization along oil roads led to a significant population increase from 74,000 to 260,000, a growth rate double that of the rest of the country.[8] In another part of the Oriente, oil roads have led to a 90 percent increase in the deforestation rate and opened up 2.5 million acres of previously untouched homelands of eight indigenous tribes. About 300,000 poor peasants from the Andean region have colonized the area, clearing and burning land to raise crops and cattle on rain forest soil ill-suited to agriculture.[9] And in the 254,760 ha Cuyabeno Wildlife Reserve, which was established in 1979, an oil road built by Petroecuador attracted 1,000 colonist families, who now impact about 25-40 percent of the park's area.[10]

1. Paulina Garzon, "Oil Development in the Western Amazon," Presentation to a meeting of the Amazon Coalition, 16-20 November 1995 at Lago Agrio, Ecuador.

2. Charles B. Koons, *Environmental Assessment of the Oriente District of Ecuador,* Prepared for the Congress of Ecuador, Houston, TX, 1-4.

3. Judith Kimerling, *Petroleum Development in Amazonian Ecuador: Environmental and Sociocultural Impacts* (Washington D.C., Natural Resources Defense Council, October 1989), 11-12.

4. *Amazonia Por La Vida: Debate ecologico sobre el problema petroleo en el Ecuador* (Quito, Ecuador, Acción Ecologica, 1993), 12.

5. Ibid., 23.

6. Kimerling, *Petroleum Development in Amazonian Ecuador,* 23-27.

7. Koons, *Environmental Assessment of the Oriente District of Ecuador,* 5.

8. Chris Jochnick, "Amazon Oil Offensive," *Multinational Monitor,* January/February 1995, 12.

9. Jack Epstein, "Ecuadorians Wage Legal Battle Against US Oil Company," *The Christian Science Monitor,* 12 September 1995, 10.

10. George Ledec, *Minimizing Environmental Problems from Petroleum Development in Tropical*

already taking place in a recently designated protected area, local officials should be heavily involved in the assessment activity, and the company should participate in developing an operative plan addressing the overall management needs of the entire protected area.

During completion of the EIA, it is vital to establish a consultation process with all relevant stakeholders, including local and provincial government agencies, affected communities, and local and international NGOs. These stakeholders should be involved in data collection and alternative identification, and should be given a chance to review and comment on any documents that result from the process. EIAs should also be subject to an outside, independent review. The UNEP principles advise against making any decisions about project activity until there has been sufficient time to receive and consider comments.[54]

After the EIA is completed, the company should create an environmental management plan (EMP) that includes detailed information about the operations practices that will be used to minimize and prevent environmental impacts, based on the results of the EIA. The EMP should incorporate the best alternatives that were identified in the EIA, or convincingly demonstrate why they would not be feasible.

3.3 Environmental Monitoring and Evaluation

Even the most thorough environmental impact assessments and management plans will not necessarily provide adequate protection against unforeseen impacts of activities in a sensitive environment or interactions between oil workers and indigenous people. An effective monitoring program will monitor not only direct operations, but also the associated impacts to the surrounding ecosystems and social structures. Monitoring should be seen as a tool to measure the success of environmental and social programs and to prevent mistakes by gathering baseline information about ecosystems and communities and measuring changes over time.[55]

Ecological and social monitoring and evaluation programs should be designed and implemented before any exploration activities begin. In general, these programs should have four specific goals: 1) evaluating all social and environmental programs; 2) testing whether these programs are having an overall positive effect on conserving critical habitats and protecting indigenous people; 3) providing feedback to guide further management policies and practices; and 4) integrating and maintaining information about the project site.

The monitoring and evaluation program should be conducted by an interdisciplinary team of scientists, guided by a company-appointed coordinator. With the aid and participation of the company, local communities and government, the team should establish a database to provide the protocol for collecting, storing and using data. This database should be compatible with the project's data management systems. Generally, information is collected in collaboration with local residents, based on biological sustainability, field experiences, available literature, and consultation with other specialists.

Biodiversity monitoring tracks both natural changes in ecological composition over time and changes in ecosystems that result from project activities.[56] The most common format for an ecological monitoring program involves the selection of ecological indicators, based on criteria that fit the monitoring objectives and the technical and logistical constraints of each phase of the operation. Indicator species or factors are often described as ecological "litmus-paper." Indicators behave as detectors or signals of their environment, and by observing them, it is possible to determine whether there have been changes and the intensity of those changes.[57] The program should have a clear time-line with indicators chosen for each phase of the operation.

A set of indicators will include specific animal and plant species as well as broader indicators such as forest cover or water quality. Determining which species to choose as indicators may be difficult, as a species or factor may not always accurately reflect the complexity of the local ecosystem and habitats. In other cases, the presence or absence of a single species or population of species can be used to accurately assess overall environmental quality.[58] Birds are often one of the best indicators for biodiversity, because they reflect the overall diversity of plant species, and hence other animal life, in specific ecosystems. Ultimately, selecting indicators or a monitoring approach depends upon the objectives of the monitoring exercise. An indicator should reflect changes in habitats or ecosystems and should be selected according to its degree of sensitivity to these changes.

Any ecological monitoring strategy should ask the following questions: Is the basic objective of biodiversity conservation being achieved? Are local successes also regional successes? Are the indicators responding to the overarching objective? Are the indicators reflecting the long-term results of conservation efforts?

A monitoring program should begin well before seismic exploration starts, with activities such as landscape macroviewing using GIS and overflights, commercial species mapping, and collection of broad baseline data for all indicators. The pre-seismic phase represents a critical and valuable opportunity to gather data on the ground and to access information before any human disturbance to the area. Once the seismic survey begins, monitoring teams should collect baseline information on forest composition and populations of indicator species. After seismic surveying has been completed, the team should gather data by repeated line transects to determine changes in forest cover and understory, and levels of regeneration and succession. Samples of all taxa, including other ecological indicators such as water quality, should be taken repeatedly at regular intervals. During the post-seismic phase, samples should be taken more frequently in the areas surrounding base camps. Monitoring should continue throughout each phase of the operation.

3.4 Environmental Impacts of Seismic Exploration

An oil operation can have profound impacts on the surrounding environment even if it never results in promising reservoirs or leads to any drilling activity. In the initial stages of exploration, noise from surveying aircraft, helicopters and seismic explosions may cause animals to flee the area, in some cases, making it more difficult for local people to find food. While the shot-hole method is preferable to vibroseis because it eliminates the need for roads, cutting seismic lines is still required and may lead to erosion and subsequent water contamination or sedimentation of streams.[59] Seismic lines may also fragment habitats or cross migration routes, interfere with mating patterns, corner larger animals and form an impassable barrier to smaller animals.[60] Finally, a seismic grid can disrupt watershed drainage, leading to a change in hydrology and an increased risk of flooding.

A seismic survey of a remote area involves the management and support of hundreds of workers living in a base camp that may only be used for a few months. Local communities may benefit from improved water, sanitary systems or other amenities provided to the workers stationed in or near a village, but the presence of oil workers may also have a strong impact on their surrounding environment.[61] Workers with shotguns may hunt and collect protected animals for food and extra income, depleting the biodiversity of the area. Improper disposal of wastes from the base camp can lead to contamination of local water and food supplies and environmental degradation.

3.4.1 Best Practices: Seismic Exploration

Although petroleum exploration has had significant environmental impacts in the past, techniques and practices have been developed to greatly minimize the damage associated with seismic operations. The International Association of Geophysical Contractors (IAGC) recommends focusing on seven different issues before beginning a seismic survey: time of year, regulations, scouting, cultural issues, wildlife, emergency response and operations. (See Box 3.2)

Once these issues are addressed in an environmental management strategy, the company should proceed with seismic activity, making sure to minimize impact. Seismic grid lines should be cleared by hand with machetes and hooks, to a width of no more than 1.5 meters. Surveyors should minimize the amount of vegetation cut, leaving small, low vegetation, root stocks and topsoil in place and reseeding when necessary. Trees wider than 20 cm in diameter should never be cut, but rather walked around. When trees are cut, workers should ensure that they fall in the right direction, away from streams or larger trees, to minimize ancillary damage. After a tree is felled, workers should scatter branches and make sure the tree trunk is laying flat on the ground to speed up decay.[62]

When digging shot-holes, surveyors should be certain the charge is deep enough and the hole small enough to prevent extensive destruction to the surrounding area. Workers should ensure that no unfired charges are left in the field, backfill the holes with cuttings when they are finished, and determine that wet holes are not contaminating groundwater.[63]

To reduce the potential for disturbance of wildlife during seismic operations, a company should evaluate the state of wildlife in the area before operations begin. Workers should be forbidden to hunt or fish, and advised to

Box 3.2: Issues to Consider Before Planning a Seismic Operation

1. *Time of year:* weather, rainy season, migration and breeding patterns, hunting season.

2. *Regulations:* existing requirements, relevant regulatory agencies, required reporting, permit applications.

3. *Scouting:* already completed surveys, available workers, existing trails, water supply depths, information that can be obtained through overflights or existing maps.

4. *Cultural issues:* local and indigenous populations, culturally important sites.

5. *Wildlife:* local species, migration paths, endangered or protected species, special reporting procedures.

6. *Emergency response:* contingency response plans, hazardous materials storage.

7. *Operations:* logistics, monitoring, training, waste disposal, energy supply, reclamation.

Source: International Association of Geophysical Contractors, *Environmental Guidelines for Worldwide Geophysical Operation* (Houston, TX, IAGC, August 1992), 5-7.

avoid contact with animals whenever possible. They should
also stay away from traditional native hunting and fishing grounds, and pets should be prohibited at the camp.[64] All food and equipment should be brought in via helicopters, so seismic crews do not need to use local resources.

Technological advances in seismic exploration may help to reduce both the environmental impacts and economic costs of a surveying operation. The traditional form of seismic exploration used for exploring broad concession areas is called 2D seismic surveying. 2D seismic uses sound waves to produce two-dimensional line recordings of three-dimensional wavelengths. Geologists must then interpret this data to determine where potential reservoirs may lie. Because this technology is inexact, there is always the risk that an exploratory well will miss a reservoir and come up dry.[65]

Accuracy in exploring smaller, promising areas of a concession can be improved by utilizing 3D seismic technology. This methodology uses a high-speed computer to produce three-dimensional images of a geological structure. 3D surveys have the advantage of improving resolution and detail on seismic images, thus reducing the probability that a well may be dry. 3D seismic also allows companies to find and exploit reservoirs in new and existing oil fields that might have been missed with 2D surveys, potentially raising the success rate for exploratory drilling from 20 percent to as much as 80 percent. Since a "dry hole" may cost $750,000 or more, this increased accuracy translates into important savings for the oil company. Fewer dry holes also means that fewer exploration wells will have to be drilled, thus reducing the amount of land-clearing and environmental disruption that accompanies exploration operations.[66]

Although experimental 3D seismic surveys began in the late 1950s, the method did not become economically feasible until the 1980s, when technology had become sufficiently advanced. Even then, most 3D surveying took place offshore. In recent years, however, land-based 3D seismic has become affordable for even small companies, and it has become evident that any additional up-front costs of 3D seismic on land yield far more valuable benefits.[67]

An even newer technology, 4D seismic surveying, may increase accuracy and economic and environmental benefits even more. 4D seismic adds the element of time to

Box 3.3: Using Helicopters for Exploration: Chevron in Papua New Guinea

Chevron Niugini, a subsidiary of Chevron Overseas Petroleum, Inc., is operating the Kutubu Joint Venture oil extraction project in the Kikori River basin of the Gulf and Southern Highlands Provinces of Papua New Guinea. As of June 1994, the project had produced more than 85 million barrels of oil, and it is expected to produce another 140 million before operations end.

The dearth of roads, commercial airfields and other available infrastructure in such a remote area meant that Chevron had to find another way to transport personnel and equipment during exploratory phases, in order to avoid the costs of building permanent access roads. The company decided on air transport and successfully used helicopters to minimize costs and environmental impact during exploration. Chevron Niugini was able to reduce exploration costs from $1,360 to $267 per foot ($4462 to $876 per meter) between 1985 and 1989.

Chevron's heli-lift operation involved two types of aircraft: the American Boeing Vertol 107 helicopter and the Russian Aerospatiale Puma SA330J helicopter. The Vertol, which is able to carry up to 11,000 lbs at sea level, averaged about 6,500-7,000 lbs per load at the drill site, which is 3,600-5,050 ft above sea level in the highlands. The Puma is able to carry 6,500 lbs at sea level and about 5,000 lbs at the operations site. While the helicopters usually used a 100 ft (30 m) lead line to carry equipment, the Vertol is capable of using a 200 ft line if necessary. Using three Vertols and two Pumas, the average cost to ferry equipment was about 12-20 cents/lb/m.

The rigs that Chevron used in Papua New Guinea are called "transportable by anything," or TBA. These rigs can break down into individual 4,000 lb (1818 kg) loads. Transporting the rigs out to the drill sites required anywhere from 200 to 325 loads over distances of one to 40 miles for a period of seven to 27 days. Before drilling could begin, a total of about 300-425 loads was needed to bring in all the equipment and personnel for each rig. Because they need to be easily disassembled and transportable, helicopter rigs tend to be smaller than conventional rigs, meaning a smaller footprint on the ground and lower assembly, equipment and operations costs. The TBA rigs used at Kutubu weigh about half that of a conventional rig and can be assembled and disassembled with ease. Between 1983 and 1989, Chevron was able to reduce drilling costs fivefold using these rigs.

Source: E.R. Wagner, and M.S. Juneau, "Helicopter-Supported Drilling Operation in Papua New Guinea," (Richardson, TX, SPE/IADC Drilling Conference, 1991), SPE/IADC 21926.

a 3D survey, using models done at the beginning of production and periodically during production. This method allows companies to understand how the oil is flowing, and to predict and identify drainage patterns and geologic processes that may improve the yield of reservoirs over time. 4D technology may enable companies to increase their return from a single field by as much as 30 percent over the use of 3D alone.[68]

Several variations on traditional seismic methods have been developed to minimize the impact of 2D, 3D or 4D surveying on sensitive ecosystems such as tropical forests. The Poulter Method of seismic surveying uses explosive-filled pouches placed on stakes and detonated above ground. Because there are no holes dug, this method produces little direct environmental impact.[69]

Amoco has patented a new recording system technology for doing seismic work in swamps and standing water. Originally developed for use in the wetlands of Louisiana, the Single Group Recorder (SGR) can be used in any sensitive ecosystem where it is necessary to minimize ground impact. The SGR is a light-weight, portable, radio-controlled computer that is used to record and store seismic data along a seismic line. The information is then downloaded to a main computer after a full day of data gathering. The equipment is controlled by a main control unit that can be placed several kilometers from the seismic line, minimizing the need for land-clearing and vehicle use.[70]

A system like the SGR should be used in any sensitive area to reduce land-clearing. The system can be helicopter-deployed in a rain forest, eliminating the need to lay seismic cables. Surveyors simply walk along the trail with a transmitter pole and receiver. The elimination of cables avoids the introduction of extra noise into the recording, minimizes disturbance to wildlife and allows a crew to reshoot only the problem area if a certain part of the line is not recorded properly.[71]

One way to reduce environmental disturbance from seismic operations through policy reform is for governments to require that seismic data become public information. A single concession area may change hands many times over the course of several decades, with each company that buys or acquires the lease running its own seismic survey and coming to its own conclusions about whether an area should be developed or not. Allowing public access to the survey results will significantly reduce the need to repeat seismic surveys. While it is likely that a company may only want to turn over this information after it has decided not to explore in a certain area, making seismic data public sooner would help other companies that may be surveying adjacent tracts of land.[72]

3.4.2 Best Practices: Helicopters

The expense and environmental impact of seismic operations can be greatly reduced by using helicopters as a means to ferry people and equipment into exploration sites, rather than building roads. Although helicopters have so far only been used for seismic surveying and exploratory drilling operations, they may also be used for some transportation during actual production stages.

Helicopters can reduce operating costs by eliminating the need to build a long road to reach a remote drill site. Although helicopters are expensive to maintain, the lack of materials available for road-building, the expense of constructing a road through undeveloped terrain, and the additional road mitigation and access control costs outweigh the transportation cost differences. In addition to being fairly remote, rain forest sites may also have very unstable ground, making roads expensive to maintain.

A helicopter-supported operation requires the clearing of helicopter landing pads, or helipads, which average about one-half hectare in size. These helipads should be placed as far apart as possible, and when feasible, they should be placed in existing clearings or areas of secondary growth, away from critical habitats and breeding areas.[73] Local materials should be used to build the helipads. One company used the logs that had been cut to clear the landing site, eliminating the need to bring in outside materials.[74] To further minimize the potential disturbance to wildlife and trees, helicopters should be outfitted with long lead lines for carrying and dropping cargo, allowing them to fly further above the forest canopy.[75]

When helicopters are used to transport drilling rigs to exploratory drilling sites, the rigs and pumps tend to be smaller and lighter, and thus easier to break down and fly in. These rigs have the advantage of using less equipment, materials and personnel, lowering drilling costs in the field. Using helicopters and lighter rigs can reduce total drilling costs as much as 80 percent. (See Box 3.4) Smaller rigs also have environmental benefits, illustrated in the following section. A drawback to smaller, lighter rigs and pumps, however, is a limitation on performance because of lower horsepower. As wells get deeper, it is necessary to use larger, more powerful rigs. For every 1,000 feet of drilling distance, a rig needs about 100-150 horsepower.[76]

3.4.3 Best Practices: Personnel

The most advanced technology and the strictest environmental regulations will mean nothing if workers and contractors are not educated about the impacts of their activities, trained in the use of new methods and technologies and monitored to ensure proper implementation. Among the most important requirements for effective environmental management and implementation are input by environmental experts during the earliest design stages, communication between a company and its contractors about goals and regulations, regular monitoring visits, and a management team that believes in and will enforce the rules and regulations.[77]

In a traditional oil operation, there are few, if any, people who are involved in the process from start to finish. Generally, designers and planners are involved in the beginning, followed by geologists and other exploration specialists, who then hand the operation over to engineers and development experts. When the operation is done, remediation experts may be called in to help with reclamation. In this traditional model, environmental experts are not involved until the operations and development stage of the project. The discontinuity of this system can result in inconsistent implementation and management practices. To minimize the environmental impact of a project, it is important to integrate environmental experts into project management from the earliest stages of planning and design through to the end of remediation. For instance, to handle environmental issues at their new concession site in Ecuador, Amoco hired a full-time environmental manager based in Quito to ensure that environmental issues were dealt with properly and to understand the Ecuadorian legislation and regulations.[78]

To minimize the impact of worker activity, there should be strict rules and regulations enforced in the camp. Pathways and travel routes should be clearly marked and enforced to protect sensitive areas, curbing the natural tendency of people to walk the shortest route between two points. Managers should control hunting and poaching by ensuring that workers have plenty of food, especially meat, and enacting regulations against the sale and transport of animal products.[79]

Environmental impact as well as the risk of migration or establishment of new villages can be minimized by following an off-shore model for handling personnel. Workers should follow shift rotation, for example, two weeks at the site and two weeks off, and should be ferried to the base camp by helicopters from the towns and cities in which they live. All activities should be strictly confined to the base camp area and families should be prohibited from living at the base camp. In addition to minimizing impact, this rotation schedule may increase worker productivity and efficiency.

Upon arrival, workers should be educated on important environmental issues and trained in all company guidelines and regulations. All workers should be required to sign contracts that allow for penalties or dismissal if any of these rules are broken. It is also important to maintain management involvement and delineate the responsibilities of everyone at every level of the organization. These responsibilities should be regularly evaluated and procedures and policies revised as needed.[80]

Much of the early work on an oil project, including seismic exploration, may be done by a contractor external to the oil company. Environmental guidelines should be strictly detailed in the contracts with construction crews and seismic surveyors. These requirements should be reviewed with workers and their importance stressed. Before making any hiring decisions, the company should conduct a pre-award evaluation to determine a contractor's health, environment and safety record, and a company representative should be stationed at the site to ensure that the contractor is following the regulations.[81]

To control worker activities at its exploration site in Ecuador in the 1980s, ARCO prohibited hunting and fishing by personnel, trained workers in environmental regulations and issues, and disallowed personnel from wandering off the drill site. Throughout the operation, the company provided for continuous assessment of activities and consultation with local people and experts.[82]

Shell Gabon, a subsidiary of the Royal Dutch/Shell Group, implemented strict rules governing workers at its operations in Central Gabon, on the west coast of Africa. Managers found that "[t]raditions change slowly," in the oil industry and that the firm commitment of supervisors to enforcing new methods of working was vital to success. To prevent hunting and poaching, workers were not allowed to have firearms or transport live animals and game meat. Employees were trained and educated on environmental issues, and each worker had to sign a contract saying that if he was caught hunting, he would be fired. All environmental regulations were also clearly written into contracts with the organizations that conducted seismic surveys.[83]

During their operations in Sumatra, Indonesia, Lasmo Oil (Malacca Strait) Ltd. found that effectively managing an environmental strategy required a management system tailored to the specific environmental, cultural, and institutional factors and capacity. In Sumatra, one of the most important aspects of this strategy was a high level of commitment and participation from senior management, along with clear but flexible organization, proper implementation, and built-in monitoring and evaluation.[84]

3.5 Environmental Impacts of Land-Clearing

By far, the most extensive direct ecological impacts of traditional oil operations result from land-clearing for base camps, helipads, roads, pipelines, waste disposal and other facilities. The removal of vegetation and topsoil leaves the remaining land and soil vulnerable to erosion, especially during the rainy season, when roads may be washed out or rendered impassable. Erosion particularly threatens operations and environments in steep and mountainous areas. Removal of the forest canopy during extensive land-clearing exposes delicate rain forest soils to increased sunlight, leading to desiccation of topsoil and higher ground temperatures that alter the essential biological composition of the soil.

As in seismic work, critical habitats may be affected by land-clearing, and disruption of watersheds and changes in hydrology can also increase the risk of flooding, particularly in lowland areas. Archaeological and cultural sites are also at risk of being destroyed during the process, and damage may be exacerbated if sites are not assessed or local people are not consulted prior to development activities. Finally, the opening of access into the rain forest may lead to severe indirect impacts, including colonization and deforestation, which are discussed further in Section 3.6.

3.5.1 Best Practices: Land-Clearing

To prevent soil erosion and sedimentation of waterways during operations, it is important to minimize vegetation clearing, stream crossings, fire risks and other activity in sensitive areas. Bulldozer use should be minimized or avoided, but when necessary, operators should stay away from water and steep slopes, keeping the bulldozer blade at least 10 cm above the ground at all times to minimize topsoil disturbance.[85] Erosion will also be reduced if major civil engineering activities are conducted during the dry season.

Vehicle, boat, air and foot traffic should be kept to a minimum, and equipment maintenance should not be done in the field, to avoid pollution risks from fuel spills. Workers traveling in vehicles should be instructed to remain on existing routes at all times, avoiding short-cuts through uncleared land. Vehicle speed should be strictly limited and wildlife and aquatic nesting areas avoided. When traveling through water, workers should move slowly and at all times avoid refueling vehicles in water. Pilots should maintain a suitable altitude in the air and keep an appropriate distance from wildlife and nesting birds.[86]

In order to avoid permanent sedimentation or disruption of habitat, streams should be forded only when necessary, in appropriate places and at a right angle to the stream. When it becomes necessary to cross a stream, workers should avoid disturbing stream bank vegetation, which shades the water, and remove any temporary bridges or other structures as soon as they are finished.

Workers should be sure to minimize impacts during construction of facilities as well. Before construction begins, the area to be bulldozed and trees to be felled should be marked. Tractor activity must be restricted to that area only, and no brush, trees or dirt should be pushed outside the designated area. Any trees that might fall away from the marked area should be pulled back with a cable. A base camp, including a helicopter landing pad, can be about 2,000 square meters. When constructing the base camp, workers should take care to minimize leakage from sumps, ensure proper storage of fuel and proper waste separation and disposal, avoid leveling of ground by using jacks for trailers, and control fires. Building an airport or other facilities at higher elevations reduces the number of trees that need to be cleared for sight lines.[87]

When clearing land, all trees surrounding cleared areas should be left alive and healthy as sources of seeds and organic materials. All large trees, which provide shade for the camp, as well as trees that local people recommend preserving, should be left standing. Branches from live trees bordering clearings, roads and construction sites should also be left to provide shade and help future regrowth.[88] Felling trees from level areas, rather than steeper slopes, reduces the potential for erosion and damage to other trees. Boards should be cut with conventional hand-held chainsaws. Chainsaw operators should be paid by boards cut per day to show that felled trees are used as fully as possible. The use of upper sections of trees should be supervised and enforced. Transportation of boards from the forest should be done by helicopter or hand, and never by bulldozer.

3.6 Environmental Impacts of Roads

Expansion of a petroleum operation from exploration to drilling and production may require the construction of a new network of roads for access and transportation of equipment, personnel and oil. The direct environmental impacts of roads are similar to those involved in land-clearing. However, the principal environmental threat of road-building comes from the fact that roads provide corridors of access to colonists into undeveloped areas. The indirect impacts of newly increased access include spontaneous colonization along oil roads and the accompanying deforestation and habitat conversion as colonists move into previously unsettled areas. Colonists may burn the forests on both sides of the road to create homesteads and raise cattle and crops. It has been estimated that for every 1 km of new road built through a forested area, roughly 400-2,400 ha are deforested and colonized.[89]

At many tropical oil production sites, the most devastating environmental impacts have resulted from this extensive deforestation and settlement changes along roads built to service the facilities, rather than from the actual extraction process. Oil roads are used primarily for building and servicing base camps, well sites, pipelines and transformation areas. With conventional technology and practices, roads are generally considered essential for transporting heavy equipment to and from the concession site, and, along with rivers and streams, offer the means for shipping materials, pipelines, supplies and people into the site during operations and for pipeline maintenance after production ends.

In addition, miners, hunters and small-scale loggers may also move into the area. Roads open wider markets for timber and non-timber forest products such as animal goods and plants that before may have had only local subsistence value. The increased ease of extraction and transportation raises demand for these products, prompting settlers and farmers to clear wider areas of forest. Rain forest soil is generally very infertile and incapable of supporting crops for long, and conversion into cropland and pasture exposes areas to increased salinization, alkalization and erosion. This is particularly true in steep mountainous regions, which are more vulnerable to erosion and have very slow growth rates, thinner soil and lower productivity. As soils wear out after a season or two, colonists move on to the next block of land, clearing more forest and pushing settlement further into fragile and marginally productive lands.[90]

3.6.1 Best Practices: Roads

As a general rule, oil companies should avoid building roads unless there is a real, rather than perceived, need. Thus, roads should only be considered when production operations are being established, and never during exploration.[91] Indeed, many oil companies have found that it is generally possible and cost-effective to conduct a seismic survey and exploratory drilling operation without building a road.

If a company decides it is necessary to have a road for production, there are many steps that it can take to minimize the impact of this development. Any roads already existing in the area should be used to the fullest extent possible. When constructing new roads, engineers should avoid building loops, which can fragment habitats and jeopardize complex ecological processes.[92] It is also important to evaluate the drainage of an area and the stability of all slopes before construction to ensure that a road does not alter watershed drainage.[93]

Traditionally, roads have been built by bulldozing the land and using flat logs to form a corrugated road surface, upon which gravel or sand can be laid. This process, in addition to requiring the harvesting of a great deal of timber, can also lead to severe soil compaction. Newer techniques and materials, such as geotextiles or unimats, may help to reduce these effects. Conoco Inc. used unimats—“waffles” of wood traditionally used to protect the arctic tundra—to prevent erosion on roads at their project in the Congo. Using unimats saved Conoco $100,000 in reconstruction and remediation costs.[94] In Ecuador, Maxus Corporation used geotextiles rather than the traditional corrugated wood road-base to build an access road on their 494,000-acre block adjacent to Yasuni National Park. This process utilizes a sand mixture placed inside a geotextile envelope and covered with crushed gravel. The road itself was about 15-20 feet wide and the right of way was reduced to 80 feet wide, rather than the conventional 200 feet. Geotextiles are more durable and save both money and time. Using geotextiles, Maxus was able to average more than 12 km of construction per day. Previously, the quickest road-building through a rain forest averaged about 3.5 km per day.[95]

Any new roads or points of access to the site should be strictly policed to prohibit access by unauthorized personnel. Several companies have successfully controlled access to their sites in this way. In order to control colonization and deforestation along the access road to their operations in Ecuador, Maxus paid the government and local people to establish and staff control posts to prevent access to nonresidents or unauthorized people. To further reduce ease of access and impede settlers, the company used a monitored ferry to transport people and equipment across the 1.4-km wide Napo River, rather than building a bridge.[96] Concerned about the growing number of hunters, colonists, loggers and others in the area surrounding their project site in Gabon in the late 1980s, Shell worked with central government authorities to control access to the site. The few access roads into this relatively isolated area were heavily guarded, with all travelers requiring permission to enter. The workers’ base camp was operated like an offshore platform, with no families allowed on site, and all personnel, food and equipment imported by air.[97]

Controlling access is critical for avoiding indirect impacts and requires the full support of national and local governments and local communities. A national government may have political reasons for wanting to open and maintain access to undeveloped areas, such as a desire to populate weak border regions of its country. Road-building may also involve a trade-off with local communities, who may welcome a road because it facilitates access to their homes, or also may oppose a road for the very same reasons. Thus, it is important to understand the opinions and desires of the local people and governments and to clearly specify provisions for policing and post-operation destruction of a road in any contract documents.

3.7 Environmental Impacts of Drilling and Production

Waste generation increases sharply once promising structures have been identified and an operation moves into exploratory and then production drilling. Improper handling and discharge of waste and toxic substances during drilling can pose a threat to the surrounding environment and communities. Groundwater is particularly susceptible to contamination, which can have profound health impacts on wildlife and local people. The most significant source of water pollution during drilling is inappropriate disposal of the formation water that is extracted along with oil from the well and contains oil, high levels of chlorides and heavy metals. Although this formation water can be disposed of by reinjection into the well, companies often choose to discharge it into local waterways to avoid the added time and expense of reinjection. The resulting contamination of ground and surface water can lead to serious and, sometimes, deadly impacts on local people, animals and vegetation.[98]

Reserve pits, also called oil sumps or ponds, are another source of contamination. These sumps are open pits designed to store drilling wastes, primarily drilling mud that contains oil and many chemical additives.

When subjected to heavy tropical rains and floods, the pits can overflow, contaminating water and soil and trapping wildlife. If a pit is unlined or is not landfilled when production stops, oil and other toxins can also seep into groundwater through the earthen walls.[99]

When oil separates from the drilling wastes in the reserve pits, it forms a new surface layer, some of which evaporates and promotes ground-level ozone formation in the surrounding air. High levels of ozone may cause respiratory problems for site workers. In addition, the heavy hydrocarbons left in the oil in reserve pits are sometimes used to maintain local roads, contaminating the land and water.[100]

Contamination of soil and water are not the only increased pollution risks during exploratory and production drilling; air pollution can also be a significant problem. During drilling, excess natural gas that cannot be commercially sold is burned, rather than captured for use or reinjected into the formation. This burning creates airborne pollutants, such as carbon dioxide, methane and sulfur dioxide, some of which are toxic or may contribute to climate change and acid rain. The flaring and burning of gas and oil also increases the likelihood of fires, a particular threat during the dry season.[101]

As regular oil production and transportation begins, the risk of contamination and pollution spreads throughout a much larger area. Oil spills can contaminate land and water, kill wildlife and permanently mar the ecosystem. In the very moist tropical rain forest environment, oil wastes and spills can easily filter into the local water supply. The most apparent danger is oil spills from breaks in a pipeline that lacks the proper spill response equipment or that may not be routinely maintained and monitored. Spills can also happen during production, transport, and unpredictable natural and human disasters, including earthquakes, landslides, and sabotage.

3.7.1 Best Practices: Drilling

Perhaps the greatest level of innovation, in terms of new technologies or new applications of old technologies, has been in the field of drilling technology, where engineers and managers have had to radically rethink traditional strategies to minimize both the economic costs and environmental impacts of drilling in sensitive and remote ecosystems.

One important application of an old technology in a new setting is the use in onshore operations of directional drilling from cluster platforms, first used on offshore rigs. Cluster, or multilateral, wells involve drilling several wells at various angles out from a single platform.[102] A typical well site occupies about five acres, and in order to drill 100

Box 3.4: Innovations in Drilling: Conoco in the Congo

Conoco Inc. operated in the Congo from 1984 to 1992. The company drilled several exploratory wells, but did not find any commercial quantities of oil, and eventually pulled out of the area. At first, all their blocks were offshore, but about two years into operations, Conoco received rights to explore an onshore block of about 500,000 acres, composed of 10 percent rolling savannah, 40 percent rain forest and 50 percent swamp.

Original cost predictions were about $4 million per well. However, after studying the area, engineers realized that mobilizing the necessary machinery to remote locations and clearing a 12,000 square meter plot for each drilling rig would be prohibitively expensive. Faced with the challenge of cutting costs and minimizing impacts, the company had to rethink its plans for drilling. Using seismic data, Conoco engineers had mapped the substructures of the sites and discovered the most promising places for drilling.

Fortunately, much of this area was near a large river that ran through the concession. In two cases, the river ran close enough to the crests of promising substructures that they decided to drill wells directly from the river. Engineers took a 12,000 square-meter rig that had been designed for the desert (where space is not an issue) and reconfigured it to cover only 5,000 square meters. They then mounted the rig on a barge, floated it down river, anchored it above the target, and drilled straight down through the water, using a closed-loop mud system to minimize waste generation.

While the first two on-shore wells could be drilled from the river, the third had to be drilled from land. In addition, because of uncontrollable factors, the well needed to be drilled during the rainy season. Concerned about erosion on roads during the rainy season, the company used uni-mats, “waffles” of wood traditionally used in the arctic to protect the tundra, on the surface of their roads. The rig was floated up the river on the original barge, along a tributary and across a lake to an existing 3 km logging road. It was then placed in a 5,000 square-meter site that had been prepared in a semi-cleared area, used previously by local people to grow manioc.

Source: Rod MacAlister, Manager, Federal Affairs, Conoco, Inc, interviews with authors, Washing-conventional wells, a company would need to clear 100 five-acre sites, for a total of 500 acres. With cluster drilling, the same project might need only 10 well sites, each with 10 directionally drilled wells, for a total land-clearing of only 50 acres. Cluster platforms also allow for economies of scale, with several different wells sharing the same pipe-lines, roads, equipment and processing facilities. While it costs more to build a cluster platform than a traditional drilling platform, the added cost savings of not having to provide additional roads, pipelines and land-clearing for conventional sites generally makes cluster drilling cost-effective and environmentally superior.[103]

Cluster drilling has been used successfully to minimize the footprint of drilling operations in Prudhoe Bay, on Alaska's North Slope. Technological innovation has allowed wells to be drilled with as little as 10 feet between them, whereas when production began at Prudhoe Bay, wells were drilled 120 feet apart. A 20-well drill pad, which in the 1970s would have occupied more than 25 acres, now covers only about 10-12 acres.[104]

To drill directionally from a cluster platform, workers begin drilling vertically and then "kick off" or angle the hole toward the reservoir. This deflection is usually done over a length of several hundred feet so that the angle is not too sharp and the drill string, which is somewhat flexible, does not break. For wells that require very sharp curves, segmented pipe with greater flexibility is used.[105]

Directional, or horizontal[106] drilling, is not a new technology. The first multilateral directional wells were drilled in the 1950s in Russia and the Ukraine, and another in eastern Siberia in 1968. However, after these initial experiments, none were drilled anywhere until the mid-1980s.[107] Today, there are still only about 7,500 horizontal wells in the world.[108] Slowness in adopting this technology has been mostly due to the higher costs and difficult logistics of negotiating a curved hole, but recent technology and experience have reduced both the costs and problems associated with these wells.[109]

A recent study of more than 800 horizontal wells in the United States found that drilling costs averaged only about 8 percent more than for vertical wells. Among the technological advances that have reduced costs by greatly improving the accuracy and scope of directional drilling are more efficient motors, more accurate steering equipment and coiled tubing, which is a continuous string of flexible steel pipe on a large reel. Coiled tubing can save time and money by increasing flexibility and eliminating the need to add sections of pipe periodically during operations.[110] It is also now possible to drill at greater angles, 120 degrees uphill or more, and for further distances. For instance, a 30,000 foot-long well can be drilled to reach a reservoir that is actually only about 8-9,000 feet deep.[111]

From an environmental perspective, horizontal drilling can be particularly useful if the target reservoir is directly beneath an important ecological feature. A well drilled recently by Bright & Co. at the Padre Island National Seashore in Texas had to be drilled directionally, because the target was under an important wetlands area. Workers drilled straight down for 1,830 feet and then kicked off at two degrees for every 100 feet, up to a maximum of 29 degrees. The final well was eventually about 8,900 feet long, reaching a target zone of 7,506 feet true vertical depth.[112]

Another drilling innovation that has allowed companies to save money and minimize the footprint of their operations in sensitive ecosystems is slim hole technology, which allows workers to drill narrower wells and thus use less materials and equipment. Slim hole drilling rigs have enabled oil companies to cut costs and impact because they use significantly less and smaller equipment, produce less waste, require fewer crew members, and have a smaller footprint. Slim hole rigs are also much lighter than conventional rigs, allowing for easier transport by helicopter, and making exploration in remote areas more feasible.[113]

Total Company was able to save 15 percent on costs for a two-well, helicopter-supported slim hole project in Gabon, recovering 6,100 feet of core in the process. And in 1992 and 1993, four slim hole exploration wells were drilled in the Congo for British Petroleum Exploration Company, Ltd. and Statoil, resulting in a 40 percent reduction in costs.[114]

There has been much written about the promise of slim hole technology, but oil companies have been hesitant to totally adopt it. Of the 45,000 to 50,000 wells drilled in 1995, only about 1,000 were slimhole.[115] Although the technology has been shown to be "feasible and economical, [it] is waiting for the push to become an industry accepted practice."[116]

Slim hole rigs are considered a relatively new and "unknown" technology by a downsizing, competitive industry that has relied on tested, mainstream technologies for decades.[117] Slim hole drilling also carries larger risks than conventional drilling and requires a more detailed knowledge of the geology of an area. With slim holes, drillers have less control over the well and more difficulty with "kicks," which happen when the pressure in the well gets too high and drilling fluids flow back up the well. Because a slim hole well is narrower, a given volume of oil is spread over a longer distance, increasing pressure in the well.[118]

Many of the problems and concerns with slim hole rigs have been addressed and rectified in recent years, and technology is constantly changing. In addition, there is a significant opportunity for cost savings with these rigs which, although they may have daily rates 20 to 25 percent higher than conventional rigs, can save an average of 25 to 40 percent on the overall project through reduced waste and a smaller well site.[119]

Whatever type of drilling technique or rig is used, it is very important to avoid contamination of groundwater from pipe leakage. Groundwater resources should be located and identified in pre-operations impact assessments. Surface casings should be cemented into the borehole at least through all potable groundwater zones, if not further, and casing should be monitored throughout production to ensure that any leaks are found and repaired.[120]

3.7.2 Best Practices: Waste

Reducing waste at all stages of an operation (source reduction) is far more cost-effective, and environmentally benign than attempting to mitigate and clean up after the fact. In general, there are two kinds of costs associated with waste: immediate costs from waste management and disposal before and during an operation, and long-term costs associated with liability and remediation after an operation has finished. Long-term cleanup costs are almost always much higher than immediate costs.[121]

Waste is produced throughout an oil project and can range from kitchen waste at the base camp to toxic materials produced during processing. The most significant waste, in terms of bulk and toxicity, is produced during drilling. An oil exploration and production operation produces three kinds of waste during the drilling process: formation water, drilling fluids and associated wastes.

Formation water, or produced water, accounts for about 98 percent of the waste stream during a drilling operation. Total formation water produced can reach thousands of barrels per day. This water, which occurs naturally below the surface and comes out of the well along with the oil, is salty and oily and can contain toxic chemicals. Produced water also contains naturally occurring radioactive material (NORM), including barium sulfate, radium sulfate and strontium sulfate. The NORM can leak out of production water as it cools upon reaching the surface, posing an occupational hazard to workers. Worker protection measures should be implemented and worker health and occupation monitored to prevent illness.[122]

An operator has three options for disposing of produced water after it is pumped out of the well and separated from the petroleum: injecting it back into the producing formation to sweep the oil out faster, injecting it into a non-producing formation, or discharging it onto the surface.[123] Although discharging formation water onto the surface is the easiest option, it is also the most environmentally destructive and can lead to serious liability and remediation costs. To minimize both environmental impacts and financial costs, rain forest oil operations should reinject all produced water back into formations, along with additional cuttings and wastes. When reinjecting produced water, operators must ensure that the water does not contaminate groundwater through casing leaks or poor cementing jobs. Pipes should be corrosion resistant and monitored to identify leaks. Pipes should also be routinely checked for scale build-up of NORM. These scales should be ground-up and reinjected with production water. All materials contaminated with NORM should be properly disposed of at an off-site facility.[124]

The next biggest category of waste is drilling fluids, including drilling muds and cuttings, which make up about 2 percent of wastes.[125] Traditional drilling fluids are made with metal compounds such as chromium and iron, but newer materials use calcium instead. Several mud producers are developing more environmentally friendly "oils" for oil-based mud that are less toxic than conventional muds. Although the newer materials may cost $200-$600 per barrel compared to $100 per barrel for conventional mud, they have the advantage of being reusable.[126]

The smallest group of wastes produced during drilling are associated wastes, which account for less than one-tenth of 1 percent of total waste. Associated wastes include cooling tower water, sludge, sand, waste fluids and oily debris. Companies can reduce the toxicity of associated wastes by using organic, rather than chemical, corrosion control and preventing spills. In addition, water that touches the drilling equipment, such as stormwater runoff, washing water and lubrication water, should be diverted, minimized and reused, rather than discharged into the environment.[127]

The traditional method of waste disposal at an oil operation is to dig huge pits or sumps to collect and hold all types of waste. However, a traditional waste pit, which might hold drilling muds, cement, formation cuttings and discharge, wash-down water and completion fluids, contains a great deal of toxic material that could seep into the soil and groundwater. Waste pits should never be used in rain forest operations. Instead, a large capacity tank, similar to a frac. tank, should be used to hold liquid and solid wastes during operations. A frac. tank is a tank of approximately 20,000-gallon capacity that is used to hold liquids when wells are fractured or when oil is diverted. These tanks are routinely used in offshore operations, as there is nowhere to dig a waste pit next to an offshore platform. While tanks are brought in on barges to offshore operations, they can be ferried into remote rain forest locations via helicopters. At the end of operations, all produced oil and water should be separated, with the water reinjected into the well and the oil processed or shipped to an off-site facility. Frac. tanks with open tops should be screened, or covered with netting, at all times to ensure that birds and other wildlife do not become trapped in the pits.[128]

Pits can still be used to catch stormwater run-off that may have been contaminated through contact with equipment and oil. The pits should be lined with an impervious 20-30 mil. geosynthetic liner and all oil should be separated from the water before discharge. Stormwater control pits should also be netted to avoid trapping animals.[129]

At the end of a drilling operation, a waste tank will contain thousands of barrels of solid and liquid wastes.

The liquids should be injected back into the production well, and the solids transported to an appropriate off-site waste disposal facility.[130] Reinjection as a waste disposal technique has been used for a long time, but in the past, it was mostly used after the fact, to clean up a site after an operation was completed. What is different about newer techniques that companies are using in the rain forest and elsewhere is that they are now grinding up cuttings, mixing them with the formation water and reinjecting the entire mixture continuously throughout operations.[131]

At its Wytch Farm operations southwest of London, British Petroleum successfully reinjected 30,000 barrels of slurried drill cuttings waste into a producing sandstone formation. The company used an existing water injection well to inject the waste into the aquifer of the Sherwood reservoir, because all other options had freshwater aquifers that were used for drinking water. Although there was increased pressure at the injection site in the beginning of reinjection operations, this pressure subsided after about five months, and the slurries remained in the formation without seeping into surface or freshwater aquifers.[132]

To inject slurried waste into a formation, drillers must first fracture the formation by increasing the pressure in the hole and then inject the wastes into the fracture. It is very important to grind the cuttings to a small enough size and maintain them in a stable slurry mixture through agitation. Each injection of cuttings should be followed by an injection of water to clear the path.[133]

A closed-loop mud system (CLMS) can be used to manage drilling muds without a waste pit. This system employs a series of above-ground steel tanks loaded on flatbed trucks to store, process and recycle drilling mud, cuttings and other fluids. Although a CLMS requires higher up-front costs than traditional waste pits, the economic and environmental benefits of the system greatly outweigh these costs. By eliminating the need to construct a several acre waste pit, CLMS reduces the footprint of the drill site, also lowering the costs of environmental impacts, labor, materials and equipment. CLMS reduces the volume of mud required and allows that mud to be recycled. In addition, the tank system can be moved easily from well to well as drilling progresses. Finally, at the end of operations, there is no need for costly reclamation of waste pits and no risk of liability from the impacts of these pits.

The CLMS uses solids control equipment and chemically enhanced solids separation to minimize produced waste and to segregate solids and liquids in drilling fluids. Liquid wastes collected in this system can be reinjected while solids can be trucked off-site to a suitable disposal site. Although some of the first CLMS equipment experienced problems, newer models have met these challenges by utilizing drilling fluid systems that minimize the degradation of drill solids. If a system does not have the right design, the solids might get too small, and anything smaller than about 10-15 microns cannot be removed with mechanical equipment only. The most effective solids separation equipment are linear motion shale shakers, which have fine mesh screens to separate out smaller solids, and hydrocyclone centrifuges.[134]

At Chalkley Field in Cameron Parish, Louisiana, Exxon's New Orleans Drilling Organization was able to cut waste management costs in half by using a CLMS. The company used shakers to remove 75 percent of solid waste from the mud. Traditionally, the remaining solids are removed through dilution, whereby the mud mixture is dumped into an equal volume of new drilling fluid. However, if an operation does not have a waste pit, this process is impossible. For that reason, Exxon used a CLMS equipped with chemically enhanced centrifuging (CEC) equipment to remove the finest solids from the mud. The centrifuging process can also be done without chemicals, using several high-efficiency centrifuges, but this process is unable to remove the very finest of the solids.[135]

Amoco also used a CLMS at its Southern Permian Basin Business Unit in Houston, Texas, reinjecting water into the production formation. Using this system, the operation reduced saltwater production by 39,000 tons and decreased commercial offsite disposal costs of produced water by 27 percent, saving about $325,000 annually.[136]

Although the drilling process produces most of the waste from an oil operation, daily activities and fuel use by the hundreds or thousands of workers at a site can also have a significant environmental and economic impact. Most of the pollution outside of drilling results from improper handling and disposal of waste at the base camp, from vehicles and in other facilities.

To prevent pollution from spills, fuel and oil should be stored properly at base camps and operations sites. Proper storage includes keeping these materials on flat, stable land, out of flood zones and above the high water mark. Storage areas should be equipped with secondary containment systems and located downslope from camps and away from other combustible materials. All storage areas should be clearly marked and routinely inspected. Vehicle maintenance standards should include similar environmental precautions. When refueling, operators should stay away from rivers, use drop pans and automatic shut-off nozzles, and have tools on hand to clean up leaks and spills.[137]

Finally, worker-generated waste at base camps needs to be fully processed and disposed. Septic tanks should be properly constructed and all digging should be done by hand rather than with heavy equipment. Solid waste such as kitchen waste should be separated and composted at some distance from the camp in a covered hole. Nonbiodegradable waste should be collected and stored to be transported later by helicopter from the well site back to the base camp. Plastic materials should not be incinerated.

3.7.3 Best Practices: Pipelines

The debate over whether or not to build a road and the effects of increased access during oil operations extends to pipeline construction. There is disagreement over whether it is necessary to build and maintain a full road throughout pipeline operations, but it is generally agreed that at least some sort of swath needs to be cut for pipeline construction and maintenance.[138] Although it is difficult, if not impossible, for vehicles to travel down a narrow swath, settlers can still walk along the pipeline route into undeveloped areas, even if a trail is only a few feet wide,

To minimize land-clearing or road-building, pipelines can be put together manually, and temporary roads, built while the pipeline is under construction, can be taken up once construction is complete.[139] In Sumatra, Indonesia, Lasmo Oil (Malacca Strait) Ltd. used a temporary railway to construct a pipeline in 1990, saving 33 ha of primary forest that would have been cleared for a road, as well as hundreds of hectares that might have suffered indirect deforestation as a result of the road's presence.[140] A road is also not necessary to monitor the pipeline; the entire stretch can be monitored by air, as most pipelines in the United States are monitored. Air inspection will identify minor leaks or weaknesses, while sensing equipment can help identify large leaks.[141]

All pipelines should be constructed of double wall piping, with pressure monitoring and automatic cut-off valves installed along their entire length, particularly on each side of a water-crossing and in coastal areas. With shut-off valves, in case of a break in the pipeline, only the oil within a short span between the valves is lost. All connection points at loading terminals should have spill containment sumps, and emergency response teams should be stationed at loading terminals, capable of reaching any part of the pipeline system within two hours.[142]

3.7.4 Best Practices: Reclamation and Mitigation

Even the most environmentally benign oil operation will require remediation or restoration of the project site after operations have ended, and many will require a highly intensive, costly, reclamation program. For an oil company, it is far more cost-effective to practice reclamation

Box 3.5: Mitigation and Remediation: ARCO in Ecuador

Between 1988 and 1989, the Atlantic Richfield Co. (ARCO) drilled three exploratory wells on its 200,000 ha concession in Pastaza Province, Ecuador, located about 180 miles southeast of Quito in the jungle between the Napo and Pastaza rivers. The concession is located in a hilly region with steep, forested slopes, about 1,400 feet above sea level. For each well, the company cleared about 1.42 ha of dense forest using machetes, chainsaws, and small tractors.

Drilling rigs and other heavy equipment were flown into the site by helicopter, eliminating the need for roads and lessening the impact on the surrounding area. To minimize erosion, earth-filled sacks made of a cloth similar to jute were placed around the project areas to slow the flow of water and hold soil in place. Any topsoil from cleared land was stored for later replacement, and an onsite nursery was established to aid in remediation activities.

After exploratory drilling was completed, ARCO implemented a comprehensive restoration program at the site. Drilling fluids were reinjected at each well, and cuttings and semi-solid fluids that couldn't be injected were solidified and buried. At one well site, cuttings were mixed with soil, placed in lined trenches or pits and buried under four feet of clean soil with a layer of topsoil on top. At another site, workers relined a previously lined pit, mixed the cuttings with cement and then sealed the pit with a flexible membrane cap, covered by a layer of clay and four to six feet of soil and topsoil.

Wooden boards from the drilling sites were made into pallets, which were then placed over the entire surface of the well site, filled with topsoil and fertilizer and allowed to regenerate. The pallets protected the soil and seeds from the sun as the wood decayed, but the method was not as successful as ARCO had hoped. For the next site, workers placed a cover of local vines over the soil, which provided the needed moisture and soil conditioning for regeneration. During operations, they grew grasses, vines and shrubs in an onsite nursery, using seeds and cuttings collected by local people.

The company found a distinct difference in regeneration rates between drilling platform areas and camp areas. At platform sites, in the process of removing and later replacing and replanting topsoil, workers had destroyed the original root and soil systems, but in campsites, where land had been cleared only with machetes and chainsaws, the roots, soil and other elements were left intact. As expected, regeneration was much quicker in camps and needed less intervention.

Source: Dilworth W. Chamberlain, et.al., "Vegetative Restoration at Petroleum Exploratory Drill-sites in the Ecuadorian Amazon," prepared for the Society for Ecological Restoration 1995 International Conference, 14-16 September 1995, at Seatduring operations or, better yet, to avoid damage that has to be cleaned up later, eliminating the need to have to return and extensively reseed or replant. In the United States, oil companies are required to post performance bonds to ensure that funds are always available for reclamation in case of accidents and other environmental damage.

The previous sections have described some of the steps that can be taken throughout an oil operation to reclaim land and revegetate or minimize the need to practice remediation. Reclamation should be done during all stages of the operation, with workers at each stage cleaning up as they go along. Before any activity begins, the company should have a full reclamation plan for each phase. Among the activities that should be included in this plan are the restoration of natural drainage patterns, the removal of temporary stream crossings, the stabilization of stream banks, and revegetation.

To minimize the cost, personnel, and equipment involved in reclamation, all operations should control erosion and promote rehabilitation by minimizing the amount of topsoil removed, recovering bare spots with topsoil and dead vegetation, sowing grass, planting shrubs, and avoiding the use of bulldozers whenever possible.[143] To prevent erosion and runoff of soils at its Rabi field in Gabon, Shell used a technique called hydroseeding, which utilizes a mixture of binding agents, nutrients, and 10-12 species of local plants to stabilize soil immediately. In another area of the field, the company closed off a seven km loop road in 1990 and successfully regenerated the area by breaking up the laterite and covering it with topsoil.[144]

When operations are finished at each stage of a project, all materials and facilities, including wooden landing platforms for helicopters, drilling equipment, metal drums, wooden road supports, pipeline parts, living quarters, temporary bridges, and concrete flooring, should be broken up and removed. All wastes should be treated and transported to an acceptable waste disposal facility. Lined waste pits should be properly sealed and the surrounding area inspected for stray waste. Compacted soils should be loosened and erosion prevention measures implemented. All roads should be taken up and the soil broken up to encourage regeneration. After removal of all equipment, a program of reseeding and revegetation should be undertaken with native species according to natural forest regeneration strategies.

Contaminated soils can be treated through bioremediation, a process in which naturally occurring microorganisms are introduced into the soil, where they break down the hydrocarbon molecules into simple carbon and oxygen compounds. In many instances, the bioremediation process results in richer soils.[145] Before leaving the site, and several times in the next months, soil and water samples from the surrounding areas should be analyzed to detect any remaining contaminants.

Box 4.1: Acculturation of Indigenous Populations

The term acculturation is used by anthropologists to describe a process of “slow and steady erosion of independent and sovereign native life ways and their absorption into larger cultural, political and economic spheres.”[1] Acculturation impacts each group differently, and varies depending on a group's proximity to the market economy and degree of past exposure to the outside world. One model of acculturation establishes a range of impact levels, from “isolated” and “intermittent contact” to “permanent contact” and “fully integrated contact.” Under such an approach, “isolated” cultures are both culturally and economically independent. Cultures exposed to “intermittent contact” generally have established trading relationships and are not considered economically independent, although they might retain cultural and political independence. Cultures subject to “permanent contact” are those that have effectively lost their cultural, political and economic autonomy, although they may retain some semblance of their native identity. Finally, “integrated” individuals and communities no longer retain any cultural identity with their traditional lifestyles or communities.[2]

1. Napoleon A. Chagnon, *Yanomamö: The Last Days of Eden* (San Diego, Harcourt Brace Jovanovich Inc., 1992), 245.

2. David Price, *Before the Bulldozer* (Washington, D.C., Seven Locks Press, 1989), 12.

4. SOCIAL IMPACTS AND BEST PRACTICES

Throughout Latin America, the expansion of development frontiers threatens not only the region's biodiversity, but also its human population, from isolated indigenous groups to communities of farmers and colonists. Oil development, mining, logging, road-building and agriculture have opened access to large, undeveloped areas, and in many countries, have led to severe social costs.[146] Social impacts can include the disruption of traditional production systems and social structures, increased crowding on traditional lands,[147] the spread of deadly diseases, demographic shifts and an unnatural dependence on outside aid. While many of the technological and management innovations discussed in the previous section can reduce the environmental "footprint" of modern oil operations, other strategies are needed for addressing the social challenges facing the oil industry.

The cultural adaptations of indigenous societies to development have varied, depending on the amount of infrastructure already present, the degree of previous contact, existing levels of acculturation, and the proximity to existing market economies. (See Box 4.1) Historically, access to and contact with the outside world, through colonists, missionaries, loggers and miners, has exacerbated the process of acculturation, resulting in displacement and marginalization. In the case of relatively isolated[148] groups, contact has the potential to change traditional balances of power, social structures and established hierarchies, diminishing the ability of these groups to maintain their independence.

Despite the complexity of social issues surrounding oil development in the tropics, an informed and well-managed project can avoid or significantly reduce these impacts. Nevertheless, in the past, oil companies that have been forced to deal with these issues, either because of a threat to their operations or due to international pressure, have rarely succeeded in effectively addressing social concerns. Many companies have simply avoided social issues altogether, often because the topic is beyond the expertise and experience of project developers, who are usually trained as engineers or environmental managers.

A successful social management program requires a long-term commitment to on-the-ground assessment and substantial interaction with NGOs, indigenous networks, and other local stakeholders. The World Bank and other international financial institutions have begun to address social issues and now require more detailed social impact assessments and mitigation plans before projects can be approved. Within the industry, several companies have recently begun to work with cultural experts and local and international groups to determine and test "best practices" designed to minimize negative social impacts. However, this is still a relatively new area for the oil industry as a whole, and there are few documented experiences to draw upon.

This section presents a series of principles for establishing social management strategies to address and prevent social impacts. This summary, however, is only a general introduction to the issues that project managers will face, and each approach must be adapted to local conditions. The long-term success of any social program will depend not only on company commitment, but also on responsible oversight by national governments and the ability of local people[149] and organizations to participate early on in the decision-making process.

4.1 Social Roles and Responsibilities

4.1.1 The Role of Industry

Any exploitation of petroleum reserves in populated areas requires that companies proceed with extreme caution. A commitment to social issues means including new parameters in decisions about development criteria, including where a company will work, under what circumstances it may limit development, and at what threshold the company will end involvement with a particular project. The ability to make these decisions requires a knowledge of the affected communities and stakeholders, a thorough understanding of the potential social impacts from operations, and active involvement of the public at all stages of project planning. In cases where a company is not able to guarantee a long-term commitment to protect tribal lands and indigenous communities, development should not proceed.

Companies must assume responsibility for the actions of their direct employees, as well those of contractors, subsidiaries and local employees, by providing guarantees covering the establishment of controls and supervision. In establishing a development strategy, the company should work with experienced specialists and with the informed participation of affected communities. There should be a point-person on site at all times who is accountable for day-to-day implementation of impact assessments and management plans, as well as a social monitoring and evaluation program to gauge the success of social programs.

The first international industry document to incorporate the protection of indigenous people as a general industry standard was the E&P Forum's 1991 guidelines. While providing no detailed recommendations, the document does offer a one-paragraph summary of the industry's responsibility to identify and respect the rights of indigenous people. The guideline refers to each company's obligation to ensure that cultural "integrity and traditional native customs and lands be maintained" and that "contact with indigenous populations be coordinated with local government agencies and recognized representatives where they exist." It also states that, in the absence of this representation, assurances should be made for appropriate consultation with the local populations about the project, their interests and expectations.[150]

4.1.2 The Role of Governments

While companies are responsible for the day-to-day design and implementation of oil exploration and development activities, national governments hold the ultimate respon-sibility for determining whether development plans are culturally appropriate, overseeing operations and protecting the human and legal rights of citizens. Unfortunately, although many governments openly praise their innovative national laws and constitutions designed to protect and promote human rights, the reality is that most federal and provincial agencies do not enforce these laws during project implementation. Governments frequently lack the technical or financial capacity to deal with indigenous issues and are often unconcerned with the status of indigenous people. Instead, governments often choose to place their primary concern on economic development. When laws do exist protecting the rights of local people, they usually do not differentiate between indigenous groups and colonists, and are often ill-informed and ineffective.

However, governments are required to meet growing environmental and social requirements to qualify for international development assistance. International procurement procedures require borrowing governments to undertake rigorous social analysis of possible impacts and establish public consultative mechanisms for affected communities throughout project design, implementation and evaluation. The World Bank and other multilateral development banks (MDBs) also require government institutions and local organizations to have the legal, social and technical skills to carry out sustainable projects.

In compliance with these standards for all sector-wide development, governments should also require companies and contractors to adhere to recognized "best practices" and international human rights agreements. In addition, prior to implementing any energy development agenda, it is advisable that the appropriate government agencies work with contractors to conduct full social and legal assessments regarding the status of land claims and tenure for all territories considered for development. Governments should also assist companies in clarifying land titling issues in complete consultation with local people. (This issue is discussed further in Section 5).

4.1.3 The Role of Local People

Even if governments and corporations act to protect people and their environment, it is only through the active involvement of affected communities and stakeholders that their interests can be fully safeguarded. Local people should participate in the process from the start, planning, questioning, designing, challenging and evaluating projects under consideration in their territories.[151] Interested stakeholders should increase their knowledge of potential social impacts, seek professional assistance to fully understand their legal rights, and demand the right to participate in all social impact assessments and management contingency plans. Empowered stakeholders should elicit the participation of local populations, help disseminate information throughout communities and conduct environmental and social hearings.

4.2 Social Impact Assessments

To fully understand the potential social costs of a project, governments and companies should conduct a social impact assessment (SIA) before any decisions are made about whether to proceed with exploration activities. Most of the major international development institutions have begun to use social impact assessments in project design, requiring borrowing governments to establish an appropriate "indigenous peoples plan."[152] These plans describe potential social impacts and identify appropriate mitigation steps based upon complete consideration of the development options requested by the affected communities. Aside from providing important information that will determine the types of social impacts, SIAs also provide valuable information that project managers can use to avoid areas inhabited by isolated people or areas prone to hostile contact situations.

Unfortunately, few companies have determined explicit guidelines for conducting SIAs, and, as a result, the majority of industry social assessments provide only a limited description of potential impacts and the range of alternative management practices available to a company.

The SIA should assess all the potential social impacts from an operation, including the associated impacts from contact situations with oil workers. These assessments provide a better understanding of how recipients of social programs actually benefit, and also serve as a comprehensive "social blueprint" for developing concessions. In the long term, accurate SIAs can pay off in real economic terms by reducing the potential for downstream conflicts, the need to conduct subsequent project-specific SIAs, costly remediation measures, and difficult local and international public relations battles.[153] In some cases, early social profiles may indicate that the potential for negative social impacts or conflict with indigenous populations is too great for a company to continue pursuing development of a particular block.

SIAs should be conducted simultaneously with EIAs as soon as a concession is identified, in order to ensure that project alternatives are included as options to the original project design. Companies should work with appropriate social experts who have experience in the area, familiarity with the communities, and technical knowledge of the operations. These experts should be able to help project managers develop methodologies for data-gathering, conduct consultations, and generally serve as a point of contact for affected stakeholders. Project managers and specialists may also want to have community representatives involved in data-gathering by accompanying social experts at different stages of the SIA process.

Just as in the EIA process, the first step in an SIA is the "scoping" period, during which project managers determine the most important issues to be addressed and the overall parameters of the assessment. This process offers an opportunity for early participation by stakeholders. Scoping determines an initial profile of social issues and potential impacts, the methods and procedures for public consultation, and a time-line for completion. The process should also determine benchmarks for measuring the success of the SIA process, such as the degree of public involvement, and a time-line for distribution of documents.

After the scoping period is complete social experts should determine what type of baseline information will be needed, based on local conditions. Among the potential social impacts that should be addressed in the SIA are current health status of communities, existing diseases, nutritional levels, population size, age distribution, traditional education systems, literacy rates, political and decision-making capacity and structures, existing social services, community organizations, wealth distribution, employment levels, resource use, availability of cash, local colonization, degree of contact and acculturation and any past displacement of indigenous communities.

Primary information for both the SIA and social monitoring plans can be complied from the relevant literature and the active participation of appropriate stakeholders in gathering and analyzing information. While information about contacted and integrated communities will involve interaction with these communities, data on known or suspected communities of isolated indigenous people should only be gathered remotely. Contact with these groups should never be attempted by an oil company, and if accidental contact does occur, it should be handled with extreme caution, through trained specialists.

Data on isolated groups can sometimes be gathered through aerial surveys, analysis of satellite images, and interviews with people who have worked in or passed through the areas, including travelers, loggers, missionaries, traders, local pilots, miners, members of indigenous

Box 4.2: Participatory Rapid Rural Appraisal

Surveys and interviews are among the most common tools for gathering socio-economic data about a community. However, local people may sometimes be suspicious of such a process, associating it with interference in their daily lives. Learning and appraisal methods, such as Participatory Rapid Rural Appraisal (PRRA), can help overcome these obstacles by facilitating mutual exchange and empowering local people to take an active part in the development of community programs and solutions.

PRRA seeks not only specific statistical data, but also confirmation of information by using a variety of sources and techniques. The three key features of this approach are a monitoring team made up of people who will look at an issue from a variety of angles; a range of levels of analysis, such as villages, households and individuals, to get different perspectives; and a series of different survey and interview techniques to account for any inaccuracy or bias in a single methodology. It is also important to have separate meetings for men and women and for various age groups, to ensure that a range of perceptions and opinions, rather than only those of the dominant groups, are represented.[1]

Among the topics which might be covered in PRRA information-gathering process are:

1. A time-line of all major events in the community as far back as possible, including any other major development projects, natural disasters and population growth.

2. The skills and knowledge possessed by individual community members. Such information can help community members assess how they can be most effective at participating in all aspects of social impact assessments and monitoring programs.

3. Historical and current population size and composition. This data helps community members understand changes in their community and actively participate in preventing negative impacts from development projects.

4. Formally organized groups or institutions. This information helps determine which community groups have had influence in decision-making and community development.

5. A comprehensive list of problems facing the community.

1. Shell International Exploration and Production B.V., "Social Impact Assessment Guidelines," HSE Manual EP 95-0371, June 1996, 21.

federations and networks, and members of other local communities. Other evidence of isolated groups in the concession area may become apparent to workers and social experts during the operation, through visible signs such as tracks, abandoned campfires or indigenous objects. All information about the locations of communities should be reported to contact specialists to assist project managers in planning future movements to avoid these areas. (This issue is discussed further in Section 4.6.1 below.)

The SIA process should also identify other assessments, management criteria and contingency plans that need to be conducted prior to exploration activities. These studies should describe procedures for every contact scenario, medical or health emergencies, and other unplanned events such as oil spills, fires, accidents or violence. Medical and contact contingency plans are necessary in concession areas overlapping indigenous territories, and should be finalized prior to the start of operations with trained people on site ready to implement them. After the social assessments are completed, the company should develop a social monitoring and evaluation program to measure the success of mitigation and contingency plans in preventing or reducing social impacts.

4.3 Social Monitoring and Evaluation

Just as it is important to monitor ecological changes through environmental indicators, it is equally vital to track the social impacts of an oil operation that overlaps with indigenous lands and local villages. While the most progressive industry guidelines mention the need for environmental monitoring and evaluation in the field, there is no discussion of the need for social monitoring or social audits.[154] This problem is compounded by the fact that social monitoring programs are time-consuming and involve complex interactions between social and ecological systems.

A social monitoring program should use both quantitative and qualitative tools to assess the impacts of project activities on economic and cultural systems. These tools can include interviewing, use of demographic data, surveys and learning and appraisal methods, such as Participatory Rapid Rural Appraisal.[155] (See Box 4.2) The social monitoring team, which should include anthropologists, medical doctors, local health workers, development specialists, biologists, tropical agronomists, and economists, should work closely with the ecological monitoring team. The company should also hire a group of local professionals to work with the scientists and learn their methodologies.

Because most social impacts from oil operations are indirect, social indicators will be less rigorous and more flexible and holistic than ecological indicators. Depending on the area and type of operation, indicators should focus on objective economic factors, such as prices in selected markets, wage levels, and occupational structures. Social indicators can also include consumption/production patterns, gender roles, demand for local vs. external goods, basic health, disease epidemiology, mortality, nutrition levels, availability of health services, vaccination rates, public perception of the company, attitudes toward conservation and sustainable development, expectations, degree and kind of involvement with the industry, social cohesion and use of space. Ultimately, a social monitoring program should ask: Is this project changing how populations relate to their environment?

Like environmental monitoring, social monitoring should be well underway before seismic exploration begins. A clear communications strategy between the company and local communities and governments should be established, allowing all stakeholders to have immediate access to the company if negative impacts are discovered. The monitoring team should develop participatory techniques, including formal surveys and more casual individual and group interview methods. Ideally, these surveys should begin before seismic surveying and be repeated at each phase of the operation. Interviewers should be able to speak the local languages, and it is best if they are representatives of the sampled communities.

Throughout the operation, the monitoring team and trained local experts should continue to monitor objective economic and social indicators in selected areas. The team should analyze the results of its monitoring and assemble monthly reports, sponsored by the company and circulated throughout the community. The company and its contractors should continue to be easily accessible to local groups and government representatives. During site restoration and reclamation the company should facilitate workshops for all stakeholders to review information, resolve any possible conflicts and define mitigation strategies.

4.4 Best Practices: Stakeholder Participation

Few conventional oil operations have thus far succeeded in initiating an effective dialogue with indigenous populations. In the past, many oil companies have addressed this issue either by turning to intermediaries such as missionaries, or by depending on the most vocal individuals within communities to serve as leaders and/or representatives for both the people and the company. This system has led to a poor exchange of information, miscommunication between companies and indigenous people, significant delays in project implementation, mistrust among oil operators and indigenous people, unrealistic expectations by local stakeholders and widespread opposition to projects. In some cases, long periods of silence by oil companies generated anger and distrust among local communities, leading to violent confrontations. Companies are now beginning to see the shortcomings of past

Box 4.3: The Emergence of Indigenous Coalitions

Within the last several decades, one of the most important developments among indigenous communities in Latin America has been their political mobilization into powerful local, national and international networks and coalitions. These networks have empowered indigenous groups with the means to protect their cultural identities, maintain self-determination and ensure, through customary territorial rights, that they benefit from natural resource extraction on their land. Through these networks, indigenous people have become not only effective advocates, lobbyists and decision-makers in national policy-making forums, but also powerful negotiators and participants in determining the outcome and implementation of development projects.

The value of these networks, however, is not limited to larger national and international organizations, since small, localized indigenous groups also have made an impact through their ability to obtain project information, seek educated and technical advice and, if needed, collaborate with larger networks on regional, national and global campaigns. As these networks grow and achieve international standing, many governments and corporations are realizing that the rights of indigenous people can no longer be ignored in the formulation of national development policies and the implementation of resource extraction projects.

In Ecuador, the Awa people, in preparation for the national demarcation of their traditional lands, mobilized to establish their own political structure and organized a coalition to negotiate with the state in support of their interests. Based on the experiences of the Shuar in southern Ecuador, the Awa created their own federation comprised of 15 regional centers. Each center is composed of Awa citizens from a specific region, and is governed through a locally elected council. Representatives from these centers also participate in larger Awa meetings at a central federation.

The Awa Federation is responsible for coordinating with the National Indigenous Confederation of Ecuador (CONAIE), a successful indigenous federation that interacts with government agencies on natural resource extraction projects, agricultural initiatives, and other national development policies. Separate from the network, the Awa have submitted their own funding proposals to international development agencies to establish educational programs and refine techniques for sustainable resource management. This federation has also become highly skilled at devising political stratagems and uses selective participation and hard-line bargaining tactics to push the government into decisions it otherwise would oppose.[1]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Yora/Yaminahua women and children at a settlement near Rio Cashpajali, Manu National Park, Peru.

On an international scale, in 1990, Acción Ecologica, an Ecuadorian organization, founded the Campaña Amazonia Por La Vida with several other indigenous groups and NGOs. This group has expanded its reach by partnering with other international groups and networks to facilitate cooperation and coordination of various monitoring programs related to oil activity in the Amazon. The Amazon Coalition, a group of North American organizations, also monitors and confronts the impacts of oil projects. Last year, the coalition coordinated a visit of experts and indigenous people to several oil concessions in Ecuador to share information about project impacts and make recommendations on future activities.

In addition to broad-based coalitions, local people have also formed networks and launched campaigns targeted at specific projects. In 1994, a coalition of organizations from Ecuador (including groups representing the colonist population in the Amazon) formed La Frente de Defensa de la Amazonia in response to negative environmental and social impacts in the area. Other networks have formed for the explicit purpose of monitoring companies and coordinating "resistance campaigns" against potentially destructive projects. In 1995, Acción Ecologia helped launch what has become a highly visible network called "Oil Watch." The goal of this network is to facilitate the exchange of information and foster communication between various organizations in several tropical countries. Among its wide range of goals, the network is actively working to connect and train indigenous groups and advocacy organizations throughout Latin America.

1. M. Janet Chernela, "Sustainability in Resource Rights and Conservation, The Case of the Awa Biosphere Reserve in Colombia and Ecuador," in

practices and to experiment with innovative social programs designed to improve the lines of communication with stakeholders.

Before project activity begins, managers should staff local offices with appropriate social experts, and avoid using general contractors, such as seismic crews, to establish contact or negotiate with local populations. In addition to hiring outside social experts, the project managers should find a local full-time community liaison officer who has appropriate training and can meet with communities on a regular basis. This team should be responsible for designing and implementing the consultation mechanisms, as well as monitoring their success.

4.4.1 Communicating with Stakeholders

The first step in designing a successful participation and consultation mechanism is determining who the affected stakeholders are, including indigenous people inhabiting community-owned lands, ethnic groups with designated territories, local communities of farmers, miners and loggers, and representatives from local NGOs and governments. Migrant populations, including colonists who have legal land title and those without any legal recognition, should also be considered stakeholders. As a general rule, companies should work directly with local federations as well as ensure regular consultations with smaller community groups to avoid the possibility of under-representing communities who do not consider themselves represented by larger federations. Social experts should conduct rapid assessments to determine how information is best distributed throughout these communities, looking at local structures for decision-making and the level of participation in organized local groups and federations. (See Box 4.3) Experts should also determine general community attitudes toward these groups and how effective they are at representing stakeholders and distributing information on an emergency basis.

Social experts should work with project managers to explain the operation and its potential impacts to affected communities, and determine their expectations, including perceived benefits from any compensations schemes. Local stakeholders should be able to provide input, including review and comment on important documents such as environmental and social impact assessments and management plans. Companies can convey their message to local people through the use of educational materials, describing the operations and potential impacts in an easy-to-read format translated into local dialects. Indigenous organizations in Peru have produced their own manuals explaining the impacts of oil exploration and development, as well as newsletters and informational guides to oil concessions in their territories. Companies can also explain their operations and deal with community concerns through "town hall" meetings, periodic workshops, regular written communication with local groups, and the mass media. Other techniques for communication include open-ended interviews, key informants, focus groups, community mapping, popular theater, and ranking and priority-definition games.

Several oil companies operating in remote areas have begun to create mechanisms, such as commissions or arbitration bodies, to resolve community concerns and redress grievances. These "bodies" can be composed of company

Box 4.4: Impacts of Colonization on the Yanomami People

The Yanomami nation includes more than 20,000 individuals living in an area of the Amazon straddling the Venezuela-Brazil border. The Yanomami have survived as a nation for more than 2,000 years, despite periodic episodes of contact with Western society. However the expansion of roads and other development into their territory within last two decades has changed their situation considerably, and many anthropologists and observers believe the Yanomami could soon face cultural extinction.

The construction of roads in Yanomami territories has led to uncontrolled invasion by colonists, while the expansion of oil and mining concessions have led to severe violence and health impacts in their communities. Oil roads have "reduced some Yanomami to hunger, disease, beggary, alcoholism, and prostitution." Poorly planned and developed oil and mining projects have resulted in massive environmental contamination and competition for resources. In July 1993, 16 Yanomami women, elderly people, children and infants were brutally massacred by Brazilian gold miners. Just four months later, 19 Yanomami were killed by environmental contaminants, including mercury poisoning from mining operations. Many more have died from the spread of infectious diseases to which they have no natural immunity.

Source: Leslie E. Sponsel, "Relationships Among the World System, Indigenous Peoples, and Ecological Anthropology in the Endangered Amazon," in Leslie E. Sponsel, ed., *Indigenous Peoples and the Future of the Amazonia* (Tucson, AZ, The University of Arizona Press, 1995), 270.

representatives, local community members, and representatives from impartial agencies such as a federal ministry of justice or local courts. In Ecuador, for example, ARCO established an impartial committee called the "Technical Commission," composed primarily of representatives from three indigenous federations, PetroEcuador, and ARCO. Initially the commission was designed to handle growing community grievances over the company's compensation schemes. However, over time the commission has become a convenient structure for handling other social problems and disputes, and it now also oversees the hiring of all consultants and experts related to ARCO's operations.[156]

Indigenous networks and federations are also using environmental hearings to ensure proper investigation of impacts and participation by local populations. Similar methods can be used in the field to resolve conflicts and define solutions, including periodic workshops, environmental and indigenous advisory councils, and planning boards. Third party visits by members of other indigenous communities, international groups, representatives from the scientific community, the press and government employees can provide input on the project and give local people the opportunity to interact with companies.

At Chevron's Kutubu Petroleum Development Project in Papua New Guinea, the company and its partners have set up a community affairs department to handle contact and communication with all communities in the project area. The program is intended to empower stakeholders to interact with each other regarding the operation or other development activities in the region, and build stakeholder capacity for participation and management of their resources through a system of formal property rights. Community development officers are supposed to conduct regular visits to the communities to determine concerns or other social problems and hold workshops for community leaders to develop skills in village development. While it is too early to determine the success of this type of community affairs program, particularly with more isolated groups, the program does suggest ways to formalize
two-way communication about all oil activities and social programs.[157]

4.5 Social Impacts of Access and Colonization

Increased access through new or expanded roads, seismic lines and pipeline paths poses not only an environmental threat but also a significant social threat by attracting colonists who will exploit newly accessible lands and affect the social dynamics of an area.

The potential social impacts of road development are the same whether the roads exist for the general purposes of economic and political integration or are built for temporary use at oil operations. The major direct impacts of road projects can include deforestation, air pollution and the bisection of parks, preserves and habitats. These direct effects are often followed by the indirect effects of both planned and spontaneous colonization, including land speculation, unsustainable agriculture, cattle ranching and continued deforestation. Colonization increases the opportunities for new contact situations between indigenous people and migrants, speeds acculturation, and leads to increased competition for local resources. Colonization can also lead to massive demographic stress on local social services and government capacity.[158]

The long-term impacts of colonization on local peoples are well documented throughout Latin America. In the Peruvian rain forests, indigenous people have been displaced by colonists, who are themselves highland Indians driven from their lands by colonization and population growth.[159] In Ecuador, colonization has expanded along the two principal oil roads that run parallel to Yasuni National Park. Within only a few years of construction, colonization on both sides of the roads stretched for five kilometers into the forest, with colonists using the access to further exploit river and forest resources for the production of cattle, coffee, maize, manioc and rice.[160]

The effects of colonization are some of the most complex and troubling issues for oil companies operating in Latin America today. Far-reaching impacts on both indigenous people and local communities are difficult to predict, and, without the company's diligence, they are almost impossible to control. In most countries, access problems are exacerbated by national property rights systems in which the government controls oil activities on land that is owned by private citizens or indigenous groups. Under these legal systems, the government retains possession of all subsurface natural resources and local people are often powerless to control whether oil activities are conducted on their lands or how they are implemented.[161]

In many countries, existing government policies and legislation also offer positive incentives for colonists to exploit untouched land. Often, governments require that settlers actively work the land in order to establish tenure.[162] For example, the Ecuadorian "wastelands law" gives legal title to anyone who clears rain forest land and puts it into "productive use," usually meaning farming and cattle ranching.[163] These laws often lead to the displacement of indigenous groups that do not have formal land tenure rights.

4.5.1 Best Practices: Respecting Indigenous Land Rights

To prevent the social impacts associated with colonization, companies must not only control access points created by roads, pipelines and seismic paths, but also recognize and protect customary and legal indigenous land rights. Companies should also respect the rights of indigenous people to determine the rate of development on their lands. To meet these goals, companies must have a clear understanding of the social context of an area, including information about historic claims and established customary entitlement of indigenous people. Companies should also make a long-term commitment to monitor any demographic changes in local populations.

At its Kutubu Petroleum Development Project, Chevron is in the early phase of implementing an innovative land titling program that provides assistance to indigenous communities by incorporating traditional lands into formal land tenure. Under this program, communities will receive royalties from profits generated by the concessions and assistance in managing these funds through accounts registered under Certificates of Incorporated Land Groups (ILGs). The company has also established a complex system for communication and capacity building in which ILGs are organized into smaller village development communities that provide two-way communication and ensure that their rights are protected.[164]

In some cases, communities have sought their own

Box 4.5: Conflict and Violence

Many natural resource extraction projects have engendered conflict and violence among workers, indigenous people and colonists. For the most part, confrontations have been limited to fights within communities and local robberies. However, at times, local people have been willing to make their point through more serious actions, including kidnapping, murder and terrorism.

Many conflicts have resulted from a history of outside incursions into traditional lands, environmental contamination, or violations of sacred places. This has been further compounded by the marginalization of indigenous people through racism and prostitution. Violence and conflict cannot be ignored by industry, governments or local people. These incidents threaten the safety of both oil workers and indigenous people, as well as the environmental safety and performance of oil operations.

The level of violence and robberies in or near oil towns is extremely high, with the number of robberies in oil communities estimated to be twice that of non-oil communities.[1] Alcohol, which is available from oil workers and in local cantinas, is often blamed for violent confrontations between oil workers and indigenous people.[2] Many local people have claimed that, in alcohol-related incidents, oil workers are hardly ever reprimanded and, unlike the indigenous people, are protected through their connections with local authorities. Feelings of anger and frustration are further exacerbated by the fact that indigenous workers are often forced to side with oil workers and the company after a conflict, creating stress and conflict and, in some cases, a breakdown of community relations. Conflicts also erupt within indigenous communities as a result of pressure from increased colonization and land conversion, particularly when communities are forced to live on land that is too small to support foraging practices.[3]

In the past few decades, conflicts have escalated into violence as indigenous people have tried to protect their territories. In 1987, for example, a group of Waorani Indians killed two missionaries sent by an oil consortium to appease them, and, in 1993, a group of Cofan Indians attacked Petroecuador workers with spears and guns, effectively halting oil production.[4] The Shuar, Waorani, Cofan, Secoya and Siona Indians have also detained oil workers and marched on production sites with machetes and shotguns. Among the tribe members' demands were consideration of environmental impacts and to be informed, as landowners, of the procedures and operations on their land.[5] Anthropologist James Yost, in an analysis of the Waorani, suggests that, when indigenous groups face death from contact with outsiders, some individuals may respond in the traditional manner of revenge killing against the outsider. Yost also warns that, if an epidemic occurs and results in deaths, oil workers' safety may be jeopardized for up to a year. [6]

1. Acción Ecologica, *Oil Watch* (Quito, Ecuador, Acción Ecologica, 1996), 81.

2. In the oil town of Coca, Ecuador, there are an estimated 400 cantinas serving only 18,000 people. Ibid.

3. Hillard Kaplan and Kate Kopischke, "Resource Use, Traditional Technology, and Change Among Native Peoples of Lowland South America," in Kent H. Redford and Christine Padoch, eds., *Conservation of Neotropical Forests* (New York, Columbia University Press, 1992), 106.

4. Judith Kimerling, *Petroleum Development in Amazonian Ecuador: Environmental and Sociocultural Impacts* (Washington, D.C., Natural Resources Defense Council, 1989), 5.

5. "Clean-up time," *The Economist*, 20 November 1993, 50.

6. James A. Yost, *Assessment of the Impact of Road Construction and Oil Extraction Upon the Waorani*, document prepared for Conoco Ecuador, Limited, April 1989, 13.

legal remedies to protect their lands by establishing protected areas and conservation set-asides. In Panama, Kuna Indians living in the Comarca indigenous territory mobilized their efforts to establish a protected area when they learned that a new feeder road would further increase uncontrolled colonization and encroachment on their
traditional lands. With the help of both national and international institutions, the Kuna Indians convinced the government to recognize their customary land rights and set aside 2,024 hectares of tropical forest as a nature preserve. This unprecedented effort has enabled them to protect their political and cultural identity from encroachment by the outside world.[165]

4.6 Social Impacts of Contact

The most significant social change that an oil operation presents in a remote area is the presence of hundreds of oil workers and contractors. Contact between oil workers and local people can significantly impact traditional social structures. This impact will differ depending on the sensitivities and perspectives of various social groups and their degree of previous contact. While all groups face health and economic threats, less integrated indigenous groups are at much greater risk of cultural displacement and marginalization than colonists or other local residents who have already felt the larger consequences of cultural change and abandoned their traditional lands and practices.

One ethnobotanist who has worked for a decade with the communities of Manu National Park in Peru has said that "even if the logistic means, the right equipment, and the perfect conditions are present, it is hard to imagine any contact that would not have as a result deaths, trauma and other harm to the indigenous populations of the area."[166] For relatively isolated indigenous people, contact can lead to an alteration of community relations, a tendency toward individualism within traditionally group-oriented societies, the emergence of a class system, and the generation of tension and division within families and communities. Contact also has the potential to alter traditional balances of power and established community hierarchies. As a result, communities can rapidly lose their ability to sustain their nomadic lifestyles and traditional methods of subsistence economy, and face increased dependence on outside aid. Even after only sporadic contact with oil workers, colonists, or Western goods, indigenous people have historically been disinclined to return to their traditional social strategies. In the Oriente region of Ecuador, according to one study, the impacts of contact from oil operations were "catastrophic," leading to loss of land and "broken down traditional bonds that have brought malnutrition and new diseases," pushing indigenous communities to "the bottom rung of a hostile market economy."[167]

Exposure to outside workers and infrastructure can

Box 4.6: Impacts of Contact on the Machiguenga People

The Machiguenga are an indigenous people now living in settled communities along the Urumbamba River and the Western headwaters of the Madre De dios river in the Peruvian Amazon. Today there are roughly 10,000 Machiguenga living in villages of up to 25-35 individuals. ■ Before contact with the Western world, the Machiguenga lived as foragers, fishermen and farmers.

However, contact resulting from encroaching oil and timber concessions in the core of their territory and periodic waves of colonization by Andean settlers, has meant rapid cultural and ecological change. Anthropological accounts reflect measurable impacts from these encounters, including a radical change in the Machiguenga traditional subsistence lifestyles, a decline in overall health, a loss of community unity, and a dependence on outside aid.

The Machiguenga have also experienced health problems, including a decline in nutrition, weight, and height. In 1986 the population was struck by a whooping cough epidemic that killed ten people. The group's social relations and community structure have also suffered, as they have lost control over their local economies. Years of resource competition with a growing colonist population has led to resource scarcity, a decline in sharing among community members and a rise in theft of food and Western tools. Alcoholism remains a serious problem for many of the communities, leading one observer to state that the Machiguenga are now drinking much more beer, often to "the point of drunkenness."

Today, the Machiguenga have become completely dependent on cash to buy their food and purchase Western tools and goods. They have been described by many sources as a people that is "very depressed." One anthropologist observed that the Machiguenga "seemed to feel abandoned" and "stated repeatedly that no one was helping them."

Source: Michael Baksh, "Changes in Machiguenga Quality of Life," in Leslie E. Sponsel, ed., *Indigenous Peoples and the Future of the Amazonia* (Tucson, AZ, The University of Arizona Press, 1985), 188-201.

have a profound demographic impact on both indigenous people and local communities. Demographic shifts can take the form of a population loss or population increase, and the negative effects from both can be devastating, particularly for relatively isolated indigenous groups. Population loss can diminish cultural identity, which is often sustained through traditional knowledge, such as foraging strategies and ethnobotanical knowledge passed from generation to generation.

Changes in cultural subsistence patterns can also result from population increases, which may lead to increased competition for resources. Most anthropological accounts suggest that population increases are the direct result of sedentarization, a slow process by which indigenous communities take up residence in small areas that are accessible to local markets and natural resources. For example, missionization among the Yuqui Indians of Bolivia has led to sedentarization and a threefold increase in population since contact.[168] These unnatural conditions lead to increased exploitation of resources beyond the capacity of the surrounding environment.

For the Machiguenga of Peru, contact with missionaries, colonists and other outside influences has shifted settlement patterns from semi-nomadic to sedentary villages and has led to the establishment of densely populated, permanent settlements and a "free-falling quality of life."[169] The fate of the Yora (Nahua) Indians of Peru after contact with the missionary group "Instituto Linguistico de Verano," suggests a similar trend. In the mid-1980s, Shell Oil Co. facilitated the relocation and missionization of the entire tribe under the pretense of social mitigation. The transformation of the Yora (Nahua) to a society dependent on durable consumer goods prevented them from practicing their traditional subsistence lifestyle and led to familial and community disintegration.[170]

4.6.1 Best Practices: Contact

Given the difficulty of predicting how indigenous groups will react to the presence of oil infrastructure and workers in their territories, and the potential for serious impacts from even incidental contact situations, it is essential that companies be prepared with contingency plans that describe procedures for different contact scenarios. In some cases, companies should withdraw completely from an area that is inhabited by isolated groups of people. However, in cases where work can proceed, contact between oil workers and local communities should be based on the communities' understanding of the potential impacts of contact and their informed consent to interaction. All oil workers should undergo formal education and training on the population of the area, the potential for negative impacts from contact, and reporting and emergency procedures.

With the guidance of social experts ("contact specialists") and local and international NGOs, international oil companies have recently begun to design and implement such social programs. In Peru, Mobil Oil Corporation and its partners established a "contact contingency program" and a response team consisting of medical and anthropological specialists who have experience with the indigenous communities in the area and speak the local dialects. The team works on retainer to collect social information, ensure adequate communication, and provide medical assistance should contact situations arise.[171]

In areas known to have isolated communities, the company should proceed cautiously and follow a "no contact policy." In any accidental contact situation, workers should signal that they are unarmed, retreat and immediately notify the contact specialist, project managers and nearby crews. Work should be temporarily stopped to give indigenous people at least 24 hours to retreat. Isolated groups will react to contact with outsiders in different ways including, aggression, retreat or collaboration. In most cases, they will prefer to retreat.

The contact specialist should record accidental interactions and investigate whether any medical attention or further communication is needed. All indigenous objects should be left in place. Project activity should be delayed temporarily until the contact specialist can determine whether the location of operations, such as seismic lines, interferes with indigenous lands or traditional activities. If sightings continue for long periods of time, the contact team or project manager will have to consider whether there is a need to permanently stop work in those areas. It is also necessary to develop guidelines for preventing other outsiders, including colonists, loggers and missionaries, from gaining access to the site and eventually the indigenous communities. For this reason, companies should keep all information regarding the whereabouts of isolated indigenous groups confidential.

Indigenous people may also deliberately make contact with oil workers, in which case, workers should try to minimize physical contact to lessen the chance for spreading disease. The contact response team should handle these situations through the use of interpreters to determine the most appropriate response. In case of violent confrontations or signs such as broken sticks or bows, traps and crossed sticks that can be interpreted as attack warnings, operations should stop immediately, workers should be evacuated and the contact response team should be prepared to provide medical assistance to both the oil workers and indigenous people. Workers should be kept out of the area indefinitely until the situation can be properly resolved. To prevent contact at base camps, including the potential for theft or attack, all clothing, tools, equipment and food should be locked up or hidden. Guards should be posted outside the camp to deter returning visitors.

4.7 Health Impacts

Oil operations can have profound health impacts on all local people, ranging from exposure to new and deadly diseases to the toxic effects of contact with crude oil and other contaminants. While indigenous people, particularly isolated groups, are especially susceptible to new infectious diseases, the dangers of contaminated food, water and soil are also a threat to all people in the affected area.

4.7.1 Contact and Health

The presence of oil workers or any other outsiders can pose a threat to the health and well-being of local people, particularly indigenous people who may not even have the basic immunities to fight off the common cold. The brief exposure of one person to an oil worker can lead to the spread of infection throughout entire communities. The danger of this exposure is particularly acute during the exploratory phase of an operation when seismic crews traverse hundreds of square kilometers. Diseases can also be spread through contact with cultural agents, such as mestizos or acculturated representatives of the indigenous group, who gain access to the project area. In many well-documented cases, contact-related illnesses have been spread through the exchange or theft of contaminated clothing and other goods. In a 1989 report, anthropologist James Yost lamented that he had "buried far too many Wao friends and their new babies who contracted the common cold from either oil company workers or tourists and then succumbed to secondary pneumonia."[172]

The impacts of these diseases do not stop with infection. Illness may be only the first phase in a longer process of population loss, displacement and complete acculturation. Population losses and the weakening of social units through disease may encourage a community to turn to outside sources such as missionaries to obtain medicines. Additionally, fear of disease and loss of group structure can lead to the abandonment of ritual sites, traditional villages and meeting houses, causing significant lifestyle change and collective, prolonged depression stemming from cultural marginalization and death.

Contact-related health impacts have devastated many different indigenous groups in remote areas of Latin America. In one five-year period, the population of the Northern Ache Indians of Peru declined by more than 50 percent due to the spread of contact-related colds that developed into dangerous respiratory illnesses.[173] Also in Peru, a group of 150 Yora (Nahua) Indians, who previously had no contact with Western goods, came down with influenza after attacking a Shell base camp. More than half the population of the Yora (Nahua) community died within one year of exposure.[174] Studies of the Yanomamö Indians in Brazil suggest that the mortality rate in their villages was directly proportional to the degree of contact with the outside world.[175] And in Ecuador, the Waorani were considered "remarkably healthy" prior to contact and had developed their own successful remedies for illnesses indigenous to their native lands. However, the transmission of viral diseases from colonists and oil workers has become a major cause of death for the Waorani.[176]

In many concession areas, alcohol has also become a threat to the health of indigenous people, as well as a source of conflict. Once alcohol is brought to or near an oil camp,
it is difficult to prevent it from being shared with local people. The presence of alcohol has been devastating for many indigenous groups who have an enzyme deficiency that makes it difficult for them to metabolize alcohol.[177]

4.7.2 Pollution and Health

Health impacts arise not just from contact with workers, but also from pollution and contamination related to an oil project. While these impacts affect all people, regardless of their degree of acculturation, they are particularly dangerous for those who depend more heavily on the forest for food, water and shelter. Petroleum products contain many highly toxic and harmful compounds that can be absorbed by plants and rapidly enter the food chain.[178] Prolonged exposure to crude oil can cause serious health impacts, including cancer, birth defects, blood disorders, and damage to the central nervous system. Bioaccumulation of these toxic compounds occurs when oil is absorbed through the skin, through ingestion of contaminated food or drinking water, or through the inhalation of gases, dust and soot.[179]

These pollution-related health impacts have been widely reported in countries such as Ecuador, where the government has recorded at least 30 separate spills in the main Trans-Ecuadorian Pipeline since 1987 and millions of gallons of crude oil have been spilled or discharged into the environment.[180] Studies of oil exposure by the largest government hospital in Coca, Ecuador, documented a rise in child mortality resulting from oil-related accidents and contaminated drinking water. Other health-care providers in the area found substantial increases in birth defects, childhood diseases and skin rashes, and extremely high rates of malnutrition in areas impacted by oil development. Another exposure study, conducted by the Ecuadorian Union of Popular Health Promoters of the Amazon, looked at 1,465 people in ten communities, 1,077 of whom resided in oil-contaminated areas and 388 in non-contaminated areas. Those in communities that had been exposed to oil had a higher rate of illness, including miscarriages, respiratory ailments, dermatitis, headaches, and nausea.[181]

Environmental degradation and contamination can impact the nutritional levels of indigenous people through increased pressure on fauna, resulting in an overall reduction of the local resource base. An indigenous network in Ecuador found that a loss of animal protein was associated with reduced resources, because of oil contamination of rivers and streams and illegal fishing or hunting by oil workers.[182] The decline of nutritional values is most common in communities near oil roads and drill sites. Having lost their traditional food sources, many indigenous groups are forced to travel to nearby towns to buy game and canned food products.

4.7.3 Best Practices: Health

To avoid the introduction of new diseases and the contamination of local air, food, and water, companies should establish comprehensive contingency plans. Project specialists should conduct rapid health assessments that examine basic health problems, disease epidemiology, mortality, prevalence of vaccinations, current nutritional levels, availability of health services, and attitudes about health problems and services. During this process, all oil workers should also be interviewed to determine their resource use and social interaction patterns. Several companies are beginning to recognize this responsibility. Shell's corporate guidelines for social impact assessments, for example, require the use of health risk assessments and health risk management plans, as well as long-term monitoring and surveillance programs.[183]

All employees of an oil operation should be prepared to deal with medical issues before any seismic work begins. In addition to establishing a contingency plan and training workers in its implementation, a contact specialist and a doctor should be kept on retainer to deal with potential medical situations such as infection, the spread of disease or a possible epidemic. The company should also keep a physician on retainer in the field to treat possible illness or disease for both workers and local people. Project managers should ensure that any required medicines can be on site within 48 hours after a contact situation or medical crisis has occurred. Should a medical emergency arise, it is essential that special programs, including the provision of food and medicines, be set up to assist the affected families.

To lessen the possible spread of disease from workers to local people, workers should be required to undergo thorough and regular medical checkups both in the base camps and in oil towns. Complete medical records and histories of all workers should be kept on file. In addition, medical staff should be on call throughout the entire length of the operation to monitor the health of any workers, who, if sick, should not be permitted to enter the field. Vaccinations should be kept on site and administered to indigenous people, all local communities, and every oil worker. The contact specialist and community liaison can help to communicate the need for vaccines to local groups in an unthreatening manner and can help coordinate distribution efforts. Project managers can also lessen the opportunity for disease transmission by giving each worker his own mosquito net and mattress.

A main strategy for reducing the risk of exposure to crude oil and other toxic compounds should be to follow the strict environmental management and control practices that are detailed in Section 3 above. Instituting these practices will reduce the risk of spills and contamination. When implementing pollution control procedures, workers and managers should pay special attention to the areas that local people depend on for the bulk of their food and drinking water. Monitoring programs should also focus particularly on these areas.

4.8 Social Impacts of Dependence on Outside Aid

One of the great dilemmas facing conservationists, social scientists and oil companies is that economic development projects can have both positive and negative social impacts. On the one hand, resource development offers valuable opportunities for the extension of financial and material benefits to a diverse set of national and local interests. On the other hand, these compensation schemes can be highly detrimental to traditional resource development schemes and the cultural integrity of native indigenous populations. Even well-managed and well-intentioned compensation schemes can lead to unforeseen impacts. An analysis of the complex and often drastic changes that have occurred in several indigenous cultures suggests that this is an issue the industry should approach with extreme caution.

Until very recently, project managers have used compensation schemes mainly as a public relations strategy for generating good will among local people and preventing opposition to their projects. Compensation schemes have also been viewed as an outlet to access local labor markets. However, compensation has rarely been effective in actually mitigating the severe effects of development. Even though many social experts dispute what the impacts of Western goods and money truly are, there are many examples that show the futility of depending solely on the promise of job creation and access to goods to correct larger social problems.

In the past, compensation schemes have led to significant social impacts, particularly on indigenous communities that are less integrated into the economic marketplace. Many cultures that have been exposed to Western technology have generated new cultural patterns based upon the acquisition of Western goods such as machetes, aluminum cooking pots, modern medicines and steel axes, and the loss of access to these items can be traumatic. The introduction of hook-and-line fishing had a major impact on the diet of the Tayakome Indians, who live outside Manu National Park in Peru, causing them to shift from a hunter-gatherer lifestyle to rely primarily on fishing. And for the Mascho-Piro Indians, who also live outside Manu, the introduction of guns led to increased hunting of larger game and much greater pressure on local resources. The

Mascho-Piro now use guns to obtain more than 90 percent of their game meat.[184] Often dependence can be so great that indigenous communities will relocate near already acculturated and settled market areas rather than return to their traditional lifestyles or territories.

Anthropologists have noted that exposure to technology is often seen as a means of empowerment within an indigenous community, and power struggles can erupt when one individual or group is recognized over another. This is particularly relevant when such individuals or groups do not represent the traditional apex of a village or community hierarchy. When access to technology is denied, or removed, social and economic problems can result, including conflicts over the loss of status or power. In addition, in some indigenous communities, personal property or cash on hand may be a foreign concept. The less acculturated a community is, the more unaccustomed the people will be to monetary rewards, and any unequal distribution of either cash or goods can lead to confusion. Power and prestige struggles may also develop within the communities, leading to the breakdown of group structure, internal conflicts, and eventually distrust of the compensators.

4.8.1 The New Job Market

Although compensation schemes have often had negative social impacts on relatively isolated or unacculturated indigenous groups, many local communities of colonists, miners or farmers have reaped benefits from both long- and short-term compensation programs. An oil company's presence in an area often means improved sanitation, water distribution, health care, education and nutrition for existing communities. In addition, the creation of job markets has allowed local communities to participate in the financial benefits of oil development. Nevertheless, it is important to implement these programs with caution to ensure that the improvement of social services or the creation of job markets do not cause negative social impacts. New job markets, particularly temporary ones, that involve the relocation and occupation of substantial numbers of men from surrounding communities can lead to an increase in the workload of women, dependency on cash and new consumer goods, and division or destruction of familial units.[185] For these reasons, compensation schemes should be carefully planned to maximize benefits to the local communities.

The experiences of one oil contractor in Peru illustrate the potential for increased pressure on women to meet nutritional and production needs when temporary labor markets contract men away from the community. A company called City Services, acting as a contractor for an oil company, hired large numbers of men from local villages and towns to work in oil fields. Since the people were in no danger of acculturation, it was considered a good idea to provide increased access to local and domestic markets. Yet, to the surprise of the company and the subcontractors, there were significant adverse impacts on the local communities. A shortage of labor prevented the communities from maintaining their traditional production systems. Women were forced to farm smaller uncultivated plots with low soil fertility. This disruption led to the abandonment of agricultural fields and a food shortage in the community.[186]

The presence of oil operations near local communities can also lead to inflation in the local economy. This inflation may be attributable to a decline in resources due to deforestation and increased hunting and fishing by newly arrived oil workers and colonists. In addition, oil workers and company representatives may be willing to pay higher prices for goods, services and transportation, leading to temporarily inflated prices. In fact, the towns surrounding oil projects may be the most expensive in the country. In Ecuador, prices for basic food items, such as produce, are about 25 percent higher in oil communities than in Quito.[187] As supplies dwindle and prices rise, the value of fish, game and other products increases, forcing communities to use more forest resources to meet their needs. The availability of new infrastructure such as pipelines or barges can also lead to the loss of jobs and, eventually, to conflict between oil workers and local communities. This was recently the case in Petén, Guatemala, where the development of a new pipeline has replaced an existing transportation sector, causing the loss of hundreds of jobs and direct conflict between oil contractors and unemployed local truck drivers.[188]

4.8.2 Best Practices: Compensation

Although various forms of compensation can be used to share the benefits of development projects, there should be the expectation of greater change in some local communities than in others. Social impacts that might arise from various compensation schemes can be lessened significantly by tailoring projects to specific communities, based on the amount of contact they have had in the past and on educated decisions by the people involved.

The only way to avoid impacting local economies entirely is to completely isolate any project activities from local economic activity. However, this is often an impossible, and in many cases undesirable, option. The first step in lessening the potential negative impacts associated with labor and cash compensation programs is to conduct an additional social impact assessment before designing any compensation scheme. The companies should also ensure that they will monitor both the short- and long-term impacts to the hired individuals and their communities. In situations where it is necessary to employ people from local communities, companies should limit contract length to short time periods, and assistance should be provided to help those individuals return to their communities when their contracts expire. This will also help avoid the loss of valuable workers in local production areas.

Companies should make clear what local people can expect from their contracts, so that there are no misunderstandings about contract length or obligations. When hirees come from relatively isolated communities, they should not be relocated for any reason to sites that are far away from their homes.[189] Companies should ensure, as part of their hiring practices, that they do not hire or compensate illegal miners or settlers in the area, and local populations should be aware of fraudulent hiring agents.

Careful planning with all representatives of the communities and well-managed execution of these programs can lead to positive results. In Peru, Mobil Oil is working with both men and women in local communities to ensure that the families and communities of workers actually benefit from the extra income earned through oil jobs. Under this scheme, earnings are placed in funds that are managed by the women in the communities. In Papua New Guinea, Chevron has helped to establish a job compensation scheme and is funding a program that offers training for community rangers, technical assistance in the development of land-use plans, sustainable agriculture and fishery development, nature-based tourism, and the development of non-timber forest product ventures, such as the harvest and sale of butterflies and rattan.[190] While the project is still in its early stages, it does provide a potential means for long-term access to compensation and an opportunity to prevent younger men from leaving their villages to search for jobs with other oil, logging or mining companies.

The establishment of ARCO's "technical commission" in Ecuador is also a good example of a consultation mechanism that can be used to overcome conflicts associated with unequal distribution of compensation to local communities. According to an official complaint lodged by a representative indigenous network, at first the company compensated only a small group of families with direct salary in an attempt at "bribery by divide and rule."[191] These compensated families were empowered to take over seven small indigenous communities, severing ties with the larger indigenous organization. The technical commission was initially formed to address these complaints. The commission now meets frequently with the mandate of overseeing general environmental and social problems associated with the operation, determining compensation schemes, and hiring all experts to work on the environmental and social impact assessment process.[192]

Determining who should receive and allocate any compensation packages should also be done with care. In many communities, relying on just one individual or representative to disperse rewards equitably to all members may be ineffective and lead to conflicts within the community. Some companies that followed this strategy in the past faced problems such as misperceptions and conflicts that eventually led to irreparable bad will and distrust.

A preferred model for companies to follow is "community-based compensation," whereby remuneration is done communally and not on an individual basis. Under this approach, managers work with the communities to determine their expectations for a compensation program, how financial compensation will be allocated and for what it will be used. In some cases, compensation should be awarded either in kind with food and/or tools or in cooperation with larger social units such as entire communities, rather than just one family or individual. Designation of the benefits should be through participatory methodologies, with assurance that funds will be administered properly. In addition to donations, other funding given to support projects should focus on local development initiatives. Because local people may be affected by more than one oil concession, a joint policy should be developed with other oil companies in the area to ensure consistency and success in implementing social programs and compensation schemes.

To avoid the problems associated with temporary inflation, companies should include programs for responsible participation in the local markets and economies as part of their overall compensation strategy. In purchasing services or goods, companies should insist on price controls that are consistent with market prices. They should also work with the communities to monitor sourcing and consumption of local produce and services. Companies should do a thorough analysis of the impacts of their infrastructure on the occupational structure and wage levels in a community and ensure mitigation measures through price controls and strategic hiring practices.

5. LEGAL AND FINANCIAL MECHANISMS TO PROMOTE BEST PRACTICES

As demonstrated above, oil development has the potential to cause extensive and irreversible ecological and social damage, especially in tropical countries with uncertain regulatory frameworks. Thus, progressive legislation accompanied by strong institutional support and innovative funding mechanisms will be vital if tropical countries tapping their petroleum resources are to avoid exchanging their vast biological capital for temporary infusions of foreign currency. Oil concession contracts should require companies to follow "best-practices." Reiterating a company's obligation to comply with all relevant environmental and socio-cultural legislation, and setting specific environmental guidelines for individual projects, will play an equally critical role in minimizing the adverse impacts of development. This section describes legal and financial mechanisms that help to ensure environmentally sensitive oil development.

5.1 Legislation

Legislation that directly addresses environmental and socio-cultural concerns is essential to conservation efforts. This section describes the various layers of constitutional and statutory authority that are required for effective protection of people and the environment.

5.1.1 Constitutional Provisions

Government regulation resting on a solid constitutional foundation carries the greatest weight and authority. Countries should consider drafting explicit constitutional provisions that recognize the need for conservation of natural resources and protect each citizen's right to a healthy environment and a cultural identity. Such provisions will serve as "mandate[s] for public authorities to attack the roots of environmental problems,"[193] and will ensure that governments have an unimpeachable legal basis on which to do so. They may also be instrumental in providing individuals with standing to sue in order to uphold environmental rights.

Sixteen Latin American countries have constitutions stating that natural resources must be conserved and used rationally,[194] and 10 of these countries have constitutional provisions creating a basic duty to protect the environment.[195] Unfortunately, many of these provisions have proven insufficient in the past, because they were too broadly worded, because governments lacked the institutional capacity to enforce them, or because economic priorities superseded all other considerations.[196] Recent developments in South America, however, suggest that constitutional reform is continuing, and that environmental principles are increasingly a priority.

For example, Peru and Colombia have elevated environmental protection to the status of a "fundamental right," which is especially significant in countries that have constitutional tribunals with original jurisdiction over such rights. In addition, Peru and Colombia's new constitutions include entire chapters on environmental and natural resource protection. Although a consensus among scholars and practitioners has not yet been reached, it appears that Peru's constitution creates alienable private natural resource rights that encompass an obligation to protect the environment, a significant departure from previous approaches to natural resource ownership. The new Colombian constitution requires the controller general to make annual reports on the state of the environment to the congress, and to assign values to "environmental costs." It also grants the prosecutor general the authority to defend collective rights, including the right to a healthy environment.[197]

Constitutional reform in Latin America seems to be moving in a positive direction. However, constitutional provisions function only as an initial, though fundamental, measure to ensure environmental protection. Constitutional principles must be supported by specific legislation and agency regulations to ensure that they are ultimately implemented.[198]

5.1.2 National Environmental and Socio-Cultural Legislative Policies

The next layer of environmental and socio-cultural regulation should consist of broad legislation establishing comprehensive national conservation policies, recognizing the rights of indigenous people, and setting general parameters for all activities that have significant social and environmental impacts. These national conservation policies act as an important unifying force, providing a legislative umbrella for more specific statutes and working as a catalyst for additional legislation addressing new environmental problems.

This category of legislation should include several different kinds of laws. First, governments should enact laws establishing the need for conservation and sustainable development. These laws should also require both government agencies and private parties to comply with procedural controls such as permits and environmental and social impact assessments. Second, governments should enact laws clearly stating that federal and local governments are responsible for regulating management of the country's natural resources, and should establish land management priorities. Finally, governments should enact legislation recognizing the rights of indigenous people to occupy their lands, to receive compensation for use of their lands if they choose to allow development, and, finally, to continue their traditional way of life.

Protection for indigenous people is especially critical. Indigenous people are often neglected in government decision-making, even though they may be the first to suffer from poorly coordinated development projects. The rights of indigenous people have been recognized by every international institution, from the United Nations, the International Labor Organization, and the Organization of American States, to multilateral development banks and NGOs.[199] There is also a trend in international law toward specifically recognizing the customary rights of indigenous people to their traditional lands and cultures, beyond traditional human rights law protecting personal security and health.[200] These international principles should be explicitly recognized in domestic legislation and become an integral part of all land management and resource exploitation decisions.

Several Latin American countries, including Brazil,[201] Colombia,[202] Mexico,[203] Venezuela,[204] and Peru,[205] already have broad conservation laws. Colombia, for example, passed the National Code on Renewable Natural Resources and Environmental Protection in 1974, which articulates Colombia's policy on the use of the environment and renewable natural resources and establishes an environmental information system and environmental impact assessment requirements.[206] Brazil's Act No. 6938 establishes environmental quality standards, environmental zoning, and economic incentives for environmentally friendly technology.[207] However, even countries with national environmental policies should make certain that all three elements mentioned above—resource management plans, procedural safeguards, and indigenous people protections—are clearly articulated.

5.1.3 Sectoral Legislation

Although national environmental policies tend to be more specific than the broadly stated constitutional principles they are derived from, they too must be supplemented with more detailed statutes and regulations. These statutes should regulate individual industries, establish protection for particular natural resources (such as forests or watersheds), and address the needs of each indigenous population. Sectoral legislation that addresses discrete environmental and social issues, and that provides government agencies with the authority to issue even more specific regulations, ensures that constitutional provisions and national policies are translated into results on the ground.

An effective framework of environmental laws must include all the levels of regulation described above, from constitutional provisions to agency regulations. Countries lacking sectoral statutes and the agencies to administer them will lack the regulatory mechanisms necessary for effective implementation of national policies. Conversely, countries relying solely on sectoral legislation are also limited. For example, Costa Rica, like many other Latin American countries,[208] has separate laws addressing public health, wildlife conservation, forestry, mining, and water use, but no comprehensive national environmental policy.[209] Thus, conservation efforts may suffer because they are not reinforced by a central policy providing the incentive to address all matters of environmental concern.[210] In addition, the absence of a national policy reduces the chances that a forum to discuss cross-sectoral problems and coordinate responses will be available.

5.2 Petroleum Codes

Most oil-producing countries have legislation, sometimes referred to as petroleum codes, that addresses the legal and contractual requirements for petroleum exploration and extraction.[211] With few exceptions, most tropical country petroleum codes demonstrate little concern for the environment or native communities. Enacting sectoral legislation reflecting these concerns is an essential step toward providing cultural and environmental safeguards. This section provides recommendations for oil development regulations, and mechanisms for their enforcement.

Environmental provisions in petroleum codes typically require oil companies to prevent or avoid pollution,[212] to comply with environmental laws,[213] and to provide EIAs,[214] or stipulate that oil companies will be liable for environmental damages.[215] Although these are all necessary provisions, petroleum codes should be more specific in their requirements, so that social and environmental protections are increased and oil development takes place in a more stable and predictable business climate.

First, petroleum codes should explicitly state that companies without detailed corporate environmental management procedures will not be considered during the oil concession bidding process. Companies should be prepared to present evidence of a fully operational annual environmental auditing process conducted by independent corporate officers answering directly to the board of directors. In addition, oil companies should conduct environmental assessments, and should have general environmental management plans and emergency procedures for field operations, as well as specific plans for each individual development area. Companies should also be required to submit reports similar to those required by the Securities Exchange Commission in the United States, making full disclosure of the company's compliance record and possible liability from actions brought by government agencies or private parties, and providing an assessment of the impact that environmental compliance could have on the company's balance sheet.

Second, petroleum codes should clearly state that oil development in protected areas is strictly prohibited, and should establish buffer zones to ensure that potentially harmful development near or adjacent to a protected area does not occur. Although in some instances exploration and extraction in protected areas might be inevitable where a concession is awarded protected status after the development contract has been signed, this should be the only exception to the rule. In cases where an oil concession overlaps with a newly created park or reserve, governments should require companies to contribute funds for management of the protected area, and to submit revised oil development management plans explaining what environmental protection measures they will take.

Third, petroleum codes should establish strong protections for local and indigenous communities. Unfortunately, such provisions tend to be even rarer in petroleum codes than are those for protection of the environment. Notable exceptions include Haiti, Canada and Greece. Haiti's petroleum code, for example, contains a provision prohibiting exploration and extraction activities that might damage native villages.[216] Canada's code is one of the only codes that provides indigenous people with a share of royalties from oil and gas activities conducted on traditional lands.[217] The Greek petroleum code requires that all contracts be written in both Greek and English, which helps ensure that local communities are fully informed of the existence of oil activities, and of the mitigation and remediation obligations of the respective parties.[218] Though useful, the above provisions must be supplemented with a more substantial legislative framework requiring companies to make a thorough assessment of the effect of oil activities on stakeholders, and to evaluate the recourse available to stakeholders should complaints arise.

The first step in this process is to require oil companies to conduct SIAs that address issues such as land tenure, colonization, public health, and short- and long-term stress on local and indigenous communities resulting from economic development in the region. SIAs are discussed at greater length in the next section, and in section 4.2 above.

The next step is to require oil companies to identify all community leaders in the project area—including indigenous leaders, local government officials, citizens' groups, and religious leaders—and to include them in the decision-making process through roundtable

Box 5.1: International Environmental Law and Oil Development

International environmental law is one of the most dynamic fields of international law. It is comprised primarily of treaties that address specific environmental issues, for example, the reduction of chlorofluorocarbons, the stabilization of greenhouse gas emissions, and the conservation of biodiversity. In addition, a few important cases have articulated broader international environmental legal principles, and a number of others may emerge over time as customary international law. These emerging principles can be found in both treaties and in non-binding instruments, such as the Stockholm and Rio Declarations.

Environmental Treaties

Although no international treaty controls oil development in the tropics directly, several treaties lay out important obligations that have an impact on the kind of development that should be allowed. Foremost among these is the Convention on Biological Diversity, which sets forth a number of minimum requirements that parties to the convention are supposed to meet to ensure the conservation of biodiversity. Requirements that implicate oil development in biodiverse regions include those requiring the identification and regulation of all activities likely to affect biodiversity significantly, the promotion of environmentally sustainable development, and the introduction of appropriate procedures requiring environmental impact assessment of proposed projects affecting biodiversity.

Customary International Law

Because international environmental law is relatively new, only a few principles have been clearly enunciated as binding customary law. Most notable among these is the prohibition against causing environmental harm in the territory of another State or in the global commons. Principle 2 of the Rio Declaration is widely considered as reflecting customary international law: "states have, in accordance with the Charter of the United Nations and international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." This principle prohibits transboundary pollution or other transboundary environmental damage caused by oil development.

Soft-Law Concepts and Principles

An important part of international environmental law, particularly for understanding its future direction, are emerging concepts and principles. Among the principles that will most directly apply to oil development in the tropics are: the precautionary principle, which requires states to take measures to protect the environment even where full scientific certainty does not exist regarding potential environmental damage; the polluter pays principle, which requires States to enact regulations that make the polluter bear the cost of environmental damage; and the principle of environmental impact assessment, which requires governments to implement environmental impact assessment provisions on activities that may harm the environment, particularly in a transboundary context.

Trade, Investment and the Environment

Environmental provisions are also becoming more common in trade and investment agreements. For example the environmental side agreement to the North American Free Trade Agreement (NAFTA) has provisions intended to strengthen environmental enforcement and to ensure that the lack of environmental legislation does not provide a trade advantage. The Multilateral Agreement on Investment, soon to be negotiated by the OECD, will also include at least some limited environmental provisions that could provide guidance to foreign corporations negotiations.[219] Identifying community leaders may be a difficult task, especially where a project covers a substantial area, or where various phases of the development project involve different parts of communities that are represented by different individuals.[220] In addition, conducting formal negotiations with community leaders who have not traditionally been included in development decisions may present certain difficulties.[221] For example, local groups requiring legal representation to adequately protect their interests may not be accustomed to working with attorneys, and government officials may be reluctant to negotiate with non-governmental entities, especially indigenous people.[222] Nonetheless, this process of identification and negotiation is a critical and realistic goal that may lead to very positive results.[223]

Finally, oil companies should come up with a plan to avoid the potential problems identified during negotiations with government officials and stakeholders; contribute to local communities, (e.g. by funding schools, sanitation projects, health care, etc.); and establish mechanisms to address complaints that arise during the course of the project.

Establishing a complaint mechanism is particularly important. Before a project ever goes forward, local and indigenous communities must have a clear idea of their recourse in the event of a social or environmental crisis. Thus, companies should be required by law to designate corporate representatives whose responsibility it is to respond to any complaint, and who may be contacted at all times. Legislation should also require companies to establish trust funds, to be administered by community leaders, for the purpose of financing legal representation and assistance in the event of a problem. Companies should also provide a document describing the legal framework governing the project, including a summary of applicable constitutional and legislative provisions, as well as a description of the company's contractual obligations. The company should also provide information concerning non-governmental organizations and international institutions, such as the United Nations, the International Labor Organization, and the Inter-American Commission on Human Rights, that might be able to provide assistance in the event of a crisis or dispute.[224]

5.3 Voluntary Guidelines

In countries where little or no legislation governing oil activities exists, companies should establish their own guidelines to minimize environmental damage and adverse social or cultural impacts. Some companies have already taken this step. Chevron's policy, for example, states that if "the laws and regulations in an area where the company operates [do] not adequately protect human health or the environment…, the operating units shall adopt internal standards which provide the necessary protection."[225] Although this clause is broadly worded, leaving it to Chevron's discretion to determine what constitutes adequate protection of human health and the environment, it nonetheless provides a measure of protection which would otherwise be unavailable.

Various trade organizations and NGOs, including the International Association of Geophysical Contractors (IAGC), the E&P Forum, and the World Conservation Union (IUCN), have also drafted voluntary guidelines.[226] These guidelines offer standards for a diverse array of oil activities, including environmental monitoring, training, emergency response planning, road-building, waste disposal, and camp, helipad, airstrip, and bridge construction.

Although voluntary guidelines encourage conscientious best practices, they are purely voluntary and, as such, unenforceable. Thus, while public pressure and consumer awareness may in some cases operate to constrain oil companies, voluntary guidelines can by no means serve as substitutes for legislation. This is perhaps best illustrated by Ecuador's experience. In 1990, Petroecuador (Ecuador's national oil company) and the foreign oil companies operating in Ecuador agreed to abide by voluntary guidelines established by Ecuador's environmental bureau. However, these guidelines did not contain enforcement measures, and no company has fully complied with the requirements.[227] Countries in the process of expanding environmental regulations should also pass legislation incorporating voluntary guidelines by reference and stating that, where they are more restrictive than existing legislation, the guidelines become mandatory.

5.4 Environmental and Social Impact Assessments

EIAs and SIAs are especially critical because they ensure that the environmental and social consequences of oil projects are identified and assessed sufficiently early so that projects can be modified or stopped altogether. Although environmental and social impact assessments should be required in petroleum codes, governments should also enact separate legislation establishing general guidelines and requirements for EIAs and SIAs for all development activities. Ideally, legislation should require government agencies to conduct an EIA and an SIA prior to allowing companies to engage in any oil activities, including preliminary exploration. However, many environmental codes require companies, not the governments, to perform EIAs simply because oil companies may have greater financial and technical resources; this is a workable alternative only if governments supervise the company's EIA process.

In the United States, the National Environmental Protection Act (NEPA) requires the federal government to perform an environmental impact statement before engaging in any major action that could significantly affect the environment.[228] Under NEPA, an EIA must include an examination of the potential environmental impacts of a proposed activity and serious consideration of alternatives, as well as the environmental impacts of the alternatives.[229] Thus, NEPA requires that the federal government and its agencies engage in informed environmental decision-making before a proposed project ever reaches implementation, a requirement that should be included in all petroleum codes.[230]

Similar requirements should apply to SIAs. Although SIAs are only beginning to gain acceptance, functional models produced by the private sector and multilateral agencies exist and can easily be incorporated into oil contracts.[231] Section 4.2 provides a more detailed description of SIAs; this section will focus specifically on the land tenure analysis.

An evaluation of demographics and land tenure patterns in the project area is critical for several reasons. First, rapid population shifts and colonization pressures can result in conditions on the ground that are radically different from official government descriptions of the project area. Thus, lands previously unoccupied at the time of a government survey or census might be supporting significant numbers of settlers with varying degrees of legal title by the time a project is scheduled to begin. In addition, settlers with unclear title generally have little incentive to invest in environmental protections. Second, indigenous people may have land tenure systems based on different conceptions of title, including communal holdings, and different levels of title for varying land uses. These land tenure systems would have to be identified to determine whether conflicts with non-indigenous claims exist. Third, land tenure studies are important to evaluate future settlement patterns and increases in colonization resulting from access roads and pipelines built by oil companies. Finally, demographic and land tenure studies are important because companies and government agencies need to have an up-to-date assessment of the needs of growing populations in project areas to provide the necessary financial and institutional support for future populations.

Some oil companies have been proactive not only in mapping out land tenure patterns in areas affected by oil development, but also in assisting local and indigenous populations to secure title to lands they occupy. Chevron's Kutubu project in Papua New Guinea, for example, demonstrates that oil companies certainly have the resources to make significant financial contributions to local communities, and to assist in resolving title problems.

5.5 Enforcement of Petroleum Codes, EIAs, and SIAs

A petroleum code designed to protect biodiversity and indigenous communities is only as effective as the enforcement mechanism that supports it.[232] Indeed, petroleum codes with no "teeth" often lead to patterns of egregious non-compliance. For example, the environmental agency in Ecuador, Direccion General de Medio Ambiente (DIGEMA), notified oil companies in 1988 that they were required to submit EIAs for approval before initiating any new exploratory or production activities. However, because this requirement was not supported by any enforcement provisions, as of 1991, no company had fully complied with the requirement.[233]

The petroleum codes of several developed countries contain effective enforcement provisions, and using these as models for tropical countries could help increase compliance. France's code, for example, requires companies to provide EIAs and to take necessary measures to avoid pollution. Companies failing to comply with these requirements can be punished with heavy fines, and the company's manager of operations as well as the extraction permit-holder also face criminal liability. Similarly, the petroleum codes of Norway, the United States, Fiji, and the Seychelles also establish corporate liability and stiff penalties.[234]

The United States Federal Oil Pollution Act (OPA) of 1990[235] contains the most stringent penalties for companies causing oil pollution. In addition to establishing criminal liability, OPA states that the United States and Indian tribes can recover all removal costs, natural resource damages, loss of taxes or royalties, injury to real or personal property and resulting economic losses, loss of subsistence use of natural resources, and finally, lost profits or lost earning capacity because of contamination.[236] These provisions are useful in that they protect both government and indigenous people, and act as a significant deterrent to oil companies.

Stiff civil penalties and criminal liability only deter environmental damage if penalties are ultimately applied. However, governments of developing countries with lagging economies and substantial balance of payments deficits often fail to enforce laws, giving priority to immediate economic gains rather than long-term sustainable development.[237] To ensure that governments take action against oil companies with poor compliance records, citizens should have the right to sue the government to enforce its laws, whether or not an actual injury resulted from the company's violation. In addition, the right to sue the government to remedy an actual environmental injury, referred to as "citizen standing" in the United States, has proven to be an extremely effective means of enforcing environmental laws.[238]

In addition to granting citizen standing, legislation should include provisions creating local and national offices that citizens can contact to report wrongdoing by an oil company, or to report the government's failure to enforce its own laws. Government officials should also have the right to make anonymous reports concerning wrongdoing by other government officials.

Finally, in addition to pursuing judicial relief in the country where the oil development occurred, citizens in tropical countries may consider bringing suit against a corporation in the country where the corporation has its main place of business. Although such tactics would subject international corporations to higher environmental standards than purely domestic companies, the overall goal of permitting such suits would be to raise international industry standards. The holding in one such case, *Aguinda v. Texaco,*[239] suggests that foreign plaintiffs suing in the United States will encounter substantial procedural obstacles. Federal courts appear to be sympathetic to oil company claims that litigating in the United States is inconvenient when all the facts and information giving rise to the law suit occurred outside the country. U.S. courts also require a showing that judicial relief in another country is insufficient or unavailable, or that available remedies have already been exhausted before accepting to hear a case; this burden may be difficult to meet where strict environmental laws do exist but are not enforced.

5.6 Funding Mechanisms for Conservation

Funding to offset the environmental and social costs of oil activities and to support local communities is essential to any development project. Legislation requiring environmental insurance policies, performance bonds, and mitigation trust funds can help ensure that financing will be available to meet these needs. Environmental liens attaching the assets of companies failing to provide funds for remediation or for other measures required by law or by contract provide added security. Finally, conservation taxes and tax incentives can also be used to further encourage oil companies to comply with environmental rules and regulations and to generate income for conservation purposes.

5.6.1 Environmental Insurance Policies

Companies should be able to demonstrate to government agencies, as well as to inquiring citizens or indigenous groups, that their policies specifically cover the risk of environmental or social damages. Coverage should last for the duration of the project, and for a sufficient period of time after the project's completion to ensure that any latent problems will be addressed. Finally, although companies should also be required to carry comprehensive general liability policies, these should never be an acceptable substitute to a pollution liability policy.

5.6.2 Performance Bonds

Performance bonds are another mechanism governments should use to mitigate the damage caused by oil projects. A performance bond requires an oil company to post a specified sum of money for environmental mitigation and remediation before any permits are granted.[240] Because companies typically prefer not to disburse the totality of the bond on their own, they usually contract with a third party surety to cover the bond requirement. The third party surety posts the required sum of money, and in return the oil company pays interest on the sum (usually .5-2 percent of the bond amount) and remains ultimately liable for any amount of the bond that is paid out.[241] To ensure that the bond contains sufficient funds to finance any cleanup, bond amounts are set to compensate for "worst-case" scenarios. If no pollution occurs, the bond is eventually canceled. Thus, the bond creates an incentive for the oil company to minimize environmental damage so that the bond never has to be paid out.

Several factors may be taken into account to lessen the financial burden on companies imposed by performance bonds. First, companies with good compliance histories represent less of a risk to governments or third party sureties, and therefore those companies may have lower bondsman fees and decreased financing costs. In addition, bonds may also be phased in and phased out. In other words, as the project scales up, increasing amounts of money would be required. Conversely, as the project scales down, the bond would diminish and interest payments would go down. Thus, the full amount of the bond would only be required during the most intensive phases of the project, and only the amounts necessary to guarantee restoration of the development area would be maintained when development activities come to a close. Performance bonds are a useful supplement to insurance policies, because the bond is automatically released in the event that environmental problems occur. Insurance companies, on the other hand, exercise considerable discretion over what is covered under their policies, and litigation, rather than immediate remedial action, is often the result.

5.6.3 Mitigation Trust Funds

Environmental trust funds (endowments, sinking or revolving funds) are frequently used to disburse money for conservation purposes such as training environmental professionals, surveying and preserving resources, and providing environmental education.[242] Trust funds are also being used for mitigation purposes.

For mitigation trust funds, whose main focus is providing funds to limit environmental damage, an endowment alone may not be the most effective structure. Rather, an endowment with revolving and sinking components might be more useful. A revolving fund requires that money be added periodically. These additional funds are either disbursed as necessary or added to the original capital. Sinking funds are designed to disburse all the principal and income over a predetermined period of time. Thus, sinking funds are relatively short-lived compared to endowments or revolving funds.

In an oil exploitation setting, if no environmental or social harm occurs, the fund may remain an endowment and the interest can be applied to basic conservation and damage prevention measures. However, if damages do occur, the capital could be invaded and disbursed for mitigation, causing the fund to start to sink. Money would be allocated according to the severity of the damage, and a time frame could be established to control the disbursement of money from the fund.

To prevent the fund from being totally depleted, the oil company could be required to contribute additional funds each time the initial principal is reduced by a specified percentage. This is the revolving aspect of the fund. As money from the fund is used to mitigate damages caused by oil activities, the oil company will supplement the remaining principal, thereby ensuring that money is available to correct environmental and cultural wrongs for the duration of the company's activities.

In addition to providing funds for mitigation, establishing an endowment/sinking/revolving hybrid will provide an incentive for oil companies to prevent environmental and cultural damages. Establishing a fund requires significant amounts of money, but if no environmental damage occurs, the company will never have to supplement the fund. Thus the less damaging the company's activities are, the less money it will have to invest.

Establishing trust funds is a complex process, requiring intricate by-laws, a board of directors, and extensive political negotiations.[243] For this reason, mitigation trust funds might be more efficiently managed as sub-accounts in existing environmental trusts. Although provisions for managing the mitigation sub-account would still be necessary, this would nonetheless be easier and faster than establishing an entirely separate fund.

5.6.4 Tax Incentives for Conservation

Tax incentives may also further conservation efforts. For example, governments should reduce taxes for companies proactively investing in more environmentally friendly technology without being required to do so by law; companies that manage, or allow others to manage, their lands for conservation purposes beyond their legal obligations to do so; or companies making charitable contributions to conservation projects or organizations. Such deductions have been used successfully for businesses in the United States, where, for example, farmers can deduct costs of soil and water conservation practices from their taxable income.[244]

5.6.5 Taxation

Conservation taxes on oil activities represent an additional source of funding for conservation measures. Tax revenues would provide a reliable source of funding to increase the administrative capacity of government agencies in charge of environmental protection, as well as for specific conservation projects. Conservation taxation may be structured in different ways. For example, a tax could be levied uniformly industry-wide, subject to reductions if the incentives above are implemented. Alternatively, the tax could be applied as a disincentive, penalizing companies that did not actively pursue conservation measures.

5.6.6 Environmental Liens

In the United States, the Comprehensive Environmental Response, Compensation and Liability Act[245] (CERCLA or Superfund) provides money to clean up inactive toxic waste sites. Once the U.S. government expends money on a cleanup, a federal lien on the liable party's real property is automatically imposed by operation of law, and takes precedence over any subsequently filed liens. Similar provisions might be useful in tropical countries where the funding mechanisms described above for any reason prove insufficient to perform a cleanup (for example, because a company is bankrupt). Legislation giving the government the option to put a lien on all the oil company's in-country assets would help defray cleanup costs, as well as provide a substantial incentive to companies to make money available for environmental remediation.

5.7 Recommendations

5.7.1 Legislation

- *Enact a tiered framework of environmental legislation.* Governments should enact legislation addressing social and environmental issues at every level of governance, from constitutional provisions to national environmental policies, sectoral legislation and agency regulations.

- *Change voluntary guidelines to required best practices.* Voluntary guidelines drafted by NGOs or oil industry associations offer environmentally sound practices for exploration and extraction in the tropics.[246] Modifying guidelines so that they are required rather than voluntary may serve as an effective starting point for regulation, pending enactment of more stringent legislation.

- *Borrow from existing petroleum codes.* Petroleum codes in developed countries such as France and the United States may serve as valuable reference points for tropical countries developing their own legislation. The most effective developed country codes establish strict environmental standards and are supported by enforcement and monitoring provisions.

- *Integrate environmental considerations into the bidding process.* Regulations describing the factors governments take into consideration when weighing bids for oil concessions should make clear that environmental criteria will weigh heavily in determining which company is ultimately granted the concession.

- *Establish a permitting process.* Tropical countries should allow oil activities to proceed only after oil companies have complied with a rigorous permitting process. The permitting process should provide for periodic monitoring to ensure compliance and to ascertain whether new permits are required because of unforeseen changes in the project or in the project area.

- *Seek input from indigenous communities.* Governments should explicitly recognize the rights of indigenous people. These should include their right to continue to occupy traditional lands, their right to compensation for oil activities on their lands, and their right to participate in the decision-making process for oil activities that will affect them.

- *Include economic tools for conservation.* Legislation should include requirements for pollution liability insurance, performance bonds, and mitigation trust funds. Legislation should also give governments the option to put liens on a company's property, if it fails to make required funds available.

5.7.2 Enforcement

Environmental and socio-cultural legislation is ineffective without sufficient enforcement mechanisms. Legislation should include specific provisions for civil and criminal penalties, including fines and imprisonment for violations.

- *Create effective oversight agencies.* Developing countries must have effective regulatory agencies with adequate budgets and the institutional will to force oil companies to comply with codified best practices. Agencies should have the capacity to review EIAs and environmental management plans, issue permits, monitor oil company activities, and enforce regulations. Agencies should also maintain an accessible and transparent administrative process, issue explicit rules and regulations explaining the agency decision-making process in detail, and be subject to judicial review.

- *Allow enforcement by private citizens.* In addition to government oversight, private citizens should have independent means to monitor oil company activities and enforce legislation. Statutes should include provisions creating local and national offices that citizens can contact to report wrongdoing by an oil company. Citizens should also have the right to sue the government for failing to enforce its laws, and oil companies for failing to comply with statutory or contractual requirements.

- *Utilize tort liability.* Foreign oil companies may also be subject to tort liability in a country where they are either headquartered or incorporated. Citizens of the countries in which oil companies operate may consider suing an oil company in the company's home country if adequate judicial relief is unavailable in the country where the environmental damage occurred.

- *Use economic incentives to encourage compliance.* Although legislation enacting strict environmental standards and penalties for non-compliance is necessary, economic incentives to comply with environmental and socio-cultural legislation are sometimes preferable to command-and-control mechanisms. For example, companies meeting certain environmental benchmarks, companies proactively investing in more environmentally sensitive technologies, or companies making voluntary contributions beyond those required by law for environmental causes or for local populations may be rewarded with lower taxes on their profits.

5.8 Contracts

The primary concern for countries and oil companies entering into petroleum development agreements has always been to maximize production and revenues, and to do so at the expense of virtually all other considerations.[247] There are indications, however, that social and environmental concerns are beginning to receive greater attention in oil contracts.[248] In more recent agreements, for example, provisions setting minimum expenditure levels, or requirements that companies train local populations or use local goods or services, have become more common.[249] Many contracts also have provisions requiring that operations be conducted using environmentally sound practices, and mention the obligation to comply with all applicable environmental rules and regulations.[250] However, protection of local populations and the environment still receive too little attention.

Petroleum agreements provide a useful opportunity to translate broad environmental and socio-cultural legislative principles into specific contractual provisions tailored to the conditions at individual project areas. Thus, contracts should go beyond merely integrating legislation and should address the particular problems and concerns arising from the development project, creating stricter standards where necessary to protect areas of special importance or sensitivity.

This section provides an overview of the different formats used for petroleum agreements. In addition, an annex at the end of the paper offers a series of model provisions for an environmentally and socially sensitive contract. Although a contract's format is in no way determinative of its substantive provisions, summarizing the various contract types is useful for two reasons. First, certain contractual structures may be better suited to different social, environmental, or economic pressures. In Latin America, for example, the trend appears to be toward free market reform and privatization, which could signal a return to concession-type agreements. Second, contract formats that in the past have been associated with lax government oversight and environmental safeguards might carry with them an unspoken understanding that oil companies will not be subject to strict regulatory oversight.

5.8.1 Petroleum Agreements

There are five principal categories of petroleum contracts: concessions, production-sharing contracts (PSCs), service contracts (SCs), joint ventures (JVs), and hybrid contracts (HCs). These contracts all serve the purpose of formalizing an oil development arrangement, but are characterized by different arrangements for compensation, and sometimes by different levels of host-country involvement. Although concessions, PSCs, SCs, JVs and HCs are the typical contract types, petroleum contracts often incorporate different clauses and ideas from more than one category, and contract formats and provisions for the same contract type may vary greatly from country to country. Thus, precise categorization of a country's contract may not be possible.[251] Furthermore, although the following discussion of contracts describes certain historical trends or tendencies associated with each contract type, it should be clear that any contract, regardless of its format or duration, can be drafted to provide greater environmental protection or increased government oversight and participation.

5.8.2 Concession Agreements

Concessions are the oldest and most widely used type of petroleum arrangements.[252] During the first half of this century, concessions typically granted a company exclusive rights to explore and exploit a large area for a period of 60 to 75 years in exchange for an up-front payment, and sometimes a small royalty.[253] There tended to be very little involvement by the hosts in the contract implementation, and companies conducted their activities with little regard for host country needs or interests.

Modern concessions allow for more host country involvement, but are still characterized by minimalist government participation in development activities.[254] Under modern concession agreements, companies receive the right to explore, produce, and eventually sell the petroleum they extract from the leased area.[255] The company assumes the costs and risks of the operation and is usually required to relinquish percentages of the concession area at predetermined intervals. The company is also usually required to meet certain obligations, including training and employing nationals, technology transfers, satisfaction of domestic oil consumption needs before export, and use of local goods and services. The host country may also choose to participate in petroleum operations and oil pricing. Finally the host country receives royalties, bonuses, taxes on the company's profits, and a share of profits.[256]

Concession agreements are divided into exploration and extraction phases. In the exploration phase, the company determines whether there is commercial potential in an area. The company is typically bound to a work plan and may be required to expend a specified amount of money[257] The host country typically plays no role during exploration activities, and the company assumes all risks and expenditures.[258] If oil is discovered and the company has complied with work plan requirements, an exploitation permit is granted and extraction begins.[259] Extraction

Seismic team drills for shot holes along a straight survey line at the Tambopata Block, Peru.

is limited to a fixed time during which the company is required to submit yearly progress reports and is obligated to exploit the area to its maximum potential.[260]

Concessions typically last more than 50 years, making it especially important for the company and host country to develop a good working relationship in which environmentally sound practices can be promoted. Although host countries sometimes choose to become involved with production activities if oil is discovered, the host country often chooses not to do so.

5.8.3 Production-Sharing Contracts

The production-sharing contract (PSC), pioneered by Iran and Indonesia, was designed to give more control to the host country over petroleum operations.[261] PSCs have become the trend in developing countries.

Under the Indonesian PSC model, the state-owned oil company Pertamina retains control over all oil production and grants 30-year contracts. Oil companies must agree to an exploration work program lasting six years, minimum expenditures, and the submission of yearly plans to Pertamina for approval. The oil company must also pay Pertamina management fees for facilitating work programs. Under the Indonesian PSC, the company may deduct operating costs plus 20 percent of capital investments from gross production; the remaining production is then divided approximately 66 percent to 34 percent in favor of Pertamina. Pertamina may also require bonus payments once production exceeds an established minimum, and typically the company is also required to pay taxes, train nationals and arrange technology transfers.[262]

Because PSCs normally involve an arrangement in which the host country shares production responsibilities with the company, the host country is much more involved in oil activities.

5.8.4 Service Contracts

There are three kinds of service contracts. The most basic service contracts (SCs) involve arrangements in which an oil company acts as a contractor to perform a particular service for the host country for a flat fee. Because some oil companies find the right to share in production more attractive than cash payments, some service contracts have buy-back clauses allowing the company to purchase oil at a fixed rate after it receives its payment under the contract.[263]

The second kind of SC involves agreements in which the oil company agrees to provide technical assistance in the form of advice, equipment, or training, for all phases of the development project, from exploration to production, and even in some cases for refining.[264] The oil company usually receives a flat fee for its services, plus a fee based on the oil produced as a result of the cooperation.[265]

The most common type of service contract is the risk-service contract (RSC).[266] Under RSCs, oil companies accept all investment risks. If oil is not found, the company receives no compensation for its exploration expenditures. If oil is discovered, the company has the obligation to develop the field. When production begins, the oil company is reimbursed for its investment in cash, or with the right to purchase oil at a discounted price.[267] RSCs are most widely used in Latin America.[268]

Because oil companies operating under RSCs bear substantial risks, they have less of an incentive to worry about social or environmental safeguards. It is therefore especially important for RSCs to include appropriate parameters, so that the company's profit motive does not override environmental protection or the rights of local populations.

5.8.5 Joint Ventures

Joint ventures, sometimes referred to as participation agreements, are established when oil companies form an operating company for exploration and exploitation purposes with the host country government.[269] This arrangement is distinct from production-sharing, because in PSCs the government and oil companies remain independent and do not form a third corporation. However, joint ventures frequently come into being after an initial contract has already been signed, rather than as an initial agreement.[270] Thus, for example, joint ventures are usually formed when a government retains the option to participate in production, or simply retains the option to renegotiate a contract in the event profitable reserves are discovered during exploration.

5.8.6 Hybrid Contracts

Although the four contractual formats described above are conceptually distinct, in practice, petroleum agreements tend to include provisions from several different contract types, regardless of the basic structure. Many agreements, therefore, are at least to some extent hybrid contracts (HCs). However, efforts to assemble completely new types of agreements by borrowing from different contract formats became more prevalent during the 1980s. These new contracts, favored by countries such as India, Liberia, Tanzania, and especially China, were designed to allow countries to reassert control over their natural resources and maximize participation in the production process.[271]

The hybrid contract is perhaps best exemplified by the Chinese arrangement.[272] China followed the Norwegian model requiring that the state oil company have the right to participate in 50-80 percent of production. China then incorporated the Brazilian risk-service contract takeover provision, which states that if exploration is successful, the government automatically enters into a joint management relationship with the company for all oil activities. In addition, the Chinese hybrid contract uses the Indonesian production-sharing contract in-kind repayment scheme to circumvent monetary restrictions. Finally, the Chinese hybrid contract requires strict compliance with the country's new environmental protection laws, and includes a series of provisions addressing monitoring requirements and post-exploration activities.

Under the Chinese model, companies are required to submit EIAs and emergency plans, as well as reports on safety, environmental protection, and accidents occurring during development. Oil companies are also subject to inspections by government officials. In addition, companies are liable for cleanup costs, and must have comprehensive insurance coverage before beginning operations.

6. CONCLUSION

In this paper, we have tried to assemble a practical guide to the latest technologies, ideas and practices for oil exploration and production operations in the tropics. Using these "best practices," oil companies, governments, and local, regional and international organizations can help to minimize the environmental and social impacts of oil development in important tropical ecosystems. However, adoption of these practices will not be enough. At the same time, all stakeholders in the international oil industry must also adopt a new way of thinking about how development should proceed in sensitive ecosystems. Only through the integration of environmental and social criteria into all stages of planning and implementation will oil development and biodiversity conservation be able to coexist in tropical rain forests.

RECOMMENDATIONS

Environmental

Environmental Impact Assessments

- Complete an environmental impact assessment (EIA) as soon as a block is acquired.
- Begin with a scoping period to determine the parameters of the study.
- Conduct baseline studies of the biological features of an area over at least a year.
- Identify alternatives to achieve better environmental protection while meeting the same project objectives.
- Establish a consultation process with all relevant stakeholders.
- Create an environmental management plan (EMP) based on the results of the EIA.

Environmental Monitoring and Evaluation

- Implement a monitoring and evaluation program to track the direct and indirect impacts of an operation.

- Hire an interdisciplinary team of scientists to conduct the program and train local representatives in monitoring techniques.
- Base the ecological monitoring program on a set of indicators, including animal and plant species and broader ecological factors.
- Continue monitoring and evaluation throughout all phases of an operation.

Seismic

- Clear grid lines by hand using machetes and hooks.
- Do not fell trees wider than 20 cm in diameter.
- Make sure all charges go off and back-fill shot holes when finished.
- Forbid hunting and fishing and avoid contact with animals or disruption of migration and breeding.
- Use new technology, such as the Single Group Recorder system to minimize land-clearing and environmental impact of seismic operations.
- Make seismic data public information to reduce the need for repeated seismic surveys in the same concession area.

Helicopters

- Use helicopters to reduce the expense and environmental impact of exploration and eliminate the need to build a road.
- Build helipads as far apart as possible, in existing clearings, if feasible, and away from critical habitats.
- Equip helicopters with long lead lines, to enable them to fly further above the canopy.

Personnel

- Include environmental experts from the start, providing continuity throughout operations.
- Follow an off-shore model for handling personnel, ferrying workers in by helicopter for shift rotations and confining all activities to the base camp area.
- Educate workers about environmental and social issues and regulations and strictly enforce all rules.
- Include environmental and social guidelines and regulations in agreements with contractors.
- Ensure that managers are committed to and actively involved in the environmental strategy.

Land-clearing

- Minimize and, if possible, avoid bulldozer use.
- Minimize vehicle and foot traffic.
- Ford streams only when necessary.
- Minimize the removal of topsoil.
- Use chainsaws, not bulldozers, to clear land for base camps.
- Carefully mark areas to be cleared and ensure that surrounding trees are left alive and healthy for regeneration.

Roads

- Use existing roads when possible.
- Avoid building loops or altering drainage.
- Use newer building materials, such as geotextiles and unimats, to reduce soil compaction and environmental damage from roads.
- Control and monitor roads and other points of access to prevent incursion by settlers and other unauthorized personnel.

Drilling

- Reduce the number of drill sites needed by using cluster wells.
- Utilize directional drilling techniques to increase the number of wells drilled from a single platform.
- Drill directionally to gain access to oil beneath sensitive areas.
- Reduce costs and impacts by using slim hole rigs.
- Avoid contamination of groundwater resources by installing surface casings and monitoring pipes for leaks.

Waste

- Reinject all produced water and monitor casings for leaks and scale build-up.
- Collect liquid and solid wastes in a large-capacity tank during operations.
- Cover all tanks and open pits with netting to avoid trapping wildlife.
- Use a closed-loop mud system to eliminate the need for waste pits and minimize environmental and economic costs.
- Dispose of solids at an off-site disposal facility.

ENDNOTES

1. The "hotspots" approach, developed by Norman Myers in 1988, establishes the top priority tropical ecosystems for biodiversity conservation, based on overall species and phyla diversity, degree of endemism (species restricted to a particular ecosystem and found nowhere else), and degree of endangerment.

2. The megadiversity country approach was first developed by Russell A. Mittermeier in 1988. This approach recognizes that only about 12 out of the nearly 200 nations on earth are home to an inordinately large share of the world's biodiversity. Rough estimates indicate that these 12 countries may harbor 60-70 percent of the planet's terrestrial, freshwater and marine diversity within their borders. A key point of the megadiversity approach is the high level of international responsibility to protect and conserve this diversity.

3. These data are based on findings by Mittermeier et. al. at Conservation International.

4. This is only a rough estimate, as most of the world's insects remain undescribed by scientists.

5. Michael J. Economides, professor of petroleum engineering, Texas A&M University, interview with author, College Station, TX, 13 February 1996.

6. Ibid.

7. W.K. Fraizer and M.R. Brennan, "Implementation of Corporate Environmental and Safety Policy in a Developing Country: More Than Just Compliance," SPE 23251, (Richardson, TX, Society of Petroleum Engineers, Inc., 1991), 4.

8. See, for example: International Association of Geophysical Contractors, *Environmental Guidelines for Worldwide Geophysical Operations* (Houston, TX, IAGC, August 1992); International Union for Conservation of Nature and Natural Resources, *Oil Exploration in the Tropics: Guidelines for Environmental Protection* (Gland, Switzerland, IUCN, 1991); and The E&P Forum, *Oil Industry Operating Guideline for Tropical Rainforests* (London, E&P Forum, April 1991).

9. The most productive part of a reservoir of fossil fuels is in the middle. As the deposits in this section of the reservoir are depleted, operations must move toward the edges of the reservoir, which have lower permeability and lower pressure, and may be more expensive to access. Thus, many oil companies are moving away from reservoirs in the United States or in older fields in the Middle East and toward places like South America and Papua New Guinea that have untouched, younger reservoirs of oil. C.R. Hall and A.B. Ramos Jr., "Development and Evaluation of Slimhole Technology as a Method of Reducing Drilling Costs for Horizontal Wells," SPE 24610 (Richardson, TX, Society of Petroleum Engineers, Inc., 1992), 682; Economides, interview.

10. G.W. Barker, E.J. Steele, and S.J. Baldwin, "Exploration and Production Operations in an Environmentally Sensitive Area," SPE 28737, (Richardson, TX, Society of Petroleum Engineers, 1994), 1.

11. Allanna Sullivan, "Striking it Rich: Where Others Feared to Drill, One Group Hits a Gusher of Oil," *The Wall Street Journal,* 3 January 1996, p. 1.

12. Augusto L. Podio, professor of petroleum engineering, University of Texas at Austin, interview with author, Austin, TX, 9 February 1996.

13. The exception to this rule is PEMEX, Mexico's huge state-owned oil company, which has not made moves toward privatization.

14. *International Petroleum Encyclopedia* (Tulsa, OK, PennWell Publishing Co., 1995), 96.

15. "Economic Reforms," *Market Reports,* 14 April 1993; "Bolivian Petroleum Privatization Taking Shape," 43.

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146. While there is little specific documentation of the social impacts of oil operations, there are numerous accounts of the challenges and problems experienced by indigenous cultures and local communities threatened by encroaching development. These accounts are directly applicable to oil development, as the issues and circumstances which lead to contact and demographic changes, including the presence of outside workers, new access routes into isolated areas and disruption of local market economies, are similar for any large infrastructure project.

147. Many indigenous groups need large territories for migration and foraging purposes, as well as to maintain distance from colonists, mestizos and other human settlements. Any long-term outside presence that reduces the size of these territories, such as development infrastructure and the movement of workers through large-tracts of land, can pose a severe threat to their livelihoods. Glenn Shepard Jr., "The Isolated Indigenous Groups of the Rio Piedras," Report 1, October 1996, 4.

148. The term "isolated" is used in this document to refer to indigenous communities or scattered small indigenous groups that have purposely chosen to remain separate from expanding development frontiers. Many anthropologists argue that even the most isolated groups have had at least some form of contact with the outside, through exposure to settlers, missionaries and other indigenous groups, and through participation in large trading networks that have been established even in the most remote corners of the Amazon. Yet, throughout Latin America there is evidence of many communities that are surviving in the most isolated areas of the Amazon region, because they have avoided contact. As a result of this isolation, little is known about many of these groups. Some anthropologists also believe that some indigenous societies are beginning to re-isolate themselves out of fear that they will meet a similar fate as other groups that have been devastated by contact with migrants brought in by new development projects. Shepard, "The Isolated Indigenous Groups of the Rio Piedras," 2-3.

149. For the purposes of this document, "communities" are defined as a group of households that share a common territory or space.

150. The E&P Forum, *Oil Industry Operating Guideline for Tropical Rainforests,* 3.

151. See: Cindy Buhl, *A Citizens Guide to the Multilateral Development Banks* (Washington, D.C., The Bank Information Center, May 1995) for further information about opportunities for public participation in World Bank projects.

152. "World Bank Operational Guidelines" (Washington, D.C., The World Bank, September 1991), OD 4.20 #13.

153. A recent World Bank study of 25 bank-financed projects determined that projects that do not incorporate social variables "stand a high risk of being less effective than planned or of failing altogether if they neglect to build up sociocultural structures for development." Of the 25 projects, 13 were determined to be "non-sustainable," burdened by higher external costs as a result of neglecting a thorough social analysis at the early stages of a project. Additional analysis of 57 bank-financed projects identified a correlation between the "sociocultural fit" of project design and a positive economic rate of return at project completion (audit) time. The projects that incorporated socio-cultural analysis and mitigation were found to have an average rate of return at audit of 18.3 percent, more than two times the 8.6 percent economic rate of return of the other projects that did not initially consider external social costs. A third analysis of 68 World Bank projects determined that flaws in the social design of 53 percent of these projects led to various problems, including project failure. The study also suggested a direct correlation between the project design and implementation, with most project failures attributed to poor design and thus poor implementation. Michael Cernea, "Knowledge from Social Science for Development Policies and Projects," in Michael Cernea, ed., *Putting People First* (Washington, D.C., World Bank Publications, 1991), 11.

154. The E&P Forum, *Oil Industry Operating Guideline for Tropical Rainforests,* 4.

155. Shell International Exploration and Production B.V., "Social Impact Assessment Guidelines," HSE Manual EP 95-0371, June 1996, 33.

156. Robert F. Wasserstrom, president, The Terra Group, telephone conversation with author, November 1996.

157. J.B. Price, A.P. Power, and D. Henry, "Kikori River Basin Project to Sustain the Environment Alongside Development," SPE 28767 (Richardson, TX, Society of Petroleum Engineers, November 1994, 3.

158. Allyn M. Stearman, "Neotropical Foraging Adaptations and the Effects of Acculturation on Sustainable Resource Use, The Yuqui of Lowland Bolivia," in Leslie E. Sponsel, ed., *Indigenous Peoples and the Future of the Amazonia* (Tucson, AZ, The University of Arizona Press, 1995), 217.

159. A. Elois Berlin, "Adaptive Strategies in a Colonist Community: Socio-cultural and Ecological Factors in Dietary Resource

Utilization," in Debra A. Schumann and William L. Partridge, eds., *The Human Ecology of Tropical Land Settlement in Latin America* (Boulder, CO, Westview Press, 1996), 378-379.

160. This problem is exacerbated by settlers seeking legal title to their respective plots of land, which will eventually be sold to speculators, other colonists or even displaced indigenous peoples. Such colonists are locally referred to as "land salesmen," and it has been suggested that approximately half of all colonist families in the Yasuni region have taken possession of one or more plots. James D. Nations, vice president for Meso-America, Conservation International, interview with author, Washington, D.C., July 1996.

161. This system differs from countries like the United States, where subsoil rights for oil and gas often belong to the owner of the land.

162. Young, "Roads and the Environmental Degradation of Tropical Montane Forests," 974.

163. Chris Jochnick, "Amazon Oil Offensive," *Multinational Monitor,* January-February 1995, 14.

164. Price, Power, and Henry, "Kikori River Basin Project to Sustain the Environment Alongside Development," 3.

165. Shelton H. Davis, "Indigenous Peoples, Environmental Protection and Sustainable Development," IUCN Sustainable Development Occasional Paper, 1988, 13.

166. Shepard, "The Isolated Indigenous Groups of the Rio Piedras," 10.

167. Laurie Goering, "Residents Sue Texaco: Drilling Left Mess in Ecuadorian Jungle," *The Chicago Tribune,* 25 June 1996, 1.

168. Stearman, "Neotropical Foraging Adaptations and the Effects of Acculturation on Sustainable Resource Use," 216-217.

169. Michael Baksh, "Changes in Machiguenga Quality of Life," in Leslie E. Sponsel, ed. *Indigenous Peoples and the Future of the Amazonia (*Tucson, AZ, The University of Arizona Press), 190-191.

170. Richard Piland, *The Possible Socio-cultural Impacts of Oil Exploration Activities on Amerindian Populations in the Amazon,* 1996, 4.

171. Mobil Exploration and Production Peru, Inc., "Contingency Plan for Contact with Voluntarily Isolated Natives," 16 October 1996.

172. James A. Yost, *Assessment of the Impact of Road Construction and Oil Extraction Upon the Waorani Living on the Yasuni,* Prepared for Conoco, Ecuador, Ltd., April 1989, 12.

173. Hillard Kaplan and Kate Kopischke, "Resource Use, Traditional Technology, and Change Among Native Peoples of Lowland South America," in Kent H. Redford and Christine Padoch, eds., *Conservation of Neotropical Forests* (New York, Columbia University Press, 1992),105.

174. Shepard, "The Isolated Indigenous Groups of the Rio Piedras," 8.

175. Napoleon A. Chagnon, *Yanomamö: The Last Days of Eden* (San Diego, Harcourt Brace Jovanovich Inc., 1992), 266.

176. Yost, *Assessment of the Impact of Road Construction and Oil Extraction Upon the Waorani Living on the Yasuni,* 12.

177. Piland, *The Possible Socio-cultural Impacts of Oil Exploration Activities on Amerindian Populations in the Amazon*, 2.

178. Dangerous metals include cadmium, arsenic, lead, mercury, antimony, barium, cobalt, copper, silver selenium, manganese, molybdenum and thallium. Acción Ecologica, *Oil Watch* (Quito, Ecuador, Acción Ecologica, 1996), 76.

179. Center for Economic and Social Rights, *Rights Violations in the Ecuadorian Amazon: The Human Consequences of Oil Development* (New York, The Center for Economic and Social Rights, March 1994), 12.

180. Judith Kimerling, *Petroleum Development in Amazonian Ecuador: Environmental and Socio-cultural Impacts* (Washington, D.C., Natural Resources Defense Council, 1989), 26.

181. Center for Economic and Social Rights, *Rights Violations in the Ecuadorian Amazon,* 9.

182. One observer noted that "when the fish are caught and cooked, they often smell of gasoline." Acción Ecologica, *Oil Watch,* 79.

183. Shell, "Social Impact Assessment Guidelines," 21.

184. Kaplan and Kopischke, "Resource Use, Traditional Technology, and Change," 105.

185. Baksh, "Changes in Machiguenga Quality of Life," 203.

186. Piland, *The Possible Socio-cultural Impacts of Oil Exploration Activities on Amerindian Populations in the Amazon*, 4.

187. Acción Ecologica, *Oil Watch,* 81.

188. Conrad Reining, director, Guatemala Program, Conservation International, interview with author, Washington, D.C., 29 October 1996.

189. Yost, *Assessment of the Impact of Road Construction and Oil Extraction Upon the Waorani,* 18.

190. Price, Power, and Henry, "Kikori River Basin Project to Sustain the Environment Alongside Development," 7.

191. Organization of Indigenous Peoples of Pastaza (OPIP), *Call for Solidarity to Environment and Human Rights Organizations and International Community* (Ecuador, OPIP, June 1995).

192. Wasserstrom.

193. Raul Brañes, "Institutional and Legal Aspects of the Environment in Latin America, Including the Participation of Nongovernmental Organizations in Environmental Management" (Washington, D.C., Inter-American Development Bank, 1991), 21.

194. These countries, and the year the constitution was ratified or revised, are: Colombia (1993), Mexico (1917), Costa Rica (1949), Venezuela (1961), Dominican Republic (1966), Bolivia (1967), Paraguay (1967), Panama (1972), Peru (1993), Ecuador (1979), Chile (1980), Honduras (1982), El Salvador (1983), Guatemala (1985), Nicaragua (1987), and Brazil (1988). Ibid., 20.

195. These countries, and the year of ratification or revision, are: Panama (1972), Peru (1979), Ecuador (1979), Chile (1980), Honduras (1982), El Salvador (1983), Guatemala (1985), Nicaragua (1987), Mexico (1987), and Brazil (1988). Ibid.

196. Judith Kimerling, "Rights, Responsibilities, and Realities: Environmental Protection Law in Ecuador's Amazon Oil Fields," *Southwestern Journal of Law and Trade in the Americas* 2 (Fall 1995): 297-298.

197. Thomas T. Ankersen, "The Tropical Andes: Emerging Trends in Environmental Law and Policy," unpublished report, 1996.

198. S. James Anaya and S. Todd Crider, "Indigenous Peoples, The Environment, and Commercial Forestry in Developing Countries: The Case of Awas Tingni, Nicaragua," *Human Rights Quarterly* 18 (May 1996) 363.

199. S. James Anaya, *Indigenous Peoples in International Law* (New York, Oxford University Press, 1996), 39-55; Davis "Indigenous Peoples, Environmental Protection and Sustainable Development."

200. Kimerling, "Rights, Responsibilities, and Realities," 311-312.

201. Act No. 6938, 1981, (establishes national environmental policy).

202. National Code on Renewable Natural Resources and Environmental Protection, 1974.

203. General Act on Ecological Balance and Environmental Protection, 1988.

204. Basic Environmental Act, 1976 (establishes guidelines for environmental preservation and improvement).

205. Environmental and Natural Resource Code, 1990.

206. Other provisions include economic incentives, education, compulsory national environmental service, zoning laws, and environmental emergency measures. Brañes, "Institutional and Legal Aspects of the Environment in Latin America," 40.

207. Other provisions require environmental impact assessments, licensing and inspection of potential polluting activities, creation of ecological reserves and protected areas, an environmental information system, and disciplinary or compensatory sanctions for violations of the Act. Ibid., 41.

208. These countries are Chile, the Dominican Republic, El Salvador, Haiti, Nicaragua, Panama, Paraguay, Suriname, Uruguay, the Bahamas, Barbados, and Trinidad and Tobago. Ibid., 119.

209. Ibid., 27.

210. Ibid., 36.

211. Exceptions include Bahrain, Palau, and Iceland.

212. These countries, and page numbers in *World Petroleum Arrangements* (New York, The Barrows Company, 1991) are: Belize, 221; Bolivia, 238; Cayman Islands, 367; Fiji, 567; France, 583.

213. Countries and *World Petroleum Arrangements* page numbers: Pakistan, 1117; Puerto Rico, 1213; Papua New Guinea, 1137; China, 404.

214. Countries and *World Petroleum Arrangements* page numbers: France, 583; Papua New Guinea, 1137; China, 404; Ecuador, 500.

215. Countries and *World Petroleum Arrangements* page numbers: Fiji, 567; Norway, 1102; Seychelles, 1263, United States, 1491; Gambia, 622; Ecuador, 500. (Gambia and Ecuador require insurance.)

216. *World Petroleum Arrangements,* 719.

217. Ibid., 357.

218. Ibid., 655.

219. Steven Tullberg, Attorney, Indian Law Resources Center, interview with authors, Washington, D.C., 4 November 1996

220. Ibid.

221. Anaya and Crider, "Indigenous Peoples, The Environment, and Commercial Forestry in Developing Countries," 364-365.

222. Ibid.

223. For more information on identifying and negotiating with community leaders, please see Anaya and Crider, "Indigenous Peoples, The Environment, and Commercial Forestry in Developing Countries," 353-355. Anaya and Crider describe how the Awas Tingni indigenous community on the Atlantic coast of Nicaragua successfully negotiated with the Nicaraguan forestry department and the natural resources ministry to revise a timber concession. Backed by attorneys from the University of Iowa, Nicaraguan counsel, and the World Wildlife Fund, the indigenous community obtained a commitment to sustainable and selective harvesting, recognition of its ownership rights to the management area, and a labor agreement to employ community members. The Awas Tingni also obtained the right to participate in annual negotiations to determine operational plans and timber contracts with the timber company that specify volumes and species to be cut, and setting terms and prices for the harvesting.

224. Kimerling, "Rights, Responsibilities and Realities," 311-312.

225. Frazier, et. al. "Implementation of Corporate Environmental and Safety Policy in a Developing Country," 3 & 199.

226. See: IAGC, *Environmental Guidelines for Worldwide Geophysical Operations,* 1993; The E&P Forum, *Oil Industry Operating Guideline for Tropical Rainforests,* 1991; and IUCN, *Oil Exploration in the*

Tropics: Guidelines for Environmental Protection, 1991.

227. Judith Kimerling, "Disregarding Environmental Law: Petroleum Development in Protected Natural Areas and Indigenous Homelands in the Ecuadorian Amazon," *Hastings International & Comparative Law Review,* 1991, 897.

228. 42 U.S.C. 4321-4370c.

229. Ibid.

230. Ibid.

231. See, for example, Shell, "Social Impact Assessment Guidelines," and World Bank Operational Directives 4.20 and 4.30 on indigenous peoples and involuntary resettlement.

232. Countries and *World Petroleum Arrangements* page numbers: Belize, 221; Bolivia, 238; Cayman Islands, 367; Ecuador, 500; Peru, 1168.

233. Kimerling, "Disregarding Environmental Law," 895.

234. Countries and *World Petroleum Arrangements* page numbers: Fiji, 568; Norway, 1102; Seychelles, 1263; United States, 1491.

235. 33 U.S.C. 2701-2761.

236. Ibid.

237. Blinn, Keith W. *International Petroleum Exploration and Exploitation Agreements: Legal, Economic, and Policy Aspects* (New York, The Barrows Company, 1986), 125.

238. Kimerling, "Rights, Responsibilities, and Realities," 108-109.

239. *Aguinda v. Texaco,* 1996 U.S. Dist. LEXIS 16884 (SDNY Nov. 12, 1996).

240. Performance bonds are a standard feature in construction contracts in the United States and are increasingly being used for environmental purposes. For example, the Texas Parks and Wildlife Department requires performance bonds of $1 million for all pad sites before allowing mineral recovery on their lands. See Staff Guidelines for Mineral Recovery Operations on Department Lands, Texas Parks and Wildlife, February 1996. Similarly, the Florida Department of Transportation requires performance bonds for oil spill contingencies under section 377.2425 of the Florida code, although the Florida Supreme Court recently held that the Department of Transportation could not require a performance bond if the oil company had already paid an annual fee into the Florida Petroleum Exploration and Production Bond Trust Fund. *Department of Environmental Protection v. Coastal Petroleum Company,* 660 So. 2d 712 (1995)

240. Ian Bowles, et. al. *Encouraging Private Sector Support for Biodiversity Conservation: The Use of Economic Incentives and Legal Tools* (Washington, D.C., Conservation International, 1996).

242. Rubin, Steven, et al., "International Conservation Finance: Using Debt Swaps and Trust Funds to Foster Conservation of Biodiversity," *The Journal of Political & Economical Studies,* 1994, 34.

243. "Environmental Funds: The First Five Years," a preliminary analysis for the OECD/DAC Working Party on Development Assistance and Environment, April 1995, 7.

244. U.S. Internal Revenue Code §175(a), 1994. Brazil and Guatemala create exemptions for private lands used as reserves, although enforcement problems have reduced the effectiveness of their laws. Bowles, et. al. *Encouraging Private Sector Support for Biodiversity Conservation.*

245. 42 U.S.C. 9601, et seq.

246. For example, the guidelines offered by IUCN, IAGC, and the E&P Forum provide standards for many aspects of the exploration and extraction process, including: monitoring and reporting requirements, safety and training programs, evaluation of potential spill or accident scenarios, and the development of emergency response plans.

247. Zhiguo Gao, "Recent Trends and New Directions in International Petroleum Exploration and Exploitation Agreements," *World Competition,* 1994, 113-114, 125.

248. Ibid., 113-114.

249. Ibid.

250. Ibid., 124-125.

251. Ernest E. Smith & John S. Dzienkowski, "A Fifty-Year Perspective on World Petroleum Arrangements," *Texas International Law Journal* 24 (1989): 13, 35.

252. Honoré Le Leuch, "Contractual Flexibility in New Petroleum Investment Contracts," in *Petroleum Investment Policies in Developing Countries (*London, Graham and Trotman, 1988), 89.

253. Ibid., 14.

254. Smith and Dzienkowski, "A Fifty-Year Perspective on World Petroleum Arrangements," 36-37.

255. *World Petroleum Arrangements,* 62-68.

256. Ibid.

257. Ernest E. Smith, "International Petroleum Development Agreements," *Natural Resources and Environment* (Fall 1993): 38-39.

258. Ibid.

259. Ibid.

260. *World Petroleum Arrangements,* 62-68.

261. Smith and Dzienkowski, "A Fifty-Year Perspective on World Petroleum Arrangements," 37.

262. Ibid., 38-39.

263. Ibid, 40.

264. Ibid, 40-41.

265. Ibid, 41.

266. Barrows (1982), 55.

267. *World Petroleum Arrangements,* 32.

268. Smith, "International Petroleum Development Agreements," 62.

269. Ibid., 62-63.

270. Ibid.

271. Thomas W. Walde and George K. Ndi, "International Oil and Gas Investment: Moving Eastward?" *International Energy and Resources Law and Policy Series,* 1994, 323.

272. Ibid.

ANNEX 1

Model Provisions for an Oil Contract

In this section, we have assembled a series of effective provisions found in various petroleum contracts from all over the world. The result is a series of model contractual provisions which should promote further innovation and discussion for facilitating the conservation of biodiversity and the preservation of indigenous cultures.

1. Language

Contract written in _________, _________, _________, and each version shall have equal force and effect. Technical documents shall be in English and _________. Forms shall be printed out in _________.

This provision ensures that all stakeholders and affected parties understand the full meaning of the contract. However, it should not be seen as a substitute for competent advice on the meaning of the contract's terms. Affected parties, particularly local communities, should have access to a translation of the contract into easy to understand language.

2. Contract Area

(Delineate scope and size of area designated for exploratory and exploitation activities.)

This provision may also contain clauses relevant to oil development in protected areas. For example, identification of the status of the area in this part of the contract would safeguard protected areas in the case where environmental provisions elsewhere in the contract proved ineffective. The contract could specify procedures or higher standards which would apply to oil activities in protected areas found within the parameters of the contract area. Recognizing protected areas formally in this provision may be a disincentive to oil companies unwilling to tangle with more restrictions. In some countries, such as Peru, however, certain protected areas are open to a certain amount of development.

3. Management

Parties shall establish an advisory committee from Date of Commencement. The committee shall be composed of _____ representatives from host country agencies, the oil company, local communities and concerned environmental organizations. The committee shall offer advice on a financial mechanism for mitigation, dates of contract, insurance policies, training programs, and contractor's Environmental Impact Assessments and contract changes. Decisions by the committee require _____ affirmative votes for a quorum.

An advisory committee[1] is a mechanism to ensures that a host country's petroleum reserves will be developed cooperatively,[2] and that local communities have a voice in this development. Membership, voting procedures, etc., can be tailored to the needs and desires of the parties. New contracts entered into by the same partners in the same area can function under the same committee.

4. Duration

Exploration: x years
Production : y years

Duration may be divided into phases which themselves may be prolonged for a reasonable time. The ability to prolong the contract may provide the company with an incentive for compliance. In addition, a longer period may allow the parties to develop a steady working relationship and provide an opportunity for consultation with local stakeholders. Participation by the host country and local community in monitoring oil company practices can lessen the risk of long-term environmental and social damage. The advisory committee should be consulted before the company moves to the production phase and between each different phase of production.

5. Environment

5.1 Environmental Impact Assessment (EIA)

No exploration or exploitation operation may be undertaken without supplying, prior to beginning activities, at the expense of the Contractor, a report on the biological, ecological, and social characteristics of the zone covered by the corresponding title, plans for protection against uncontrolled flow of hydrocarbons, water pollution, removal of waste, and social disruption resulting from drilling. Contractor shall submit EIA to government authorities for approval. The advisory committee and members of the local community should have the opportunity to review and comment on the EIA. All proposed contract changes should be submitted in writing to government authorities, and approval must be obtained before changing approved procedures.

An EIA is almost universally recommended as a process for making an informed decision on whether or not to develop an area. If a decision is made to proceed, an Environmental Management Plan (EMP) should be created immediately. The EMP serves to mitigate the impacts of exploration and production activities and provides a model for similar future operations. If damages do occur, the parties can refer to the EMP to repair the damage. Requiring approval by government authorities will help ensure the accuracy and completeness of the information contained in an EIA. Allowing review and comment by the advisory committee and community authorities ensures that local people play an active role in the planning process.

5.2 Best Practices

Contractor shall undertake all operations according to best international standards for environmental and social protection. A competent, neutral party should be appointed to monitor the Company's procedures. The monitoring schedule should be consistent with the best practices. The neutral party shall alert the government and the advisory committee immediately after detecting the Company's non-compliance with the established guidelines. An arbiter shall be designated immediately upon notification of the Company's non-compliance, pursuant to the arbitration clause contained in this agreement.

This provision is perhaps the key to environmental and social protection in an oil development contract. The recommendations that are adopted as best practices should serve as guidelines for all oil activities. Regular monitoring of company practices by a neutral third party will ensure compliance with the selected best practices.

5.3 Mitigation

Contractor shall take all necessary measures to mitigate any pollution or damage caused by activity related to exploration and exploitation. Such measures shall include, but are not limited to:

5.3a Securing insurance to cover pollution, and

5.3b Posting an environmental performance bond.

5.3c Contributing to an existing mitigation trust fund. Contractor may also be required to establish a mitigation trust fund.

5.3d The extent of insurance coverage, the amount of the environmental performance bond, and the amount of contribution to a mitigation trust fund shall be determined by the government in consultation with the advisory committee. Funds will be used to remedy any pollution or damage caused by operations immediately upon detection.

This provision requires the Company to take measures to minimize potential environmental harm. Requiring the Company to obtain insurance and to post an environmental performance bond should provide incentives for the Company to abide by best practices. If environmental harm does occur, the insurance and performance bond will provide the funds necessary to mitigate the damage. Prompt action after harm occurs will greatly reduce both the potential environmental impact of an accident or pollution-causing event and the cost of subsequent remedial measures, such as restoring natural habitat.

5.4 Strict Liability

Where any petroleum is discharged during exploration or production, the Contractor is liable to reimburse any person (including the State) who suffers damage. Damage includes any harm or injury, to the environment, property, or self, resulting from the Contractor's activities.

This provision was adopted from Norway's 1985 Petroleum Act.[3] Strict liability in the contract allocates parties' responsibilities for pollution related to oil activities. A parallel concept is found in the Civil Liability Convention (CFC), which holds oil companies strictly liable for oil tanker accidents.

6. Applicable Laws

Contractor states that it is fully aware of all current laws and regulations regarding petroleum, the environment, and indigenous communities, and undertakes to be subject to all such laws.

This provision ensures that the company will be bound by all of the host country's pertinent legislation, including laws regarding the environment and native peoples.

7. Indigenous Peoples

7.1 Guidelines

Company shall acknowledge and respect the rights of the indigenous community throughout exploration and extraction activities. To effectuate this condition, Principles 1, 10, and 22 of the Rio Declaration on Environment and Development should be followed.[4] Also, Contractor's activities should conform to the United Nations Draft Declaration on the Rights of Indigenous Peoples.[5] Special attention should be given to Part II of the Draft Declaration, which rejects the four principal threats to indigenous people's survival: forced relocation, forced assimilation, militarization of their territories, and official denial of their indigenous identity.

This clause provides specific standards regarding the rights of indigenous peoples. Requiring the Contractor to abide by these progressive standards will promote the protection of indigenous cultures.

7.2 Provision in EIA

The EIA, in addition to evaluating environmental impacts, shall address the potential effects of oil activities on indigenous peoples. The EIA should also include measures to avoid negative impacts on native communities.

Requiring consideration of the effects of oil activities on indigenous people is a proactive requirement that should help prevent harm before it occurs. If oil activities do interfere with local people, the EIA will provide guidelines for correcting the infraction.

8. National Heritage

Contractor shall inform host country authorities immediately about any archeological find, and cease any practice which may harm such find, until cleared by notified authorities.

This clause protects archeological finds and prevents the possibility of further damage by requiring the Contractor to cease activities. Procedures for proceeding in this event should consider both the need for protecting significant archeological sites and the Company's desire to conduct operations in the region.

9. Taxation

Typical taxation rates are between 40% and 50%. Host country should consider allocating a specific percentage of this tax towards conservation measures.

This clause could contain innovative measures for promoting conservation. Tax money that would typically go to the host country government could be used for the preservation of indigenous cultures, scientific research, environmental education, or other conservation activities.

9.1 Sustainable Development Fund

Contractor shall pay ____% profits/barrel for the establishment of a Sustainable Development Fund. Payment shall be made within 30 days from the end of the year when commercial production is established; subsequent contributions shall be made quarterly within ____ days after the ending of each calendar quarter.[6]

Money from this fund should be used to finance studies for the sustainable development of petroleum and the development of renewable energy resources. The fund should be administered by an organization that is independent or semi-independent from the government. Governance of the fund should be conducted with NGO and community input.

10. Arbitration

Parties shall submit all disputes of contractual terms and performance to an arbitration panel following procedure and rules designated by the International Arbitration Association.

Many business agreements include similar arbitration clauses. Arbitration is the preferred method of dispute resolution in construction and similar contracts. The process generally yields a less expensive and more expedient and technologically informed decision than litigation. The company can then spend funds it would normally allocate toward litigation on mitigation measures. Arbitration also enables the parties to continue performance in other areas while disputed issues are being resolved.

11. Assignment

Contractor may not transfer contractual rights and obligations, in whole or in part, without written consent of (the host country).

This clause provides that the Contractor cannot transfer its exploration and/or exploitation rights to another company without approval of the host country.

12. Responsibility for Subcontractors

The Contractor shall be responsible for all activities conducted by subcontractors. Contractor's responsibilities shall include, but are not limited to, financial liability for any environmental or social damages caused by subcontractors. Subcontractors shall abide by the same best practices required of Contractor.

This clause ensures that any activities conducted by subcontractors will require the same best practice standards required of the primary contractor. Also, making the primary contractor responsible for a subcontractor's environmental and social impacts provides incentive for the contractor to subcontract with responsible and reputable groups.

13. Data

To ensure that all relevant information is communicated to the Parties, any samples and any other information on the region's geology or environment, obtained during exploration activities, shall be submitted to the government. After a 5-year period, such information will be made available to both public and private sectors.

Requiring the company to provide information it discovers regarding the geology and/or environment of a region will help the country in assimilating knowledge about its natural resources. Making this information public after five years will allow access for both the private and scientific communities.

ENDNOTES

1. Similar advisory committees have been used in several countries to provide a consultation mechanism at oil operations. China’s 1988 Offshore Model Contract and India's February 19, 1988 production sharing contract each includes a provision for an advisory committee, called a Joint Management Committee. *World Petroleum Arrangements* (New York, The Barrows Company, 1991).

2. Zhiguo Gao, *International Petroleum Contracts: Current Trends and New Directions* (London, Graham & Trotman, 1994), 168.

3. Act 11 of March 1985, *World Petroleum Arrangements*, 1094, 1099.

4. Principle 1: “Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.” Principle 10: “Environmental issues are best handled with the participation of all concerned citizens, at the relevant level…” Principle 22: "Indigenous people and their communities and other local communities have a vital role in environmental management and development because of their knowledge and traditional practices…"

5. The U.N. Draft Declaration has not been passed as a formal declaration. However, it was submitted to the U.N. Commission on Human Rights in 1995 with the request that the Draft Declaration be considered as expeditiously as possible.

6. Gao, *International Petroleum Contracts*, 255.

GLOSSARY

*ACIDIZE: To treat oil-bearing limestone or other formations with acid for the purpose of increasing production.

*ANTICLINE: Rock layers folded in the shape of an arch. Anticlines sometimes trap oil and gas.

BASE CAMP: Area that houses oil workers while in the field, including kitchen facilities, water wells, and equipment maintenance areas.

BLOCK: A designated land area leased to an oil company for petroleum exploitation. Blocks are granted to oil companies after a competitive bidding process.

*BOREHOLE: A hole made by drilling or boring.

*CASING: Steel pipe placed in an oil or gas well to prevent the wall of the hole from caving in, to prevent movement of fluids from one formation to another, and to improve the efficiency of extracting petroleum if the well is productive.

CLOSED-LOOP MUD SYSTEM: A series of above-ground steel tanks loaded on flatbed trucks to store, process, and recycle drilling mud, cuttings, and other fluids. This system is used in place of the traditional waste pits at a drilling operation.

CLUSTER PLATFORM: A solitary oil platform designed to allow the drilling of multiple oil wells that are directionally angled to reach neighboring oil reservoirs.

COILED TUBING: A continuous string of flexible steel pipe on a large reel that is used in oil drilling operations. The flexibility of the tubing allows wells to be drilled at greater angles.

CONDENSATE: Natural gas in a liquified form.

*CUTTINGS: The fragments of rock dislodged by the drill bit and brought to the surface in the drilling fluid.

*DERRICK: A large load-bearing structure, usually of bolted construction, placed over the oil well. In drilling, the standard derrick has four legs standing at the corners of the substructure.

*DIRECTIONAL DRILLING: Intentional deviation of a borehole from the vertical.

*DRILL BIT: The cutting or boring element used for drilling.

DRILLING RIG: The physical structure that supports and encompasses the machinery and equipment for the oil well.

*DRILL SITE: The location of a drilling rig.

DRILL STRING: Steel pipe tipped with a drill bit that breaks through the ground to create the well.

*DRILLING MUD: A specially compounded liquid circulated through the wellbore during rotary drilling operations.

2D SEISMIC TECHNOLOGY: A traditional form of seismic exploration that uses sound waves to produce two-dimensional line recordings of three-dimensional wavelengths. Collected data is interpreted by geologists to determine the presence of oil reservoirs.

3D SEISMIC TECHNOLOGY: A method of seismic exploration that uses a high speed computer to produce three-dimensional images of a geological structure. Computer enhanced images provide a more accurate and detailed seismic image.

4D SEISMIC TECHNOLOGY: An advanced seismic survey method that adds the element of time to the 3D seismic technology, using models throughout the stages of production. This method allows companies to identify drainage patterns and geologic processes that may improve the yield of oil reservoirs over time.

EFFLUENT: Liquid waste material.

*FAULT: A break in the earth's crust along which rocks on one side have been displaced (upward, downward, or laterally) relative to those on the other side.

FOOTPRINT: A word used to describe the area of direct environmental impact of an oil operation on the land.

FRACTURING: A pressurization method to increase the productivity of an oil well by pumping sand and chemicals into the drill hole to further fracture the formation, thus facilitating the flow of additional oil into the well.

FORMATION WATER: A mixture of oily and salty water that is discharged from the well during drilling operations. This liquid accounts for 98 percent of the waste stream during drilling operations.

*GEOPHONE: An instrument placed on the surface that detects vibrations passing through the earth's crust.

*HORIZONTAL DRILLING: Deviation of the borehole at least 80 degrees from vertical so that the borehole penetrates a productive formation in a manner parallel to the formation.

*HYDROCARBONS: Organic compounds of hydrogen and carbon whose densities, boiling points, and freezing points increase as their molecular weights increase. Although composed of only two elements, hydrocarbons exist in a variety of compounds, because of the strong affinity of the carbon atom for other atoms and for itself. Petroleum is a mixture of many different hydocarbons.

MULTILATERAL WELL: Multiple wells drilled from a single platform at various angles to reach neighboring oil reservoirs.

NEOTROPICS: Tropical areas in the Western hemisphere, also called the "New World" Tropics.

PROVEN RESERVES: Oil reserves that are known to exist.

RECOVERABLE RESERVES: The total amount of oil that is capable of being extracted from an oil reservoir with current technology.

RESERVE PITS: Also called waste pits. Open pits designed to store drilling wastes, primarily drilling mud, which contains oil and many chemical additives.

*RESERVOIR: A subsurface, porous, permeable rock body in which oil and/or gas has accumulated.

*SEISMIC: Of or relating to an earthquake or earth vibration, including those artificially induced.

SEISMIC LINES: Narrow lanes cleared of vegetation in preparation for a seismic survey.

*SEISMIC SURVEY: An exploration method in which strong low-frequency sound waves are generated on the surface or in the water to find subsurface rock structures that may contain hydrocarbons. Interpretation of the record can reveal possible hydrocarbon bearing formations.

SHOT-HOLE METHOD: A method of seismic surveying which utilizes the incremental detonation of underground explosives in shallow boreholes along a straight survey line. The resulting sound waves are analyzed by a geophone and the resulting depiction of the underground geology is analyzed for the potential presence of oil deposits.

SLIM HOLE TECHNOLOGY: A drilling technology that allows workers to drill narrower wells using less materials and equipment. This style of drilling has the potential to reduce the environmental impact of oil operations and save costs on equipment, materials and personnel.

SLURRIED WASTE: A mixture of rock fragments, mud, oil, and water produced from the drilling process.

*TUBING: Relatively small-diameter pipe that is run into a well to serve as a conduit for the passage of oil and gas to the surface.

VIBROSEIS METHOD: A method of seismic surveying in which specially designed trucks vibrate the ground for 20-30 seconds. The returning sound waves are then analyzed as an indication of the underground geology and potential presence of oil deposits.

*WILDCAT: An exploratory well drilled in an area where no oil or gas production exists.

*Source: Ron Baker, *A Primer of Oilwell Drilling* (Austin, TX, Petroleum Extension Service: Division of Continuing Education, The University of Texas at Austin, 1994), 159-188.

LIST OF ABBREVIATIONS

ARCO	Atlantic Richfield Company
B/D	Barrel per day
BBL	Barrels
BCF	Billion cubic feet
BP	British Petroleum
CAF	Andean Development Corporation
CEC	Chemically enhanced centrifuging
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (United States)
CFT	Cubic feet
CLC	Civil Liability Convention
CLMS	Closed-loop mud system
CONAIE	The National Indigenous Confederation of Ecuador
DIGEMA	Direccion General de Medio Ambiente (Ecuador)
E&P	Exploration and production
EC	European Community
EIA	Environmental impact assessment
EMP	Environmental management plan
ENAP	Empresa Nacional de Petroleo (Chile)
FC	Fund Convention
GATT	General Agreement on Tariffs and Trade
GIS	Geographic Information System
HA	Hectares
HC	Hybrid contract
IAGC	International Association of Geophysical Contractors
IDB	Inter-American Development Bank
ILG	Incorporated land group
ILO	International Labor Organization
IUCN	International Union for Conservation of Nature and Natural Resources
JV	Joint venture
LNG	Liquified natural gas
MDB	Multilateral Development Bank
M&E	Monitoring and Evaluation
MMCFD	Million cubic feet per day
MW	Megawatt
NAFTA	North American Free Trade Agreement
NEPA	National Environmental Protection Act (United States)
NGO	Non-governmental organization
NORM	Naturally occurring radioactive material
OPA	Oil Pollution Act (United States)
OPIP	Organization of Indigenous Peoples of Pastaza
PDVSA	Petroleos de Venezuela S.A. (Venezuela)
PNG	Papua New Guinea
PPM	Parts per million
PRRA	Participatory rapid rural appraisal
PSC	Production-sharing contract
RSC	Risk-service contract
SC	Service contract
SEA	Single European Act
SGR	Single group recorder
SIA	Social impact assessment
TBA	Transportable by anything
TCF	Trillion cubic feet
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
YPF	Yacimientos Petroliferos Fiscales (Argentina)
YPFB	Yacimientos Petroliferos Fiscales Bolivianos (Bolivia)

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