SOCIOECONOMIC ROOT CAUSES OF BIODIVERSITY LOSS:
AN ANALYTICAL APPROACH PAPER
FOR CASE STUDIES

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I. INTRODUCTION

This paper is intended as an analytical approach for a series of case studies that will explore the socioeconomic root causes of biodiversity loss. These case studies will be carried out in many different locations, with a variety of environmental and socioeconomic conditions. In each location, biodiversity is threatened by human activity. Socioeconomic factors–including social, economic, political, and cultural factors–are at the root of these activities that are destroying habitats and species. The case studies will expand our understanding of these root causes of biodiversity loss as a crucial first step in developing effective strategies for biodiversity conservation.

The synthesis and review of literature provided by this paper will serve as the theoretical and methodological underpinning for these case studies. The connections between social and economic structures and biodiversity loss are not well understood. Interdisciplinary methodologies for the study of environmental problems, integrating knowledge and methods from a variety of social and biological sciences, are in the early stages of development. This paper should provide a useful reference tool and analytic guidelines for the teams carrying out the case studies. What is offered here is a first attempt to bring together knowledge from a variety of fields related to the causes of biodiversity loss. Given the diverse circumstances and the wide range of natural and socioeconomic environments in which biodiversity loss is occurring, each case study will necessarily adopt an approach and draw conclusions appropriate to each particular case. The material presented here should provide a common, though broad, framework for analyzing root causes. This framework is intended to ensure coherency across diverse case studies and facilitate general conclusions.

The paper is organized as follows: This section explores the need for new approaches to understanding the causes of biodiversity loss. Section II provides methodological suggestions and guidelines for the case studies and reviews the challenges in this type of research. The development of conceptual models is proposed as the most useful way to describe the links between biodiversity loss and socioeconomic factors. Section III presents a framework for understanding the root causes of biodiversity loss, and provides a review of key theories about probable root causes. These are illustrated with examples from the existing literature. Definitions of key terms are provided in an appendix, and an extensive bibliography is included.

Current literature on socioeconomic causes of environmental degradation is reviewed in order to draw some general hypotheses about the likely causes of biodiversity loss, and to explore and evaluate the range of methodologies available for analyzing these issues. The literature on socioeconomic causes of biodiversity loss is limited. However, a wide literature on the roles of human migration, population growth, economic policies and structures, poverty, cultural and social structures, and development patterns in determining resource exploitation provides a basis for examining the question of biodiversity loss. Examples drawn from existing case studies in this literature are used to illustrate the type and complexity of linkages leading to environmental

change. The literature review is not exhaustive; only the key arguments are discussed here. References are provided for further information[1].

Proximate Causes of Biodiversity Loss

The IUCN has defined **biological diversity** as:

> The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems[2].

Loss of biological diversity is occurring across all of these ecosystems and across all forms of biodiversity. The proximate causes have been thoroughly examined in conservation literature[3]. They are, in brief:

- habitat alteration and loss;
- over-harvesting;
- species and disease introduction; and
- pollution and climate change.

Of these, **habitat alteration** is the primary cause of biodiversity loss world-wide. Habitat alteration, essentially modifications of land cover and of aquatic habitats for human use, includes not only outright destruction or transformation but also reduction and fragmentation of habitats that in turn reduce the complexity of ecosystems.

> Some organisms, such as the smallpox virus, have been driven to extinction "in the wild" because they have been perceived as a threat to human welfare. Some, such as the Moa, have been driven to extinction because of their desirable consumption properties. For most, however, extinction has been the incidental and usually unanticipated consequence of [human] activity that has destroyed their habitat–as is currently the case with the thousands of species being driven to extinction annually due to the destruction of tropical rainforests and coral reefs.[4]

Habitat loss in terrestrial ecosystems is driven primarily by conversion for agriculture and settlements. Logging and development of tree plantations also contribute significantly to loss and fragmentation of terrestrial habitats. Hunting and extraction have significant impacts on

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[1] Most citations are summary articles or reviews of particular issues. They have been selected because they will provide useful further reading and lists of references for the teams carrying out the case studies, not because they are the most current sources for the ideas discussed.

[2] IUCN 1994, 16

[3] For good reviews of the proximate causes, see McNeeley et al. 1990; Barbier et al. 1994; Perrings et al 1995; and ESD 1995.

[4] Perrings et al. 1995, 13

biodiversity even when habitats remain intact[5]. Habitat loss in aquatic ecosystems is driven primarily by pollution. Commercial overharvesting and introduction of exotic species also have major impacts on aquatic ecosystems[6].

Rationale

To understand why such extensive alteration and destruction of habitats is occurring, it is essential to understand what lies behind these proximate causes. Only by exploring and understanding the root causes–the socioeconomic factors that drive people to degrade the natural environment–will we be able change this behavior and halt the loss of biodiversity.

Many current hypotheses about the root causes of biodiversity loss are contradictory. For example:

- poverty causes biodiversity loss, or exploitation of the environment by the wealthy causes biodiversity loss;
- economic development causes biodiversity loss, or underdevelopment causes biodiversity loss;
- rural over-population causes biodiversity loss, or shrinking rural populations cause biodiversity loss;
- traditional slash-and-burn agriculture causes biodiversity loss, or modern commercial agricultural production causes biodiversity loss, and so on.

That each of these assertions can be proven in specific cases, suggests strongly that there are some underlying root causes that offer a more satisfactory explanation of biodiversity loss.

Most analyses of the economic, social, political, and cultural causes of biodiversity loss have focused on the local level. The complexity and importance of local drivers of biodiversity loss have been revealed and explored in detail by this work. This focus on the community and micro-regional level has led to an emphasis on conservation solutions at the same level, some of which have proven effective. Other work has focused on particular sectors and, likewise, has found solutions to some specific environmental problems. The continuing loss of biodiversity, however, points to the need to take a broader look at the factors driving environmental change.

This paper seeks to connect well-known micro-level and sectoral drivers to the broader range of socioeconomic factors that shape the decisions made at the local level. A complex overlay of political, economic, and social causal factors at local, regional, national, and international scales is driving biodiversity loss. Even in isolated areas, where much biodiversity loss is occurring, a number of causal factors beyond the local level are likely to be at work. This larger context in which environmental decisions are made is too often ignored. To find more effective conservation solutions, we must step back and look at the broad range of influences on local resource use.

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[5] Redford 1992

[6] ESD 1994

Expanding the unit of analysis from the local to the global level reveals the extensive scale on which biodiversity loss is occurring. Virtually everywhere, development today entails biodiversity loss. Successful and unsuccessful attempts to promote development are contributing to destruction and degradation of habitats, overharvesting, and loss of biodiversity around the globe. The need for parks, as islands where the environment must be left alone, is a clear indication of the strength of the general trend toward altering natural environments. All other areas are threatened by environmental change.

These case studies must be open to grappling with the variety and complexity of factors driving biodiversity loss and the equally complex solutions that will be required. Their primary objective is to address these fundamental questions about the pervasive trend toward environmental change:

- **What are the underlying socioeconomic forces and circumstances driving biodiversity loss?**
- **How are these root causes interlinked?**
- **What are possible responses to these forces and circumstances that could reduce the pressure on biodiversity?**

This paper focuses on ways to address the first two questions. Only when these two are well answered for a particular site, can work on appropriate responses to the problem of biodiversity loss begin. Development of viable solutions will require the participation of a wide range of policymakers and stakeholders, which is beyond the immediate scope of these case studies. However, the case studies can offer useful recommendations and directions for thought based on a deep understanding of the root causes of biodiversity loss.

The importance of biodiversity conservation has been clearly established; there is no need to further justify a study of biodiversity issues here. Certain assumptions about biodiversity are made in this approach paper. They should also be adopted by the case studies, to ensure that efforts are concentrated on understanding root causes of biodiversity loss. These fundamental assumptions are:

1. Biodiversity should be conserved.
2. Biodiversity is best conserved in its natural habitat.
3. Protected areas are an important component of biodiversity conservation.
4. The area currently protected (both *de facto* and *de jure*) is insufficient to protect biodiversity.
5. Biodiversity conservation must be an integral part of natural resource use outside of protected areas.
6. Current conditions–economic, political, social, cultural–generally do not favor biodiversity conservation.

Root Causes

The root causes of biodiversity loss have been repeatedly enumerated, despite the shortage of substantial analysis of the impact of particular causes or of the linkages among causes. All lists of causes suggest the same group of socioeconomic factors.[7] The categories used in this paper are broadly inclusive of most of the proposed causes. These categories also reflect common divisions and distinctions in the literature. Within each category a variety of theories, arguments, and studies offer diverse explanations for environmental degradation, such as biodiversity loss. Five categories are used here:

- Demographic Change
- Inequality and Poverty
- Public Policies, Markets, and Politics
- Macroeconomic Policies and Structures
- Social Change and Development Biases

This division into five separate causes is necessarily artificial–all of these factors are closely interlinked and the relationships among them are complex. Moreover, they tend to reinforce each other. While one cause or another may predominate in a particular set of circumstances, many factors are often pushing in the same direction. Biodiversity loss is, for the most part, over-determined. In other words, in a particular location, all of these causes may be at work, contributing to biodiversity loss separately or in conjunction with one another.

These five root causes can be brought together under the common umbrella of the development model. Development as currently understood is defined by high levels of consumption and access to consumer goods, which require increasing resource consumption and transformation. The economic, political, social, and cultural structures that shape our world promote resource consumption and transformation and recognize little value in biodiversity. The contribution of resource exploitation–logging, mining, agricultural expansion–to development is widely accepted. The potential contribution of natural habitats and biodiversity is rarely recognized. Sustainability[8] has not been part of development plans; the environment has been treated as a virtually limitless source of resources and services. Socioeconomic forces and circumstances often create incentives for activities that put pressure on biodiversity and create obstacles to changes in behavior that would reduce pressures on biodiversity. Conservation efforts are struggling in many places. Socioeconomic institutions, including, *inter alia,* markets, laws, political bodies, and social norms, favor expansion of the consumption-driven patterns of development. They promote unsustainable resource consumption and degradation of ecosystems by both the developed and developing countries of the world.

Section III reviews these five likely root causes in light of the persistence of this unsustainable approach to development, resource use, and biodiversity. An effort is made to draw out some of the many linkages among them. It will be the job of the case studies, however, to

[7] See, for example, Barbier et al. 1994; WRI, IUCN, and UNEP 1992; McNeeley, et al. 1990; Asian Development Bank, 1990.

[8] WWF defines sustainable development as "improving the quality of human life while living within the carrying capacity of supporting ecosystems."

explore these causes and linkages in detail. The following section on methodology, Section II, suggests ways of understanding and describing the links between a variety of socioeconomic factors and biodiversity loss.

II. METHODOLOGY

This section provides some suggestions and direction for the case study methodology. The primary purpose of the case studies is to reveal the root causes of biodiversity loss at a particular site and explore the mechanisms through which they work. To adequately understand root causes, an interdisciplinary approach must be developed. The approach must be able to reveal socioeconomic factors working across scales from local to global, and the mechanisms linking a variety of socioeconomic factors to biodiversity loss. It must be functional within severe data limitations for both biological and socioeconomic indicators. The guidelines offered here point to some methodological options and constraints. The eventual goal is to design policies to halt the loss of biodiversity, based on solid knowledge of the root causes.

The existing literature on the socioeconomic causes of biodiversity loss does not present a clear, empirically verified picture of root causes. This literature is generally anecdotal rather than systematic or analytical. Case studies have been carried out without regard for comparability. **The framework of five possible causes presented here is intended to impart some continuity and comparability to these case studies.** Comparative analysis of the various case studies should contribute to our understanding of the major causes of biodiversity loss around the world, and facilitate the design and implementation of appropriate solutions.

Methodologies will vary from case study to case study. In fact, case studies will provide a way to explore various approaches to revealing and confirming the root causes. The common threads will be the **multi-level character of analysis** and **the development of conceptual models.** Each case study will begin at the local level, where biodiversity losses are occurring, and then move outward in its scope of analysis to understand the regional, national, and international forces at work. Each will create a conceptual model based on qualitative and quantitative data, that is, a descriptive picture of root causes relevant to the site.

The following discussion provides a selective literature review of interdisciplinary methodological approaches to environmental problems. First, major issues faced by studies linking environmental and socioeconomic factors, primarily the development of interdisciplinary methodologies and issues of scale and linkages across scales, are discussed. These issues present the greatest challenge to the study of socioeconomic root causes. Second, some thoughts on general frameworks for understanding socioeconomic causes of environmental change, particularly in the developing field of political ecology, are presented. Political ecology ideas, highlighted in Section III of this paper, have served as the basis for some of the strongest literature on socioeconomic-environment relationships. Third, some guidelines are proposed for the development of the conceptual models that will be a major final product of these case studies. The utility of qualitative and quantitative data, as well as severe limitations on data and data

collection, are reviewed. Key steps in the construction of conceptual models are described, and an example is given from a completed case study.

Methodological Issues: Interdisciplinarity, Scale, And Linkages

The study of socioeconomic causes of environmental change is inherently **interdisciplinary**. The complexity of interlinked systems at various geographical, socioeconomic, and temporal scales will require an extensive use of qualitative social science methods. All of the social sciences must be called on in order to create a comprehensive understanding of the causes of biodiversity loss that goes beyond a simple summation of traditional approaches.[9]

Experience with truly interdisciplinary work, which draws not only on several social sciences but also on the biological and physical sciences, is minimal. Theory, methodology, and analysis linking socioeconomic variables and environmental degradation are in the early stages of development.

> Geographers, sociologists, anthropologists, historians, and biologists who have ventured outside their field of technical expertise have developed important descriptions of social factors affecting diversity maintenance at specific sites. But the analysis needed to develop a broader understanding and theories from which to generalize has yet to be undertaken[10].

Specialized disciplines provide sophisticated tools, in the form of paradigms and methodologies, for analyzing many aspects of the biodiversity problem. However, interdisciplinary communication is often hampered by specialized language, perspectives, and methods. Specialized disciplines are often

> reductionist and partial when faced with an extremely complex and multifaceted ... problem ... each discipline will only approach that part of the problem which it feels is most suitable for its specialized analytical approach[11].

Complex relationships that cut across disciplines cannot be understood without greater interdisciplinary communication and cooperation.

Several **scale** issues are raised by this research. Differences in socioeconomic factors across scales imply both differences in the size or generality of their impact and differences in distance from their effect. Differences in geographical, socioeconomic, and temporal scales must all be taken into account. Some examples are offered in Table 1. Political scales, for example, could run from the village council, to provincial government alliances, to national government

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[9] Most proposals for research agendas in the field stress the need for interdisciplinary work. See Robinson 1991; Machlis and Forester 1996; Stern et al. 1992; and Meyer and Turner 1992, 1994.

[10] OTA 1987, 127

[11] Barbier et al. 1994, 57

agencies. Geographical scales could run from the local park, to the ecosystem, to the nation. Temporal scales could run from a snapshot of the situation, to a year's agricultural cycle, to a generation or longer. Particular variables play a larger or smaller role, depending on spatial or temporal scales, geographic location, and other factors[12]. Thus an analysis of biodiversity loss that considers only local-level factors will find a different range of causal factors than an analysis that looks only at global-level factors. Likewise, an analysis that looks only at the contemporary situation may ignore important historical variables that have shaped current resource use. **The best analysis will consider factors across a range of scales, weigh their relative impact, and examine the linkages across scales.**

Table 1
Examples of Scale

Temporal	Geographical	Political	Economic
today	farm	agreements among neighbors	subsistence
agricultural cycle	wildlife reserve	local council	local market
political term	ecoregion	state government	state development funds
timber cycle	nation	national government	national policies
generation	continent	international interventions	international markets

A fairly simple outline for analyzing particular cases[13], emphasizing differences in distance, describes a system with three scales or levels of causes: proximate, intermediate, and distant (Diagram 1a). Proximate causes are those that directly cause biodiversity loss such as changes in land and resource use. Intermediate and distant causes drive the proximate causes. These include changes in socioeconomic factors, such as government policies and market prices. Both intermediate and distant causes may be root causes of biodiversity loss. For example, an intermediate cause of deforestation might be local demand for firewood; a distant cause might be demand for timber in a foreign country.

[12] Machlis and Forester 1996, Roque 1997, Stern et al. 1992, Folke et al. 1997
[13] Wood et al. 1996

A more complex structure for analyzing inter-scale influences defines scale differences in terms of the generality versus specificity of the process at work[14]. This framework describes environmental change as first, second, and third level processes (Diagram 1b). First level

Insert Diagram here: 1a: Causal Scales

Insert Diagram here: 1b: Causal Scales

processes are the local ecological and social effects of wider processes. Examples of first level processes include changes in the physical environment, methods of production, living conditions, or local socioeconomic relations, such as migration, land tenure or labor practices[15]. Second level processes are the more general changes that shape first level processes. Examples of second level processes include changes in productive systems, such as expansion of commercial crops or industrialization. The third level processes are national and international socioeconomic mechanisms and structures, such as development policies, international markets, and capital flows, which shape the second level processes. For example, local demand for firewood might be a first level process driving deforestation at the local site. National forest policies allowing unrestricted logging might be a second level process with more widespread impacts. Foreign demand for timber might be a third level process with impacts on forest policies in many countries. This framework is designed to look at the effect of the global on the local; it can also be turned around to consider the impact of the local on the global.

To understand the scale at which root causes are acting in a particular case, the following questions are useful[16]:

1. What socioeconomic factors are important at what scales?
2. Is there a hierarchy among scales in the socioeconomic forces?
3. Is there continuity among scales?
4. How many distinct scales must be considered to understand the dynamics of socioeconomic root causes?

These questions serve to narrow the focus of a case study to the most important variables. Selecting the appropriate scale or scales for analysis is crucial to determining the results of the case study. The relative strength of root causes can vary widely from system to system, and the relationships among root causes will vary depending on the scale of analysis. Defining the appropriate temporal scale, given the possibility of long gaps between cause and effect, may be one of the greatest obstacles to understanding cause and effect in biodiversity loss. For example, historical patterns, such as exploitation of natural resources by a colonizing country, may continue to shape resource use through surviving patterns of land tenure. Or historical use may have degraded resources to the point where new means of subsistence have been developed that bear

[14] Garcia 1984
[15] Gallopin 1991
[16] Sanderson 1994

little resemblance to historical patterns. Defining the appropriate geographical scale can also be difficult. For example, population is highly correlated with deforestation at a global level, but the correlation decreases when measured at smaller geographical scales. Population growth and deforestation are occurring at different locations[17]. There may, however, be strong indirect linkages between population growth and deforestation, as growing urban populations demand more agricultural products from rural areas.

The **linkages** among the global, regional, and local socioeconomic and ecological systems are multidirectional. For example, changes in local systems contribute to political, social, cultural, or economic change at various levels, just as changes at regional, national, and global scales affect local systems[18]. Current international trends, such as globalization of markets and telecommunications technology, are increasing the complexity of relations. The large number of scales may obscure relationships between the local and global. Yet, as socioeconomic systems become more complex and increasingly interlinked with larger or more distant systems, local systems are increasingly influenced by distant processes,[19] and the international context takes on a growing role. The case studies should identify and explore these linkages where they are relevant to biodiversity loss.

Given the multidirectional nature of influences and effects across scales, it is useful to consider these systems in terms of linkages with near and distant causes, or as specific (local) and general causes, rather than as hierarchical systems[20]. In such complex systems, relationships within the system are continually evolving at all scales[21]. Processes at a larger scale are not necessarily more important determinants of local resource use than processes at a local scale. For example, local markets may be more important in determining hunting patterns than national or international markets. Distant causes shape and constrain local conditions but do not completely control them:

> The understanding of the concrete systemic conditions, mechanisms and processes that generate poverty and environmental degradation or foster sustainability can be most efficiently gained by concentrating on the local levels, where the direct interactions between society and nature take place. The global level may, on the other hand, be analyzed in broader terms, highlighting those changes and processes that seem to have a significant relation with the issue of sustainability[22].

While some local-level causes may be common to most of the case studies, for example local poverty, other local causes may be site-specific, such as seasonal migration. Global-level causes, such as the spread of commercial agriculture, may affect many of the sites; others, such as

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[17] Meyer and Turner 1992
[18] Gallopin 1991
[19] Gallopin 1991
[20] Folke et al. 1997
[21] Gallopin 1991
[22] Gallopin 1991, 715

changes in the price of a particular commodity, may affect only a few sites. Analysis at the local level will reveal the variety of impacts on biodiversity, whereas strictly global analysis may conceal it. This is particularly true given that biodiversity loss appears to be overdetermined–a variety of causal factors are producing the same outcome[23]. However, global-level trends may explain the similarity in worldwide patterns of biodiversity loss, if not the complexity of the mechanisms or linkages through which they work at the local level[24].

Various disciplines must work together in order to reach a full understanding of the linkages across scales. Two basic tools can facilitate an interdisciplinary approach to analyzing the root causes of biodiversity loss. First, **general frameworks** provide simple, very inclusive models or descriptions applicable to most cases. The framework presented at the end of this section and elaborated in Section III is such a general framework. Second, **conceptual models** provide more detailed descriptions of the interrelationship of variables in specific cases. These are discussed below.

General Frameworks

General frameworks are intended to provide a description of a broad range of cases, from a disciplinary or interdisciplinary perspective. Various general frameworks relating human causes to environmental change have been defined. Others which take a sectoral perspective are discussed in Section III, such as the Kates and Haarman model of population effects [25] and the Repetto and Gillis model of policy failures[26]. Broader frameworks include the POET model[27], which incorporates population, organization, environment, and technology as the key variables; and the PISTOL model[28], which considers population, space, technology, organization, and level of living. General frameworks can provide a starting point for defining a conceptual model, and a tool for synthesizing related conceptual models. They suggest variables to incorporate and possible patterns of relationships among variables; in other words, they provide some initial hypotheses to evaluate a particular case.

Global-Change Analysis:

The most extensive methodological work relating socioeconomic or human causes to environmental change is work on global-level change, particularly climate change. Efforts in this area[29] provide useful discussions of methodological possibilities and challenges in this field, but

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[23] Stern et al. 1992

[24] To explore both issues, Sanderson (1994) suggests a "multipronged approach" that begins with international systems on the one hand, and with "local institutions that resist, modify, accommodate, retreat or die before the more systemic processes that impinge on their once-isolated systems..." on the other.

[25] Kates and Haarman 1992

[26] Repetto and Gillis 1988

[27] Hawley 1986

[28] Bailey 1990

[29] These include Meyer and Turner(1994), Stern et al.(1992), HDGCP (Robinson 1991), and Gallopin (1989).

are still only preliminary efforts to understand the complexity of socioeconomic causes. This work provides some important insights into both the root causes of biodiversity loss at a global scale, and the methodological approaches to understand the linkages between socioeconomic change and biodiversity loss. It is particularly useful for the development of interdisciplinary conceptual models. However, the complexity of the models being developed and the assumption made in much of the work cited above that analysis of root causes will be heavily quantitative, make these general framework models more useful as heuristic tools than as methodological tools. The insufficiency of a purely quantitative approach to socioeconomic issues is discussed below.

Moreover, some critical distinctions preclude direct application of models of human causes of climate change to biodiversity loss. Analysis of biodiversity loss requires more attention to local change than does analysis of global climate change. Spatial relations–notably habitat destruction and fragmentation–are more important for biodiversity loss than they are for climate change. For example, in analyzing climate change it is important to know how much deforestation is taking place; for analysis of biodiversity loss it is also important to know where deforestation is taking place. If our understanding of the causes of biodiversity loss is going to lead to solutions, it must explain the site-specific effects of socioeconomic patterns at a variety of scales, as well as the aggregate or global impact of those patterns.

Political Ecology:

In recent years, a few researchers have attempted to analyze the full complexity of environmental degradation through case studies[30]. Their analytic approach has been described variously as **political ecology**, human systems ecology, and regional political ecology. Although there are important variations in the approaches taken by these case studies, two ideas are fundamental to political ecology. First, the political and the economic are inextricably linked. Second, the role of political and economic **power** is central in determining who has access to resources and in shaping resource use patterns, including environmental degradation. All of these approaches attempt to define the international, national, and regional parameters that have shaped local resource use patterns, and to examine the varying responses of local resource users to their context.

One branch of political ecology work has it roots in anthropology[31], and integrates human or cultural ecology with political economy. This work melds anthropological methods that take account of environmental influences with political economy approaches that focus on socioeconomic inequalities and constraints. The role of culture and social factors in defining and shaping resource use patterns is emphasized in much of this work.

The other primary branch of political ecology has its roots in political economy. Regional political ecology, as interpreted by Blaikie and Brookfield[32], emphasizes the political and physical

[30] The best examples of these are Stonich (1995), Blaikie and Brookfield (1987), Painter and Durham (1995); and Little and Horowitz (1987).
[31] See Painter (1995a), and articles by Schwartz, Jones, and Garland in Painter and Durham (1995).
[32] Blaikie and Brookfield 1987

aspects of environmental degradation. It "combines the concerns of ecology and political economy, thus integrating the human and physical approaches to environmental destruction."[33]. The role of political and socioeconomic structures in shaping resource use patterns are the central focus of this work. According to Stonich, who also uses political economy ideas of political and class structures, political ecology

> ... expands the perspective of political economy to include the distribution and use of natural resources and the dynamic contradictions between society and natural resources. This integrated perspective ... has been used in a variety of disciplines to demonstrate how interconnected social, economic, and political processes affect the way natural resources are exploited[34].

The political ecology framework indicates a range of socioeconomic factors to consider for understanding environmental change. Points of analysis listed here[35] emphasize the links between political and economic factors and resource use. They form the underlying framework for most political ecology studies:

1. The nature of production: is resource use for subsistence or for the market?
2. The class structure of the society: what and where is the conflict over access to resources?
3. The kinds of market mechanisms involving local producers: where are profits accruing?
4. The role of the state in shaping policies: which resource users are favored?
5. The role of international interests: what patterns of resource use are supported?
6. The ideology or cultural understanding that orients resource use (for example, the position that rapid economic growth is the best way to address social and environmental problems): what groups benefit from that ideology?

Case studies carried out within the framework of political economy[36] vary in the breadth and depth of their explanations of causal factors. Some of the most comprehensive descriptions of environmental degradation are found in this literature. However, the focus on economic and class structures tends to underestimate both the role of other important factors and the possibility of significant changes in patterns of resource use.

Chains of Explanation:

[33] Blaikie and Brookfield 1987, 17

[34] Stonich 1995, 64

[35] Schmink and Wood (1987) indicate these six political ecology factors as essential to their analysis of the process of settlement and environmental degradation in the Amazon.

[36] See the collections in Blaikie and Brookfield (1987); Painter and Durham (1995); and Little and Horowitz (1987).

All of these political ecology approaches work using "**chains of explanation**"[37] in order to address the questions of scale and linkages. They start by looking at the local level and then move up the chain of explanation through interrelationships of local resource users with regional, national, and international actors. Blaikie and Brookfield[38], examining the causes of land degradation, suggest a pattern of analysis that follows a chain of explanation through different scales, beginning with the decisions of local land managers and other groups in society who affect local land management, and moving to the roles of the state and the world economy:

> It starts with the land managers and their direct relations with the land (crop rotations, fuelwood use, stocking densities, capital investments and so on). Then the next link concerns their relations with each other, other land users, and groups in the wider society who affect them in any way, which in turn determines land management. The state and the world economy constitute the last links in the chain. Clearly then, explanations will be highly conjectural, although relying on theoretical bases drawn from natural and social science....[39]

Understanding Local Responses:

Chains of explanation provide a tool for understanding local responses to external factors. Biodiversity loss occurs at the local level, although many of the causes may be distant. The local actor–subsistence farmer or fisherman, commercial producer, government agent etc.–is acting rationally within the particular set of limits and possibilities, including social, cultural, political, economic, and environmental constraints, that prevail.

> Most loss of biodiversity is due to the independent decisions of the billions of individual users of environmental resources, and its underlying causes are to be found in the parameters in which those decisions have been made.[40]

It is the task of these case studies to look at those parameters: too often the choices they determine mean that biodiversity will be lost.

It is important, however, not to fall into the trap of seeing biodiversity destruction as predetermined by circumstances. This is the fault of much political economy work that focuses on macrolevel causes. Rather, one must remember that resource users are making decisions not only *within* their particular circumstances but also *affecting* their circumstances. Case studies must keep in mind "the tremendous diversity of local initiatives and responses to external pressures", and creativity of responses of local resource users within their circumstances[41]. The first step in each case study, therefore, must be to examine the mechanisms by which local populations are

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[37] Blaikie and Brookfield 1987
[38] Blaikie and Brookfield 1987
[39] Blaikie and Brookfield 1987, 27
[40] Perrings et al. 1995, 12
[41] Painter 1995a, Stonich 1995

directly affecting biodiversity. Later steps will ask what options are open to local resource users and why they are making particular decisions. Global and regional systems generate opportunities or constraints for local socioeconomic systems, but local responses to distant changes will depend substantially on local environmental and socioeconomic conditions[42].

These political ecology approaches provide a general framework for interdisciplinary analysis of particular cases. Thorough exploration of the chains of explanation will provide a conceptual model of the root causes of biodiversity loss.

Constructing A Conceptual Model

These case studies should aim to build conceptual models describing the primary root causes and mechanisms driving biodiversity loss at the case study site. A conceptual model "is an idea of how the components of a system fit together."[43] Such models have also been called causal maps and informal models. They provide a descriptive picture of the chain of explanation. Conceptual models are flexible, qualitative, and closely linked to the kinds of data available[44]. They are not intended to be predictive or highly quantitative. Unlike the general frameworks discussed above, they describe specific cases. Syntheses of conceptual models from case studies will provide the basis for improving or building a general framework specifically for explaining biodiversity loss.

This section describes the key steps in constructing a conceptual model. It is an effort to give some general direction, guidelines, and pointers appropriate for case studies of a variety of situations. Depending on the nature of the case and the existing information, some of the steps described below may be carried out simultaneously or be repeated before the model is completed. The following section illustrates this process with the example of a case study conducted in Mexico.

Key Steps:

1. Literature Review
2. Development of Conceptual Model
3. Data Collection
4. Revision of Conceptual Model

The construction of a conceptual model must begin with a **literature review**. This paper reviews some of the relevant general literature; there is extensive literature on most of the causes discussed here. Individual case studies must review literature and data that is pertinent to the

[42] Gallopin 1991

[43] Machlis and Forester (1996) provide the most explicit and pertinent review and discussion of the utility of various types of models of causes of biodiversity loss.

[44] Machlis and Forester 1996

particular locality or apparent root causes and compile existing information about the case study site.

A thorough literature review will provide a set of hypotheses about root causes that will serve as the basis for an **initial iteration of the conceptual model.** This model will then be revised and amplified with information collected for the case study. Before any exacting quantitative or qualitative work can be done, preliminary hypotheses must be drawn up. This is best done by asking a series of questions Who?, What?, and Why? at each step of the analysis, following a chain of explanation. The first iteration of the conceptual model provides an hypothesis, or set of hypotheses, which allows the researchers to make decisions about further data collection. The general literature review in Section III suggests a variety of relationships among socioeconomic and environmental variables that should be useful in defining hypotheses for particular case studies.

An example of questions to construct a chain of explanation follows: Biodiversity is being lost in the Brazilian Amazon in large part because of increased conversion of forest to pasture. Who is converting the forest? Small-scale farmers from the south. Why have they come to the region? Population pressures, government land promotion, and loss of land tenure. Why is the government promoting migration? To increase export production and reduce pressure for land reform. And so forth.

The scope and purpose of the conceptual model must be clearly defined if it is to contribute to our understanding of the root causes of biodiversity loss. These models will undoubtedly be complex. However, an effort should be made to keep them as simple, or parsimonious, as possible, without sacrificing understanding of the nature of the system[45]. The boundaries of the system to be analyzed must be set carefully to ensure that all the primary causes are incorporated into the analysis, with a minimum of extraneous factors incorporated. Limits must be placed on the scope of a model; otherwise a chain of explanation can be stretched out indefinitely. Variables or relations that do not add significantly to our understanding of the mechanisms at work should be not be included[46]. Systems are often too complex to analyze effectively in a single model; breaking them down into subsystems may facilitate the analysis. Those studies that select a large region, such as a river basin, as the study site will need to work down toward the local as well as out toward the macro level. Such studies may need to divide the site into different areas or sectors in order to begin a chain of explanation at the local level. Likewise, those that select several sites for comparison purposes should consider each one as a separate site initially, rather than generalizing about root causes across several distinct sites.

Assumptions:

These conceptual models will necessarily make many assumptions, based on existing knowledge of environmental degradation. Some of these are listed below. The basis for these

[45] Machlis and Forester 1996
[46] Machlis and Forester 1996

assumptions is explored further in Section III. Others will be specific to the case study. All assumptions should be stated clearly.

1. Biodiversity loss is largely a result of human activities. This is true at the global level, and is often true for a particular local situation.
2. Biodiversity loss is the direct result of many individual decisions about resource use.
3. These decisions are rational within the given set of socioeconomic parameters including, for example, social structures, prices and market opportunities, cultural expectations, institutions, and laws.
4. Policies, institutions, structures, and norms that promote biodiversity loss are providing benefits to some groups. Looking at why these policies, institutions, structures, and norms persist will help explain biodiversity loss.
5. Biodiversity loss is often overdetermined. Several critical factors may be working separately or in conjunction to promote biodiversity loss.

Scale provides a useful mechanism for defining the scope of a conceptual model, setting the boundaries of the system that will be described by the model. It also provides a useful mechanism for designing a conceptual model by suggesting the links in a chain of explanation. For this purpose, scale can be defined in terms of geographical, social, political, or economic patterns. A variety of questions about scale and linkages across scales should be asked in developing the conceptual model[47]. Questions along the following lines are suggested:

1. Which are the significant scales of the processes affecting biodiversity?
2. Which are the relevant links or interactions across scales?
3. What is the pattern and direction of change at different scales? Are the socioeconomic factors conflicting or reinforcing?
4. What are the mechanisms of influence among local, intermediate, and global socioeconomic factors affecting biodiversity?

Although analysis will start with the local and work out to the global, the conceptual model will probably not appear as a direct chain of linkages. In some cases, distant factors will affect local behavior through effects at intermediate levels; in other cases distant factors will directly affect local behavior.

A conceptual model can be effectively represented in a **diagram** or description that represents system components and flows between components. Such diagrams identify key variables, and illustrate the relations between variables and the driving forces in a system[48]. The variables in the conceptual model are likely to reflect the various theoretical or disciplinary approaches taken by the analysis, such as economic, cultural, and political factors. The flows represented in the model may be causal relations, or measures such as energy, dollars, or information. The diagram should indicate the direction and impact of the flows. Diagram 2

[47] These questions are based on Gallopin (1991).
[48] Hall and Day 1977

provides an example of a diagrammatic conceptual model based on the general framework in Diagram 1a.

The third step is **gathering further data**. Development of the initial version of the conceptual model should provide a basis for organizing data, defining gaps in the existing data, and setting priorities for further data collection. In most cases, this should include local data gathering, such as rapid rural appraisal with surveys, participatory appraisal, focused group discussions, or other social science methods[49]. It should also include research on national and international policies and socioeconomic trends, such as policies on prices or changes in political systems, which affect local decisionmaking about resource use. Drawing on the expertise of a variety of social scientists should ensure that appropriate methodologies are chosen and that the full range of socioeconomic causes is considered. Table 2 below suggests some possible data sources for analysis at different scales. For the conceptual model in Diagram 2, data might be collected on migration patterns and economic activities from the local population, on infrastructure and colonization projects from government officials, and on commodity prices and exchange rates from secondary sources.

The fourth step will be a **revision of the conceptual model** based on the new data. Some of the initial hypotheses will be confirmed; others will be disproved. At this point, new questions should arise, and it may be necessary to collect further data in order to strengthen the model. Revision should confirm that the model has been clearly described. A well-designed model will balance qualitative and quantitative data to explain links of socioeconomic factors one to another and links of socioeconomic factors to biodiversity loss. When completed, it should have the following key characteristics[50]:

1. The *question* to be answered by the model should be clearly specified.
2. The *target system* to which the question applies should be clearly specified; for these studies, this will generally be a geographic area.
3. The more distant, or *larger scale, systems* that affect the target system must be clearly specified. These include national and international political, economic, and social systems.
4. The *facts and the hypotheses*–data sets, assumptions, sources of knowledge, and accuracy of information–incorporated in the model should be clearly specified.
5. Methods for *validating* the model should be defined. These include empirical validation, through further data collection, and theoretical validation, based on knowledge and theory drawn from other cases.

Insert Diagram here: 2: Amazon Deforestation

Resource and time constraints will limit the amount of original research which can be done for these case studies. The limitations of the data and the methodology should be explicitly

[49] Roque 1997

[50] Based on Machlis and Forester 1996

indicated in the studies. Given this limitation, it will be a useful exercise for researchers to consider what additional work could contribute significantly to the case studies

Data Issues

Some components of the case studies will be based on quantitative data, others on qualitative description. The scientific community is calling for predictive, testable models of the relationship between root causes and biodiversity loss[51]. However, the nature of the data needed and of social science methodologies suggests that the development of such models will be exceedingly difficult, if not impossible for most cases. Human behavior cannot be understood in purely quantitative terms.

Table 2
Data Collection

Scale	Unit of Analysis	Possible Data Sources: Quantitative	Possible Data Sources: Qualitative
Micro	individual, household, small community	Interviews: expert informants	Interviews: oral histories expert informants Rapid Rural Appraisal Participatory Appraisal
Middle	communities, regions, economic sectors, social/ethnic groups	Secondary data: GIS, map data surveys census population incomes, employment production data land use and tenure data	Rapid Rural Appraisal Secondary data: surveys population incomes, employment land use and tenure data production
Macro	countries, regions, governments, international sphere	Policy Analysis: Secondary data: market information prices, trade exchange rates census population incomes, employment production data land use and tenure data	Policy Analysis: secondary data official interviews Secondary data: market information academic studies case studies

[51] See, for example, Machlis and Forester 1996; Robinson 1991; Meyer and Turner 1994; and Stern et al. 1992.

To distinguish between quantifiable and inherently qualitative data, Robinson[52] divides human causes of environmental change into two broad categories: physical factors and socio-political factors. Physical factors, such as population growth, consumption, and extraction of resources, are measurable in physical and quantitative terms. Quantitative description of these factors will contribute substantially to our understanding of biodiversity loss. Economics provides some of the most useful data sets for measuring consumption and extraction of resources[53]. However, when disaggregated data has not been routinely collected, for example through censuses, actually measuring these factors may be impractical for most case studies. Qualitative data may be the only option for measuring change in physically quantifiable factors. Socio-political factors, such as political power, organizations, and attitudes, are the factors by and through which decisions about physical resource use are made. These factors are inherently unquantifiable, but can still be compared across time and across various cases. They are essential to describing human behavior. The following sections discuss the advantages and disadvantages of quantitative and qualitative approaches for case studies of biodiversity loss.

Quantitative Approaches:

Quantitative approaches provide a useful starting point. Analysis of quantitative data can help with the definition of causal relations. It will be vital in identifying the proximate causes of biodiversity loss, for example, in defining the relative roles of various human activities in habitat destruction. Quantitative data should also be useful in identifying some intermediate and distant causes, particularly economic causes, for example, changes in national or international prices associated with changes in local resources use. Examples of quantitative data sources are given in Table 2 above, including GIS data, census data, price levels, and exchange rates.

A quantitative approach to analyze socioeconomic causes of biodiversity loss faces two critical problems: the inappropriateness of quantifying many socioeconomic variables and the dearth of good data for quantifiable variables. For these case studies, data will provide evidence for, but is unlikely to prove, hypotheses in a statistical sense. Statistical analysis necessarily will be limited to a few of the relationships within the model that lend themselves to quantification.

To improve the quantitative analysis of biodiversity loss there is a need for data at the appropriate levels of (dis)aggregation, with known and acceptable levels of accuracy, and clearly understood methods of data collection[54]. Data sets for quantifiable variables are frequently inconsistent and incomplete at the local level. Across regions and globally, the problems are even

[52] Robinson 1991

[53] Unfortunately, may data sets collected for economic purposes are in monetary rther than physical terms, which conceals substantial information about the environmental impact of economic activities. By making a distinction between physical flows and socio-political factors shaping decisionmaking, Robinson (1991) deliberately avoids the trap into which most economic models fall. Economic models combine behavioral and physical information in the same model by denominating physical flows in terms of money, which loses significant information about the environmental impacts of human decisions.

[54] Machlis and Forester 1996

greater. Interdisciplinary data sets are not currently available[55]. While this sort of data will not be available for the case studies, the development of descriptive conceptual models and hypotheses can provide a better understanding of what data should be collected on a systematic basis to improve our understanding of the root causes of environmental change.

Existing quantitative approaches to understanding resource use and biodiversity loss are inadequate to analyze the broad range of macro-level factors affecting local decisions. These approaches necessarily focus on only one or two pieces of the much larger puzzle, ignoring both cross-scale and interdisciplinary issues in favor of precise analysis of a single factor, often at the micro-level.

> The theoretical and methodological problems arise from the nature of human interactions with the global environment. These interactions, like the environment itself, exhibit:
>
> - interdependencies and unanticipated consequences;
> - nonlinearities between causes and effects;
> - irreversibility;
> - long time lags; and
> - nested relationships between local, regional, and global activities.[56]

Each of these characteristics makes analysis difficult and complex. Simple statistical measures of relationships between variables will have limited explanatory power because they ignore large parts of the picture. While biodiversity loss appears to be overdetermined in some cases, in others it is the result of the chance coincidence of two or more factors acting as one[57]. These relationships can best be described with words or diagrams, rather than quantitative measures. For example, mathematical models have been developed that relate deforestation to migration induced by road-building. While it is important to recognize and confirm the impact of road-building, solutions can only be found if we examine the reasons for road-building and the reasons why people are migrating. Analysis of strictly quantifiable relations cannot be expected to reveal the complexity of those relations.

Data on Biodiversity:

The case studies should present quantitative data on the extent or rate of biodiversity loss whenever it is available. This may be in the form of data on loss of keystone species, declining populations of particular species, estimates of loss of species based on habitat loss, or other available measures. Presentation of this data will clearly enhance the studies. However, these case studies are not intended to prove or provide a precise measure of biodiversity loss when it is not readily available.

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[55] One of the few relevant data sets is the bi-annual WRI World Resources Report. This data is collected at a national level, however, and can only provide approximate figures for many indicators.

[56] Stern et al. 1992, 167

[57] Meyer and Turner 1992

There is no standard, agreed measure for biodiversity loss[58]. Biodiversity loss must be inferred from surrogate or proxy measures, such as loss of forest cover, corals, or mangroves, or decreases in the population of indicator species. Extensive research is still needed on the relationship between loss of habitat and loss of individual species, on the one hand, and loss of biodiversity writ large, on the other. This research is beyond the scope of these case studies.

For the purposes of these case studies, it must be assumed that environmental changes, such as land cover change, have direct impacts on biodiversity levels, although these may not be linear or predictable. Data on species loss will not be available in most cases. Data on the proximate causes of biodiversity loss will be more readily available and provide a useful proxy for data on loss of biodiversity. Most estimates and predictions of species loss are based on estimates of habitat loss. For example, data on local deforestation or expanding farmland and pasture provides a useful measure of the extent of habitat destruction. Data on fish catches provides a measure of pressure on local marine resources. Census data, GIS data, economic data, and local surveys are among the possible sources for this information.

Box 1
Data Collection on Changing Resource Use: An Example

For a case study of common property resources in western Rajasthan, India (Box 10) , Blaikie and Brookfield (1987) collected quantitative and qualitative data. This data covers both physical changes in the region and use of common property grazing lands and water supplies, and socio-economic changes in control, regulation, and decision-making about these resources.

Quantitative data was collected on population densities for people and livestock, area of common property lands, number of watering points and area of catchments, and area under crops. Sources included census figures and village records collected during field work.

Data on change in the resources, tracking their degradation, is qualitative. Options for collection of this data included fragmentary records from ex-landlords, interviews with village elders, and other anecdotal evidence. For example, the names of common property areas traditionally reflected the quality of the resource. Names specifically connoted the productivity of the area and predominance of particular plant species, indicating the nature and quality of the resource.

Different forms of land use and habitat change have different impacts on biodiversity, as illustrated in very simplistic form in Diagram 3. The use of proxies, such as land use change, for biodiversity loss must take into account that different changes in land use or habitats will have

Insert Diagram here: 3: Land-use and Biodiversity

[58] Machlis and Forester 1996

different impacts on biodiversity. Swidden agriculture, for example, when practiced on a small scale may have a minimal or even beneficial impact on biodiversity; more extensive swidden agriculture will have more serious impact; and extensive commercial agriculture with heavy use of agro-chemicals is likely to destroy local ecosystems. Similar differences exist between the impact of small-scale selective logging and commercial clear-cutting; and between artisan fishing and large-scale commercial fishing.

Qualitative Approaches:

The need has been recognized for:

> a solid methodological and theoretical framework for simultaneously analyzing social, economic, geographical, biological, productive, legislative, and administrative or political information[59].

Qualitative, intuitive thinking is the only methodological approach that can incorporate all of these factors.

Social theory is based on models that are informal, exploratory, and non-mathematical for the most part. More exacting model building, for simulation efforts or the construction of mathematical, statistical linkages, is beyond the scope of this exercise. Building predictive models of the relationship between biodiversity loss and socioeconomic factors is not currently possible and may not be necessary for finding solutions to the biodiversity problem. Social and resource policy must be based on understanding of current socioeconomic drivers and trends. Exact quantitative measures of effects are not necessarily more informative for policy purposes: most policy tools are not sufficiently sophisticated to require precise quantitative application. Moreover, quantitative relationships are likely to change more frequently than the qualitative mechanisms that underlie them.

Case studies will be the most important tool for explaining the root causes of biodiversity loss. Case-based comparative work can cover a range of socioeconomic and environmental contexts and can facilitate comparisons of human systems that differ in their impact on biodiversity[60]. Detailed qualitative work better answers the question Why?, and therefore is more useful for finding solutions to socioeconomic problems than quantitative modeling. Individual factors may be subject to quantitative or rigorous qualitative analysis, and this should be carried out wherever feasible. However, understanding the complex interrelationships can only be intuitive. Quantitative models cannot be predictive without a good understanding of the processes linking socioeconomic and ecological systems.

Much of the relevant data, such as information on political systems or culture, is inherently qualitative[61]. Even many of the apparently quantifiable variables can be misinterpreted if indicators

[59] WRI 1995, 116
[60] Stern et al. 1992
[61] Robinson 1991, Roque 1997

are not chosen carefully. For example, use of per capita income as an indictor of poverty will be misleading where there are large disparities in income. Variables can be constructed for some social factors, such as democratization, but caution is advised since quantification of these variables will over-simplify complex relationships. Social variables need to be carefully defined. Interdisciplinary work can bring together quantitative methodologies or studies from several fields; but only qualitative thinking can integrate this information in a logical, credible explanation.

Example of a Conceptual Model

A conceptual model of deforestation in the Brazilian Amazon was used as an example above (pp. 19, 21). Here, a case study of the root causes of biodiversity loss in and around the Calakmul Biosphere Reserve in Campeche, Mexico provides a more complete and practical illustration of the development of a conceptual model.

Step 1: Literature Review:

For the Calakmul study, literature on the local situation, on the national context, and on generally recognized causes of biodiversity loss was reviewed. This literature was drawn from a variety of fields including anthropology, economics, policy analysis, and demography. Literature specific to the Calakmul site, produced primarily by academic researchers and conservation groups, included studies of population growth, hunting patterns, attitudes towards development, successes and failures of sustainable development programs, and resource use patterns. Relevant literature on the national situation included government and academic reports on agriculture, forestry, and protected areas policies, as well as on liberalization and impacts of international markets. More general literature, much of which is cited in the Section III of this paper, included studies on the effects of population growth, incorporation into international markets, and poverty. The literature review suggested the following hypotheses, among others, which contributed to the construction of the initial conceptual model.

Hypotheses specific to the Calakmul and Mexican case:

At the local scale:

- Expansion of chile production is causing extensive deforestation.
- Population growth is causing expansion of agriculture and deforestation.

At the national scale:

- Liberalization of agriculture is causing expansion of commercial crops and a decrease in subsistence production.
- Changes in land tenure laws are encouraging clearing and sale of land.

At the international scale:

- Exposure to international markets makes local production of timber and staple crops
- unprofitable.
- NAFTA is increasing commercial agricultural production.

General hypotheses relevant to the Calakmul and Mexican case:

- Improved security of land tenure promotes conservation efforts and sustainable management.
- Population growth is associated with environmental degradation.
- Poverty prevents sustainable resource use.

Step 2: Development of a Conceptual Model:

The initial conceptual model defines the scales and linkages believed to be most critical in determining biodiversity loss. The model, for reasons of clarity and parsimony, necessarily includes only those factors that the initial review suggests are important. Basic questions, many based on the political ecology questions listed on page 16, were used in constructing a chain of explanation. These questions began at the local level and then moved outward to examine the layers of factors affecting biodiversity in the Calakmul region. The hypotheses found in the literature review were used to answer these questions in the initial iteration of the conceptual model.

Insert Diagram 4a here:
Initial Conceptual Model for Calakmul, Mexico Case

Some of the questions were:

- What are the direct causes of biodiversity loss and/or deforestation in the region?
- What explains the expansion of agriculture and other unsustainable resource use in the region?
- What are the connections to international markets?
- What local patterns of resource use can be traced to incentives and limitations from national policies?
- What connections are there between local resource use and international markets?
- How are local communities trying to affect their circumstances?

The initial model emphasizes one local-level cause, population growth, and two national-level causes, land tenure policies and liberalization. Deforestation and agricultural land are taken as proxies for biodiversity loss.

Step 3: Data Collection:

In order to confirm or reject the hypotheses incorporated in the initial model, additional data was collected on local agricultural production for subsistence and markets, local timber and non-timber production, local prices, local income from government programs, recent changes in land tenure, national and international markets, deforestation, and impact of the Reserve and sustainable development programs. Further literature was reviewed on resource use patterns and attitudes towards agriculture in similar regions in Mexico, on the probable impact of NAFTA and liberalization, and on tenure policies.

Serious gaps in data on the region could only be partially filled by the case study. Physical and biological data on deforestation and species loss was seriously lacking. The isolation of the region, its frontier character, and the rapid changes that are occurring, in terms of population growth, legal status of lands, and political boundaries, make socioeconomic data scarce and unreliable. The clandestine nature of many activities in the area, such as logging and hunting, and the uncertain legality of others, such as land clearing, make it difficult to get honest responses from local people or government officials about activities or plans in the area. Moreover, while threats to biodiversity in the region are great, impact as yet has been small.

Nevertheless, a number of the initial hypotheses were disproved or brought into question in this step. For example, qualitative and quantitative data on chile production revealed that it is no longer making a significant contribution to deforestation. Information on local markets revealed that local production, even commercial production, has little relation to national or international prices, and therefore little connection to liberalized national policies that emphasize market-based decision making. The lack of links between the local level and other scales, economic, political, and temporal, emerged as one of the most pervasive characteristics of the region. As hypotheses were confirmed or disproved, and corresponding new information was gathered, a clearer picture was developed of the root causes operating in Calakmul.

Step 4: Revision of the Conceptual Model:

The revision of the conceptual model, based on the new data and further literature review required new answers to questions about the relevance of various scales and the linkages across various scales to local resource use. The initial literature review suggested that national policies affecting markets and land tenure, along with international demand for forest products, were primary drivers of local resource use. However, the new data showed that the most important linkages with the regional and national scales were probably through policies and conflicts driving migration to the region, rather than through markets. Because of disjunctions between national policies and local conditions, national policies designed to improve resource use may be having perverse effects in the Calakmul region. For example, new policies intended to improve security of land tenure may be promoting deforestation since forested land is not covered by the new policies. Local-level responses to external socioeconomic forces in some ways promote biodiversity loss and in others may protect it. For example, there is local opposition to the creation of the Reserve, but the creation of the Reserve has also led to the development of a strong grassroots organization that supports sustainable activities.

Insert Diagram here: 4b
Revised Conceptual Model for Calakmul, Mexico Case

The major methodological problem faced was in linking local activities to national and international factors. The links, for instance between national policies and local responses, are indirect. Policies pass although layers of political maneuvering and corruption, local understanding or misunderstanding, and contradictions with other policies. Then, the range of possible local responses, given poor resources and local isolation, is limited. This means that the responses elicited at the local level are minimal or unrelated to the original objectives of the

policy. The limited range of possible responses may well mean that biodiversity loss is over-determined in Calakmul.

The completed case study begins with a description of local population and resource use patterns, which are the proximate causes of biodiversity loss. From there it moves outward or upward in scale to describe the various levels of socioeconomic factors that are shaping local resource use patterns. The diagram below shows some key parts of the revised conceptual model described by the study. The revised diagram emphasizes growth of local population due to regional factors, the inappropriateness of many policies for local conditions, and the marginality of the region to markets. These are the factors that must be addressed in the region if conservation is to be achieved.

Suggested Framework

The remainder of this paper presents a framework based on five root causes (Diagram 4). The root causes appear on the left-hand side of the diagram. The case studies will focus primarily on this part of the framework. Each of the root causes discussed here is associated with several explanatory approaches, paradigms, or points of view from which to begin a case study. Too often the conclusions of case studies are narrowly prescribed by the approach. Case studies beginning from a neo-classical economic perspective will find that incorrect prices for environmental services lead to environmental degradation; case studies beginning from a Malthusian perspective will find population change responsible; case studies beginning from a Marxist perspective will find class structures to blame, and so on. The first challenge here then is to **broaden the analytical approach** to consider all of these possibilities, and to recognize that all of these factors–demographic change; inequality and poverty; public policies, markets, and politics; macroeconomic policies and structures; and social change and development biases–may be at work in positive and negative directions.

The second, related challenge, is to approach these case studies **without preconceived ideas of the solutions**. If new solutions are to be found, solutions that address the complex interrelationships of socioeconomic and environmental factors, these must derive from a clear understanding of the factors at work. The final conceptual model provides an essential tool for determining conservation strategy and making recommendations. Arriving at a set of viable recommendations will require several additional steps that cannot be detailed here. One will be the completion of biological studies to determine conservation priorities and evaluate the impact of human activities on biodiversity. Another will be the consultation of the various institutions and stakeholders whose cooperation is essential in order to achieve conservation of biodiversity.

Insert Diagram here: 5: Framework of Root Causes

III. FRAMEWORK OF ROOT CAUSES

A. Demographic Change

The world's population has more than doubled since 1950, and is growing at a rate of 1.6% a year[62]. From its current level of 5.7 billion, it is expected to reach 8.3 billion by the year 2025. Much of this growth is occurring in developing countries, where population growth has surged as mortality rates have fallen in the post-World War II period. Fertility rates have begun to fall more recently, but remain high in some of the poorest countries. The population of Africa is expanding at a rate of 2.8% annually, that of South America at a rate of 1.75%.

Recent estimates of human impact on the planet show that humans use about 40% of the annual net terrestrial growth of the planet, almost half of what the world produces[63]. As the world's population continues to grow, how much more can we consume without completely disrupting natural ecosystems?

> A point of such biospheric scope needs to be pursued in detail. What will happen when human numbers double, as is projected within another few decades? The remainder of Earth's species could hardly get by with only 20% of plant growth ... the whole process would surely culminate in progressively greater impoverishment for the biospheric supports that ultimately underpin all human activity[64].

Human populations are growing in an absolute sense at the global level. The location of population growth is perhaps equally important for biodiversity loss as the absolute numbers. Local population growth, resulting from in-migration or growth of local populations, directly affects the use of resources and the rates of habitat conversion in areas important for biodiversity conservation.

The relationship between population size and growth and biodiversity loss is complicated. Substantial changes take place in habitats as populations expand. This is confirmed by data on agriculture and pasture extensification, desertification, and deforestation at the global, national, and regional scales. Unfortunately, no systematic attempt has been made to analyze this relationship. Whether countries with more rapid rates of population growth have more rapid rates of land conversion is uncertain[65]. However, some correlation between population density and land use is clear. Countries with high population densities have converted relatively more land to agricultural use. Those Latin American and African countries with high levels of fertilizer use, an indicator of agricultural intensification, are generally those with high population densities. At the local level, the relationship between population density and land use is not so apparent in many cases[66]. Further work is needed to understand the linkages between population growth and biodiversity loss.

Reasons for Population Growth

[62] WRI 1996
[63] Vitousek et al. 1986
[64] Myers 1995, 126-27
[65] Bilsborrow and Okoth-Ogendo 1992
[66] Robinson 1991

For a variety of reasons, **absolute populations** continue to grow, particularly in developing countries. High fertility rates and poverty are clearly linked. Children are an important resource, both for the labor they provide and as insurance for their parents old age. Even when resources are scarce, children have both an economic and cultural value in many places. In fact, environmental degradation and resource scarcity may have the perverse effect of contributing to population growth[67]. Although it may not be rational for society, for poor households having large families is a rational approach; more hands are needed to make a living from meager resources. In other cases, social norms that place a value on large families persist even when the economic benefits have disappeared. Female education is widely believed to be one of the most important factors in lowering fertility; educated women are most likely to break the societal norm of large families[68]. Fertility appears to decline when wealth begins to flow from the older to the younger generation, i.e., when children become more of an economic burden than an asset. This shift is often linked to improvements in education.

Rapid **local population growth** is often a result of displacement and migration, as well as absolute growth in numbers. People migrate because of population pressures, resource scarcity, political or economic insecurity, or perceived economic opportunity. Migrants to the Brazilian Amazon, for example, came not only because of population pressures and the expansion of commercial farmland in the south. They were also attracted by the large tracts of land available at the frontier, which far exceeded their holdings in the developed areas. Migration plays a key role in land extensification, and may reduce pressures to make more efficient use of resources by providing access to new resources. Migrant small farmers have been blamed for 60% of deforestation in the humid tropics[69].

The Population Debate

The debate about population growth is framed by two polar arguments[70]. Pessimistic neo-Malthusian arguments, which have been closely tied with current concerns about environmental degradation[71], see human population growth outpacing the earth's capacity to feed and support additional people. The opposing, optimistic, arguments suggest that growing populations and resource scarcity will induce improvements in technology. Human ingenuity will allow populations to expand indefinitely[72]. Already, changes in agricultural and other technologies have allowed human populations to expand substantially. A third variation on these arguments holds that people will modify their behavior in order to lower fertility rates when population pressures become apparent.

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[67] Dasgupta 1992

[68] Dasgupta 1992

[69] Myers 1991; this figure is disputed.

[70] For useful summaries of these arguments, see Sage (1994), Meyer and Turner (1992), Barbier et al. (1996).

[71] See Erlich and Erlich (1990).

[72] See Boserup (1981) and Simon (1981).

Neo-Malthusian arguments raised questions about the earth's **carrying capacity,** that is, the number of people whom the earth can support without reducing its ability to support the same number in the future. The same concept can be applied to a country or a much smaller region. While calculating an area's carrying capacity is virtually impossible, the existence of some finite limit on the earth's capacity to support a growing human population is now widely accepted. The planet's '"ecological carrying capacity' can be increased by technology ... but ultimate constraints on consumption are nevertheless real."[73] Population growth can be clearly linked with increased alteration of natural environments, including expansion of human land use and increased consumption of natural resources.

Traditional arguments about carrying capacity, which sought to define absolute limits, have been largely superseded by arguments that consider not only absolute human numbers but also the way in which people make use of their environment. People's use of the environment–consumption and production patterns–is shaped in turn by socioeconomic conditions and institutions. The impact of population growth and density, the physical factors, depends in large part on socioeconomic factors[74].

Recent literature focuses on the links between population, poverty, and environmental degradation. These links are both numerous and complicated. Economic status–poverty or affluence–appears to be an important factor in determining population growth. Economic status is also a key intervening variable shaping the way in which the population uses the environment. Poverty promotes population growth and environmental degradation; population growth in turn increases poverty and environmental degradation. But in looking at the formative circumstances, we must not forget the importance of sheer numbers. With rapid population growth, per capita income can fall even when resources are available and economic growth is "reasonable." Population growth is one of the driving forces[75] behind the division and degradation of lands in the hands of the poor and the displacement of the poor to new lands, often to ecologically fragile areas.

On the other hand, wealth is also associated with environmental degradation. Falling fertility rates in developed countries, whether in response to population pressures or not, have been accompanied by growing resource consumption. Rising incomes change patterns of demands on the environment[76]. For example, a study of Korea[77] finds that although economic growth has led to a dramatic drop in fertility rates there, growth has also entailed a sharp increase in industrial waste and air pollution, rising energy demand, and a decline in fishery stocks. Growth has created rising consumer demand, while the push for rapid industrialization has been based on a growth now, clean-up later strategy. Although population growth has slowed, the environmental impact of the population has increased.

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[73] WRI 1992, 15

[74] See the discussion of Robinson's model (1991) in Section II.

[75] These links are explored in the Kates and Haarman model (1992), reviewed in the Inequality and Poverty section.

[76] Sage 1994

[77] Kim and van den Oever 1992

Resource Use and Population

Population growth, at a global level, is continually raising absolute consumption of resources. At the same time, technology is allowing per capita consumption to rise well over basic needs in some parts of the world. Markets are expanding to meet growing global demand, creating new opportunities for commercial production. The expansion of commercial production is in turn often related to population displacement, migration, and the expansion of impoverished populations in marginal locales. Yet, many traditional resource use patterns, such as slash-and-burn agriculture, that are viable at low population densities, are degrading at higher densities[78].

One theory[79] suggests that the rate of growth, rather than the total number, may be the most important variable in understanding the impact of population growth on the environment:

> What seems to matter is that population size and population density of countries are not per se the causes of problems such as natural resource degradation or even hunger. Rather, these problems arise when the population expands too fast in relation to the productivity of the resource base upon which it survives[80].

This argument is used to explain the existence of densely populated countries, such as the Netherlands, with relatively little environmental degradation. What this argument ignores is that high absolute population densities are supportable in some countries only because they have developed institutions or strategies for obtaining natural resources from other regions. Much resource use in low-income countries in recent decades supplies high levels of consumption in the developed world[81].

Box 2
Population Expansion in the Petén*

Rapid population expansion in the Petén region of Guatemala, driven by both push and pull factors, has caused substantial deforestation and degradation. This region, which comprises about one third of Guatemala's territory, was largely unsettled prior to the 1960s. Between 1960 and 1987, the regional population increased from 26,720 to about 300,000. The Petén was largely covered by tropical dry and wet forest. By 1990, 40% of the region had been deforested, and at least 10% of the forest was degraded. Steps have now been taken to protect the remaining forest but the government's capacity to control the effects of population growth in the region is limited.

Population has been expelled from other regions of Guatemala to the Petén by economic and political processes, as well as rapid absolute population growth. The expansion of the agro-export economy and resulting land scarcity led the government to open the region to colonization in the early 1960s.

[78] See, for example, Leonard (1989) and Stonich (1995).
[79] Jepma 1995
[80] Jepma 1995, 146
[81] Sage 1994

Poor smallholders and the indigenous Kekchi population, who were displaced by the expansion of commercial production, migrated to the Petén. Other groups, including the military and middle classes, were pulled to the region by the promise of cheap land and the possibility of obtaining mineral and petroleum rights. After the opening of an all-weather road from central Petén to the Guatemalan highlands, the region began to export maize, corn, and beans to the rest of the country.

Although the government established a colonization program to shape development in the region, colonization has been uncontrolled and anarchic. This situation was worsened by the civil war and the economic crisis of the 1980s. Government plans for managed forest use have not been implemented. The poverty of soils in some regions has led migrants to find jobs in logging and collection of non-timber forest products. Deteriorating economic conditions and degradation of soils in some areas has driven concentration of land ownership which has, in turn, driven further migration into primary forest area. Competition for land and over-use of land has been most pronounced in regions with easy road access to the rest of the country. Smallholders may decry deforestation, but are dependent on the logging industry. While commercial logging is one of the primary causes of deforestation, the use of fuelwood is also a major factor as regional population expands.

Deforestation has substantial short-term benefits for the local population. The decisions of individuals and entrepreneurs to deforest are rational within the local context of expanding populations, limited market opportunities and resources, poor soils, and land concentration. Logging, ranching, road construction, urbanization, domestic fuelwood use, and farming all contribute to deforestation; these factors are interlinked and feed on each other. It is not the population *density* in the region that is problematic, but the uncontrolled *expansion* of a population with inappropriate incentives and insufficient resources to ensure protection of the forest.

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*This is a summary of Norman Schwartz, "Colonization, Development, and Deforestation in Petén, Northern Guatemala," In Michael Painter and William Durham, eds., The Social Causes of Environmental Destruction in Latin America. Ann Arbor: University of Michigan Press, 1995.

Government and Population Pressures:

Government policies have played an important role in changing demographics[82]. Clearly government policies and investments, such as poverty reduction, education for women, and family planning programs, have reduced fertility levels. But government programs, particularly colonization and resettlement programs, have also relocated large populations to relatively undisturbed areas. By facilitating access to new areas, government construction of infrastructure has promoted movements of large populations. The environmental consequences of these

[82] Numerous studies have been carried out recently on this issue, in light of the current interest in revealing the perverse nature of many government interventions (see Section on Public Policies, Markets, and Politics). See, for example, Mahar (1989).

interventions have received substantial attention. For example, the Indonesian Transmigration Program, which moved people from Java to the outer islands, was justified on the basis of reducing the population pressure on resources in Java. The program has moved people to areas that are very different from the environments they know[83], and the apparent abundance of land in the outer islands has led to the adoption of extensive and degrading agricultural techniques[84]. In Brazil, Bolivia, and many other countries, particularly in Latin America, land extensification through government-sponsored and "spontaneous" colonization, often following government road construction, have been part of a deliberate political effort to forestall the pressure of growing populations on land tenure institutions[85]. Brazil's policy of Amazonian occupation, "a land without men for men without land", has resulted in extensive deforestation, land degradation, and further migration[86]. In Guatemala, a similar pattern is evident (Box 2).

Population-Environment Models

Several useful conceptual models of the interaction between population and environment have been developed. These models consider environmental degradation caused by growing populations and local responses to environmental scarcity. While they do not address the issue of biodiversity loss directly, they do explain causes of habitat degradation.

A basic model of population-environment relations, on which many other models elaborate, is known as the IPAT model[87], which holds that environmental Impact is a function of Population, Affluence (or consumption), and Technology, or I=f(PAT). This model recognizes that the environmental impacts of population growth depend as much on patterns of resource use as on absolute numbers of people. Affluence and technology explain the relatively high environmental impact of developed country populations in comparison with developing country populations in terms of higher resource consumption levels. Poverty and inefficient technology explain the form of environmental degradation that occurs in developing countries.

Population growth puts pressure on the environment in a variety of ways, all of which are likely to contribute to land conversion and environmental degradation in the long-term[88]. This **population pressure** may be result of absolute growth, or of local growth resulting from in-migration or resource appropriations. According to Sage's model, individuals and communities respond to population pressures through:

1. Expansion of area under use through land settlement or frontier expansion
2. Intensification and innovation in production systems
3. Outmigration or resource imports (which both affect resources in other regions).

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[83] Sage 1994
[84] Leonard 1989
[85] See, for example, case studies by Collins (1986) and Uquillas (1989).
[86] Schmink and Wood 1987
[87] Erlich and Erlich 1990
[88] Sage 1994

Population growth is in turn affected by the environment when changes in local productivity lead to growth or decline in the population. Diagram 4 illustrates a common cycle of environmental degradation induced by migration to marginal frontier areas. As illustrated by the problems in the Petén (Box 2), frontier areas may be marginal because of poor soils or poor infrastructure and lack of access to markets and agricultural extension. All of these factors increase the environmental pressure caused by population expansion.

Neither population size nor growth correlates directly with environmental change for two reasons. First, the impact of human populations varies greatly with socioeconomic factors and ease of access to environmental resources and, second, population change is not necessarily synchronous with environmental change[89]. Given the discontinuities in time scales, gradual population growth may lead to sudden environmental change. Environmental degradation may jump rapidly, rather than following a smooth trajectory, when ecosystems reach the limits of their resilience. We do not know how close we have already come to those limits. Sage warns us to "beware a preoccupation with sheer numbers of people and mathematical 'limits to growth' and rather focus upon the relationships among individuals, regions, and nations, their institutions, technologies, and patterns of resource consumption." Population growth has effects across regions and across spatial scales: pressure on local resources may result from population changes elsewhere. Nevertheless, at the local level population pressures are often a major driving force of land use change[90].

The concept of "**production pressures on resources**"[91] recognizes that carrying capacity varies with many factors. This provides a more useful model than the traditional population-pressure-on-resources model, which suggests a simple correlation between population and degradation. Population pressure works in association with other causes to create land degradation. For example, production pressure on resources encourages or forces expansion into new areas:

> Since the expansion is likely to be carried out largely by those displaced from older areas by poverty, or by other pressures of social or political origin, the new land has to be managed by those with the fewest resources to devote or divert to its management.[92]

In the case of Guatemala[93], pressure on forests in the Petén is a result of in-migration, poor resources, and disincentives to use the land efficiently. Population growth is one important factor in the sequence of deforestation and degradation.

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[89] Sage 1994
[90] Sage 1994
[91] Blaikie and Brookfield 1987
[92] Blaikie and Brookfield 1987, 32
[93] Schwartz 1995

Land-use patterns, or production systems, are the primary variable linking population and land degradation. One model [94] proposes that there are four types of **land-use change in response to population growth**. These may occur consecutively, concurrently, or cumulatively, depending on natural resource endowments and socioeconomic variables such as land tenure institutions, community controls, government policies, and international markets. As population growth, under a particular production system or technology regime, begins to put pressure on resources, one or all of the following changes will be made by local resource users.

1. Tenurial Change: Changes in individual and group entitlements to resources are used initially to retain equitable distribution. Eventually parcelization or fragmentation are inevitable as the pressure increases. Reclassification of rights–for example, turfing out recent in-migrants in the community–may occur.
2. Land Extensification: Appropriation of frontier lands or lands belonging to others reduces community pressures by increasing the availability of land resources.
3. Technological Change: Intensification of land use is facilitated by the introduction of new technologies. New technologies may require further changes in tenure regimes and other institutions. Modern agricultural technologies are sometimes associated with consolidation of landholdings and privatization of land rights.
4. Demographic Change: Efforts to reduce population pressures include a reduction in fertility and/or outmigration. Migration can start a feedback loop in which environmental degradation in a new location leads to further migration (see Diagram 4).

Cases: Few studies have directly examined the linkage between population growth, changes in land use, and environmental degradation in more than a circumstantial way[95]. A long-term study in Honduras[96] points to a clear association between population pressures and consequent land division, deforestation, and soil degradation. Population pressures arise as peasants are repeatedly displaced by commercial agriculture, each time onto more marginal land

Insert Diagram here: 6: Population and Frontier Cycle

(Box 8). A study in Guatemala[97] found that the number of small farms was expanding rapidly because of population growth, due to decreased mortality, in rural areas. Localized land extensification in established rural areas was incorporating marginal lands, with consequent environmental damage[98]. Migration to the northern Petén region of Guatemala is the most rapid in the country; there agriculture is rapidly encroaching on Guatemala's only large remaining area of forest[99].

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[94] Bilsborrow and Okoth-Ogendo 1992

[95] Bilsborrow and Okoth-Ogendo 1992

[96] Stonich 1995

[97] Bilsborrow and DeLargy 1987

[98] More land is being used in most regions than is considered appropriate for agriculture. Severe erosion problems are arising because of use of steep slopes.

[99] Schwartz 1995

A study in Kenya[100] found that, as populations expand to new lands, competition among different livelihood systems is often generated, especially in transition zones between more and less productive ecosystems. As farming populations from the highlands began to expand into the lowlands, they continued farming even on lands that were better suited to, and traditionally used for, pastoralism. The effect of population growth was closely associated with the type of production system.

"Production pressure on resources" may or may not be a result of population expansion; population decrease can have important negative effects by forcing change in traditional production systems. Several studies have found links between out-migration and environmental degradation. Declining populations may lead to fewer conservation measures because of labor shortages. For example, in the uplands of Bolivia, migration of much of the male population to the lowlands to work as paid labor has created a labor scarcity (Box 3). Intensive farming methods that include conservation measures are no longer practicable in the region[101].

Table 3: Demographic Change

Pressures on Biodiversity	**Demographic Change**
Source:	Absolute growth • cultural and economic value of children • lack of economic opportunities • failure of urban economy to absorb rural population Local growth • displacement because of commercial development, resource degradation, political forces
Effects:	• growth of resource consumption • expansion and intensification of land use • increasing poverty • exploitation of marginal lands • breakdown of traditional resource management
Sample Questions to Consider in a Case Study:	• what patterns of demographic change are occurring? • is population growth associated with changing production patterns? • is population growth altering resource tenure patterns? • what social, political, and economic changes are being driven by demographic change?

B. Inequality and Poverty

[100] Kates and Haarman 1992
[101] Painter 1995

Inequality of income and resource distribution has received much of the blame for environmental degradation. Inequality shapes patterns of resource use at all levels, from the local to the global. Economic inequality is seldom separable from political and social inequality. Economic marginalization of the poor and unequal access of the wealthy to resources are continually reinforced by political, social, and environmental inequities. Poverty, in particular, has been linked with poor management of resources. A vicious circle of poverty, degradation, and further impoverishment has been illustrated by a number of case studies[102]. Wealth, the other side of the inequality coin, has also been closely linked with environmental degradation through high levels of consumption and short-term management of resources.

Poverty and Marginality

The view that poverty relief must take precedence over environmental concerns is gradually being replaced by the view that poverty relief and sustainability are closely linked. In other words, the idea that development must precede environmental concern or clean-up is being replaced by the idea of sustainable development. Current thinking[103] holds that addressing poverty issues properly will relieve environmental pressures, by breaking the cycle of impoverishment and degradation. Various models of this cycle are discussed here.

Most studies of poverty and environmental issues have focused on land degradation because of its links with land degradation and rural impoverishment. Land degradation will often have direct impacts on biodiversity, as it forces changes in production patterns, migration, and frontier expansion. Reviewing the models of the relationship between poverty and degradation of agricultural land is therefore a useful step in analyzing the root causes of biodiversity loss. Generalizations made here about the effects of poverty unfortunately gloss over important distinctions among degrees and types of poverty. A distinction must be made here between traditional cultures, which may have few resources but are not sufficiently integrated into the economy to consider themselves as poor, and the much larger population of poor people who suffer from a shortage of economic resources. There are several issues to address in thinking about the poor in relation to the environment and biodiversity loss:

Location of the Poor:

Are the poor disproportionately located in fragile ecosystems or areas of high or threatened biodiversity?

Estimates of the coincidence of poverty and environmentally marginal places depend directly on the definitions of poverty and environmental marginality employed and, therefore, vary widely. According to estimates by Leonard[104], some 60% of the world's poor[105] live in areas of

[102] See, for example, Diagram 4 and Boxes 3,4, and 8.
[103] See, for example, recent World Bank publications such as Serageldin (1996).
[104] Leonard 1989
[105] Defined here as the poorest 20% of the world's population.

low agricultural potential, which he equates with high ecological vulnerability. These include arid lands, steep slopes, and infertile lands, where high population densities or poor land use practices lead to further impoverishment and declining social well-being. The problem is particularly acute in Asia, where 70% of the poor live in marginal areas.

> Often the lands where the itinerant poor end up are those that were previously only sparsely settled because of their remoteness, marginal nature or ecological fragility ... the poorest people ... occupy the lands that need the most infrastructure, management, and external inputs if their utilization is not to result in land degradation and environmental destruction.[106]

Leonard's conclusions have been criticized[107] on the grounds that a direct correlation cannot be made between lands of low agricultural potential and lands of high environmental vulnerability. However, a correlation at a larger scale, between poor countries and threatened environments, can be seen. The poorest countries are disproportionately dry countries. Moist tropical forests are also concentrated in low-income countries[108]. Nor can a direct correlation be made between environmental degradation, in agricultural terms, and biodiversity loss. Biodiversity may be lost long before an area becomes environmentally marginal for agriculture.

Poverty–Degradation Linkages:

Do the poor make particularly damaging use of the environment?

A number of forces lie behind unsustainable land use by small farmers[109]. Lack of financial and human resources and poor access to government resources and infrastructure all promote short-term management strategies and unsustainable use of natural resources. Relying on small plots of land for subsistence and lacking alternative sources of income, they cannot afford to plant trees or allow fallow periods. Nor do they have the time to invest in soil conservation measures such as terracing. Lack of tenure security discourages long-term investment. And isolation reduces their access to extension services and environmental technology. In the Bolivian highlands (Box 3), for example, cattle provide a store of savings in the absence of banks, with obvious consequences for the environment. In Brazil (Box 4), productivity of rice fields declined because farmers could not afford fertilizers. The response has included further deforestation.

Box 3
Poverty and Land Degradation in Bolivia*

In Bolivia, poverty and inequality have worsened over the last decade as a result of an extended

[106] Leonard 1989, 16
[107] See Kates and Haarman (1992) and Sage (1994).
[108] Kates and Haarman 1992
[109] USAID and WRI 1993

drought, collapse of international prices for the country's primary export, tin, rampant inflation, and general financial collapse. In the traditionally agricultural upland regions, poverty has led to extensification of land use and land degradation. Many smallholders migrated to the lowland Chapare region in the 1980s as a result of these pressures. Outmigration from the uplands is exacerbating the links between poverty and environmental degradation. Rising populations in the lowland areas are recreating the same patterns of inequality that characterize the uplands, driving degradation in the Chapare.

Economic hardship has affected rural family land use in the uplands. Agricultural use is encroaching on forests and community lands. Several related factors underlie extensification of land: Much of the male population has migrated to the lowlands in search of paid work, creating a labor scarcity in the uplands. Livestock production has been increased in response to economic instability and the absence of rural financial institutions; cattle provide a form of savings and investment for smallholders. Rural industries, including beer brewing, that consume firewood have expanded. Land scarcity is not caused in this case by population growth but by poverty. Poverty has created the labor scarcity that precludes intensive farming and leads to poor management of resources.

Migration from the uplands to the lowland Chapare region has been driven by poverty and resource scarcity. 59% of migrants were landless. Yet land distribution in the Chapare is very uneven. Migrant families, like the upland families, rely heavily on off-farm wage labor to make ends meet. The patterns of labor scarcity and poor resource management are inevitably repeated. The expansion of coca production in the region, possibly the only crop with a secure market, is extensive. Farmers are not making sufficient profits to invest in intensification, such as fertilizers or hired labor. Deforestation and habitat destruction are the result of the constraints poverty puts on resource management.

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*This is a summary of Michael Painter, "Upland-Lowland Production Linkages and Land Degradation in Bolivia," in Michael Painter and William Durham, eds. The Social Causes of Environmental Destruction in Latin America. Ann Arbor: University of Michigan Press, 1995.

Short-Term Views: Poverty prevents people from taking a long-term economic or environmental view. Poor farmers, fishermen, and other resource users extract what they can from the environment to support themselves, and have little time or resources left to invest in resource conservation or management. Marginal resources, which are often all that are available to the poor, are used intensively. Moreover, the poor often lack the resources, skills, or access to public programs that are needed for restorative or protective works. Inequality of human capital–education, skills, health services–contributes to poor resource management. The failure to invest in human capital perpetuates both poverty and short-term resource management. For migrants who are facing new environments where traditional knowledge and production systems may be inappropriate, this problem is particularly severe. This has been the case in many colonization schemes (Box 3).

Particular attention has been paid to questions of land tenure. Poor farmers often have no tenure or uncertain tenure of their land as a result of socioeconomic inequality. Insecurity of tenure rights and the prevalence of landlessness among the poor facilitates displacement and promotes degradation. It is widely held that this situation further promotes the short-term view. Why make investments in conservation when the land may be appropriated tomorrow? The same holds true for marine and other natural resources.

Displacement and Resource Division:

What forces push the poor onto marginal lands?

To create a model of the causes of the impoverishment and degradation cycle, Kates and Haarman reviewed the limited case study material that directly examines the linkages between poverty and environmental degradation[110]. A strong consistency is found in the way poor people lose entitlement[111] to environmental resources and enter the spiral of impoverishment and degradation. Three driving forces are common to the case studies: displacement, division, and degradation (Diagram 6). Although the three work together in different ways in different cases,

> ... with remarkable agreement irrespective of location, the case studies tell repeatedly how poor people lose their entitlement to environmental resources, how those resources are further degraded, and how such loss and degradation lead to further impoverishment[112].

The common causal factors behind displacement, division, and degradation, according to Kates and Haarman, are:

- development and commercialization
- poverty
- population growth
- natural hazards

Displacement often takes the form of displacement from untitled lands or common property resources, through expropriation or limitations on access, to make way for "development" or commercial activities. Large-scale agriculture, hydro projects, export forestry,

Insert Diagram here: 7: Where the Poor Live

[110] Kates and Haarman (1992) reviewed the 30 relevant case studies they found, which were primarily undertaken by anthropologists and geographers. The case studies found a strong link between poverty and environmental degradation. Half of the studies were from drylands, a third from tropical moist forests, and four from highland areas.

[111] Entitlement here is defined as "socially recognized access of a household to needed environmental resources."

[112] Kates and Haarman 1989, 8

and even conservation projects are common causes. Expanding populations also contribute to displacement. *Division* of resource rights and landholdings likewise occurs because of population growth, as families share resources among children, and because of economic losses that require selling off some resources. Finally, *degradation* because of excessive or inappropriate use, failure to implement conservation measures, or natural events leads in turn to displacement or division.

Patterns of division, displacement, and degradation varied from case to case, but the results for the environment and the poor were always similar. In the dryland cases, for example, displacement occurs because of development activities in areas of prime water availability and the resulting loss of access to common property resources; population pressure or resource appropriation in areas of high agricultural potential; and/or degradation due to natural events and inappropriate uses. Highland areas are often characterized by stiff competition over limited amounts of arable land, among both small farmers and commercial interests, leading to division and displacement onto easily degraded slopes and other marginal lands. Tropical forests have been heavily affected by large development projects and small farmer resettlement programs, which often result in land degradation and further displacement. Forms of environmental degradation peculiar to different landscapes, dry areas, steep hillsides, and forested frontiers, are illustrated in Diagram 7.

Ecological Marginalization:

What forces combine to increase the number of poor and worsen the conditions of poverty?

The "ecological marginalization" of the rural poor, according to one model[113], can be explained in terms of:

- rapid population growth;
- land consolidation and agricultural modernization in fertile agricultural areas; and
- inequalities in land tenure.

Population growth is clearly one of the factors contributing to poverty. The number of landless and land-poor rural households is increasing[114]. As more people become dependent on the same resources, these resources are used more intensively. Population growth contributes both to migration and appropriation of new resources, and to more intensive use of currently used resources. Strong links can be seen between distribution of education and power between men and women, at the household level, and fertility rates and resource use patterns. Both time series and cross-national data show a broad inverse relationship between fertility rates and per capita income[115].

Insert Diagram here: 8: Impoverishment and Degradation Spirals

[113] Leonard 1989
[114] Kates and Haarman 1992
[115] Dasgupta 1992

Insert Diagram here: 9: The Poverty and Environment Connection

Box 4
Smallholder Settlement and Short-Term Approaches*

Poverty and inequality reinforce other disincentives to sustainable land use. This pattern is evident in many newly settled areas of Latin America. Land tenure institutions, credit policies, availability of extension services, and other factors shape the land-use decisions of smallholders in new environments. Often these factors perpetuate poverty, and the strategies that smallholders adopt in adverse conditions lead to soil deterioration and deforestation. Two examples follow:

In the Brazilian Amazon, colonists in government-sponsored programs faced difficulties because of the inexperience of extension workers, and the inflexibility of the government bureaucracy, banks, and other institutions. The government failed to provide services that had been promised to settlers. Rice production was promoted by the colonization bureaucracy, and most titling and agricultural credit was linked to rice production. But without costly fertilizer inputs, poor smallholders suffered declining rice yields. With intensifying competition over land, these smallholders had little choice but to intensify or expand production by shortening fallow periods or deforesting new areas in order to meet their obligations and hold onto their land, thus entering a cycle of impoverishment and degradation.

Unsustainable land-use practices were also encouraged by poverty in the Lago Agrio region of northeastern Ecuador. There the cost of obtaining plots was high, and included mandatory membership in an agricultural cooperative; the surveying, mapping, and registration of the land; and the cost of the land itself. Although 25-year mortgages were permitted, permanent title was not awarded until the amount was paid in full. Without permanent title, settlers could not obtain credit. Legal transfer of the land also required a permanent title. Unsuccessful farmers were forced to sell their plots at a fraction of the real value. For the poor, this institutional arrangement clearly promoted short-term profit-making at the expense of sustainability. Pasture formation and intensified production were essential to meet basic needs and overcome these institutional hurdles. But the result was falling yields, worsening poverty, and eventual resale of the impoverished land.

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* This is a summary of Jane L. Collins, "Smallholder Settlement of Tropical South America: The Social Causes of Ecological Destruction," Human Organization 45, 1 (1986): 1-10.

Sheer numbers of poor people alone does not fully explain their increasing ecological marginalization. Land consolidation and inequalities in access to land explain much of the pattern of increasing impoverishment and degradation. Inequality in land includes not only differences in size, location, and productivity of plots, but also in security of tenure. Scarcity of land, often a result of inequality of distribution, forces people to migrate to new lands or urban areas.

Commercial agricultural development and inequalities in land tenure, bolstered by economic and political inequalities, reduce access to fertile land.[116] Population expansion forces the poor to divide and subdivide their limited land and resources. The poor are thus increasingly pushed toward remote and ecologically fragile rural areas, especially when roads or other means of access are provided, and to the edge of growing metropolises.

Migration to new rural lands is the most critical part of the cycle for biodiversity loss. While agricultural production and income have risen in fertile areas,

> the stagnation of agricultural productivity in other areas and the push of landless people out of areas undergoing agricultural modernization have placed great pressures on poor people throughout the developing world to occupy and exploit more and more marginal lands[117].

The marginal lands available to the poor are highly susceptible to ecological change and deterioration through soil degradation and erosion, desertification, and deforestation. What is of particular interest in looking at the causes of biodiversity loss is not degradation of soils or loss of agricultural potential but disturbance of ecosystems. Degradation drives migration and extensification, and thus further loss of habitats and biodiversity.

Wealth and Inequality

Inequality works against sustainability and conservation of biological diversity in a number of ways. The minority wealthy who control the resources and enjoys the profits from their use do not suffer the consequences of their degradation. At the national scale, resource control and environmental policymaking are generally concentrated in the hands of urban elites with little use for biodiversity[118]. At the global scale, wealthy consumers are primarily located far from the ecosystems upon which they rely for resources.

Wealthy resource users, such as large-scale farmers and other commercial producers, also take short-term economic and environmental views. They have the freedom to extract resources from one area, and then move their investment to another area. They are isolated from or unaffected by the environmental consequences of the production systems upon which they depend. Because wealthy resource users can appropriate large shares of the resource base, they use the resources extensively rather than making capital investments in resource management. The paradox therefore arises that the most productive areas are often used extensively, while the marginal areas are used intensively.

Inequality is also prevalent in decision-making power about resources. In the Brazilian colonization schemes, for example, the government required farmers to grow rice, while in

[116] The issue of expansion and modernization of commercial agriculture is explored in the section on Macroeconomic Policies and Structures.
[117] Leonard 1989, 5
[118] WRI 1992

Ecuador settlers were unable to sell their land at a fair price because of legal requirements (Box 4). While resource managers may have ideas about how to manage their resources well, interventions by governments and large-scale private operations often prevent sound decision-making. Many functioning common property regimes have been seriously disrupted when governments or large-scale users unilaterally imposed changes in resource use (Boxes 5, 9 and 10).

A theoretical study of the importance of inequality to resource use[119] finds that the relative power of winners and losers is a critical factor in determining environmental outcomes. For both rich and poor, greater inequality reduces concern for the future, though for different reasons. For the poor, the imperatives of day-to-day survival lead to short-term management and environmental degradation. The wealthy, because of their tentative hold on political power and greed, will try to maximize profits now without regard for the environmental consequences[120].

Interestingly, degradation of many common property resources occurs because of use by the wealthier users among the poor: those who have the largest cattle herds, require the largest water diversions, and so on[121]. Other degradation of common property resources occurs because of the introduction of new uses in an effort to increase incomes. In India, for example, growth of cottage leather industries, an important alternative source of income, has lowered water quality and crop yields, severely affecting farmers[122].

Inequality between nations has also received substantial attention. Poor countries of the world are transforming and exporting their natural resources to the rich countries in exchange for foreign exchange and imports. Studies have attempted to link the debt crisis of the 1980s in particular with an increase in deforestation and environmental degradation, but the idea that developing countries are forced into an unequal exchange of commodities for processed goods has held sway for many years. This pattern is linked with inequality within developing countries: the poor are exploiting the environment to provide exports that primarily benefit the rich. The inequality between nations has been explored largely in terms of the shape of international markets, and is discussed further under the section on Macroeconomic Policies and Structures.

Table 4: Inequality and Poverty

Pressures on Biodiversity	**Inequality and Poverty**
Source:	• poor distribution of income/natural resources/land • appropriation of resources by the wealthy • bias of economic and political systems towards promoting inequality • failure to invest in human capital
Effects:	• short-term economic/environmental views

[119] Boyce 1994
[120] Boyce 1994
[121] Kates and Haarman 1992
[122] Kates and Haarman 1992

	• poor resource management • extensive use of productive natural resources; pattern of intensive use of marginal natural resources and land abandonment • coincidence of poverty and areas of high biodiversity
Sample Questions to Consider in a Case Study:	• are large poor populations concentrated in less productive, more fragile lands and/or areas of high biodiversity? • is poverty preventing minimal and desired investments in conservation? • do tenure arrangements favor large and/or commercial producers? • is expansion of commercial production displacing populations? • are practices of wealthy landholders contributing to biodiversity loss?

C. Public Policies, Markets, and Politics: National Issues

The relationship of national laws, economic and political institutions, and government policies to environmental degradation is central to many recent explanations of biodiversity loss. Most attention has focused on ways to compensate for "failures" in laws, policies, and organizations, without an examination of the underlying socioeconomic forces that produce governance and market structures that promote biodiversity loss. While careful evaluation of these structures reveals much about the sources of biodiversity loss, we must also examine the particular political, social, and economic context in which these structures develop, and their roots in the development model. These underlying causes are too often dismissed as lack of "political commitment" to sustainable development. The following discussion reviews various types of policy and market failures that affect habitats and biodiversity, and then examines some of the underlying political causes of these failures at the national level. The next section looks at macroeconomic policies and structures that link national and international political-economies.

Two types of **policy failures**[123] are repeatedly pointed out. The first are perverse government policies that provide incentives for degradation or resource exploitation. The second are government policies and market institutions that fail to incorporate environmental values, including the value of biodiversity, into decision-making. Both types of policy failure create what are commonly referred to as "win-win" situations, situations in which the removal of a perverse policy or the introduction of interventions to compensate for market failures is expected to create

[123] The term policy failure is used here loosely to indicate failures not only in government policies but also in laws and institutions that govern markets, and in the implementation of laws and regulations, all of which may have detrimental impact on the environment.

economic and environmental benefits for everyone. Policies that have detrimental environmental impacts are pervasive and often easily identified[124].

Policy Failures

A classic text on public policy failures and the environment is Repetto and Gillis' work on forests[125]. Based on studies in a number of developing countries they find that government policies promote forest degradation and deforestation, both directly and indirectly, intentionally and unintentionally. Many of these policies were specifically designed to promote "development", including logging and forest clearing, by altering market incentives. The underlying conceptual model here describes individuals and companies responding rationally to perverse, or apparently irrational, government policies. Rational behavior in this context of distorted markets leads to degradation. Problematic policies include:

- sectoral policies;
- infrastructure projects;
- tax, credit and pricing policies;
- incentives for competing resource uses; and
- tenure policies.

A number of sector-specific forest polices encourage deforestation, including laws on the duration of timber concessions, allowable harvests and harvesting methods, and royalties and fees; policies on non-timber forest products; and policies on reforestation. Short concession terms and low stumpage prices are common among the policy failures promoting deforestation. Development policies outside the forestry sector that contribute to forest degradation include large agricultural programs, mining, dams, roads, and other infrastructure projects. The close relationship between extension of roads into forested areas and migration patterns has been frequently pointed out[126]. Less direct but equally culpable are tax, credit, and pricing policies that encourage private sector forest exploitation, and policies that encourage private investment in competing land uses such as ranching, farming, and aquaculture. Generous tax treatment, subsidized credit, and direct government subsidies have encouraged the transformation of forest to pasture, for example. Tenure policies also contribute directly to deforestation. Many countries grant private tenure over forested land when the land is "improved." In other cases, such as in Indonesia (Box 6), governments have centralized rights over forested lands, superseding traditional institutions and use rights and, often, removing local incentives for conservation. Finally, these policies work in conjunction with national policies that fail to resolve or even worsen the problems of poverty, inequality, and unsustainable development patterns, and with

[124] Useful summaries of this problem are found in Repetto and Gillis (1988), Mahar (1989), McNeely (1985), and World Bank (1994).

[125] Repetto and Gillis 1988

[126] For studies of the relationship of roads to forest clearing and settlement, see Chomitz and Gray (ESD 1995), Smith(1982), and Talbott (1995). Different methodologies are used. Chomitz and Gray use statistical analysis of GIS data to correlate agricultural expansion with road-building. Smith provides a case study of degradation along the Transamazon highway.

external factors, such as international commodity markets and trade barriers raised by other countries.

Other studies of government incentive policies and development programs have repeatedly pointed to the damage they have caused. In India[127], development policies that privatized common property grazing lands and improved access to markets have encouraged cropping on unsuitable lands and promoted overuse of remaining grazing lands (Box 10). In the Brazilian Amazon[128], development projects have included large-scale road building efforts, mining, dams, and colonization schemes. Fiscal incentives and subsidized credit have promoted cattle ranching and other damaging land uses, as well as extensive land speculation. The effect of these government interventions has been compounded by population growth, inequity, poverty, and economic instability.

Agricultural and Colonization Policies:

Agriculture been subject to extensive government intervention in most countries. In developing countries, policies often work to the detriment of the rural sector in favor of the urban sector. Interventions have been designed to serve several, sometimes contradictory, purposes. These include boosting agricultural output of domestic crops to keep food prices low for urban consumers, and boosting agricultural production for export to fund imports and debt[129]. Diagram 8 illustrates this pattern. The environmental impacts have included displacement of subsistence agriculture to marginal and frontier lands on the one hand, and mechanization and over-use of chemical inputs by commercial agriculture on the other. Subsistence farmers have been chronically short of financial resources and neglected by government extension services. Commercial producers have often benefited from substantial subsidies to production, including credit and input subsidies and guaranteed prices. The consequent expansion and intensification of land use may have a serious impact on biodiversity.

The removal of many agricultural subsidies and price controls under recent structural adjustment programs has promoted changes in agricultural production systems. Some of these changes, such as a reduction in chemical inputs, may reduce pressure on biodiversity. However, in many cases, such as Cameroon (Box 7), removal of government interventions, particularly rural credit subsidies, marketing services, and extension services, is likely to promote expansion and unsustainable use of agricultural lands. Environmental impacts will depend largely on the types of domestic and commercial crops that are produced, and the capacity of other sectors of the economy to absorb agricultural labor.

The issue of perverse incentives, land tenure policies, and environmental degradation at the frontier have been examined in detail. According to one model of environmental degradation that focuses on government policies[130], small farmers fail to invest in conservation and soil

[127] Blaikie and Brookfield 1987
[128] Mahar 1989, Wood et al. 1996
[129] For a discussion of these policies, see Schiff and Valdes (1992) and Faeth (1993).
[130] Southgate 1988

management both because of distorted price signals and because of tenure regimes that grant them only limited or uncertain rights. The case of settlement at Lago Agrio, Ecuador, where settlers could not obtain permanent title to land until the mortgage was paid in full, provides one example (Box 4). Distorted price signals have played an important role in driving subsistence farmers to the frontier. Such price signals are part of an overall development strategy that accounts for neither the social nor environmental costs of pushing peasants to the frontier and on to marginal lands. These signals provide incentives to clear land for agriculture, rather than to practice forest management. They also create disincentives to agricultural conservation measures.

Among the price signals which act as disincentives to conservation measures are:

- the high opportunity cost of labor: many subsistence farmers must also work off-farm to increase cash incomes;
- interest rates: the cost of obtaining credit is often particularly high for small farmers, in large part because of government credit policies;
- commodity prices: policy-induced low prices keep incomes low;
- subsidies for non-labor inputs to agriculture: chemical inputs are often substituted for conservation[131].

The influence of the price signals is aggravated by the tenurial regime. With insecure or incomplete tenure, farmers are unwilling to make long-term investments. This is especially true on the frontier where the process of applying for formal tenure is particularly difficult, and where legal claims are most uncertain. These problems are illustrated by the situation in the Amazon, where violence over land claims has been common. In Indonesia, the advance of the commercial frontier is delegitimizing traditional tenure institutions (Box 6). In other cases, rising land prices, due to speculation or expanding commercial agriculture, provide incentive to small farmers to sell their land and move on, and raise the price of renting land for landless farmers, encouraging further expansion of the frontier.

Market Failures and Valuation

Market failures occur when market structures do not internalize the costs of environmental degradation into the prices of goods and services. These costs, including habitat destruction and biodiversity loss, are termed **externalities**, because they are not reflected in market prices. The environmental costs of these externalities are real, however; some costs may be felt now, others in the future. A number of market failures directly foster biodiversity and habitat loss. These have been described succinctly by McNeely[132]:

- biological resources are not given appropriate prices in the market; biodiversity is generally not valued in the market at all

[131] Southgate 1988

[132] McNeely (1988) provides a description of the valuation problem and proposed policy solutions. Southgate (1995) provides a thorough case study of Ecuador's environmental problems, based on market failure theories.

- benefits of conservation are not fully accounted for in cost-benefit analyses of development; the net benefits of exploitation are overestimated
- those benefiting from exploitation rarely pay the social and economic costs; externalities are created for others or for future generations
- weak ownership leads to over-exploitation of species and ecosystems; this is known as the tragedy of the commons
- discount rates encourage depletion of resources now; future costs and benefits are discounted, so the benefits of conservation appear small
- national income measures do not include the depletion of biological resources; their loss is not subtracted from GDP.

Decisions about natural resource use are made within a context that does not place an economic value on many environmental resources. In the case of frontier colonization described above[133], the private net benefits of clearing do not reflect the social or environmental costs. They reflect the difference between agricultural and forestry rents, without incorporating the environmental values lost through habitat and ecosystem transformation.

Valuing Biodiversity:

The underlying conceptual model here holds that correction for market failures will make the costs of environmental degradation apparent, and can substantially reduce degradation. At least in theory, government policy can compensate for market failures with the imposition of taxes or charges for the use of environmental resources and services. Much of the discussion of market failures and biodiversity loss has focused on the methods for placing a value on biodiversity, as a starting point for designing appropriate policy interventions. Values to be taken into account include the genetic information stored in biodiversity and the insurance it provides against ecological catastrophe[134]. A number of methodologies have been devised for putting a value on biodiversity. These include measures of existence value, opportunity cost, contingent valuation and others[135]. None of these methods can really capture the value of biodiversity quantitatively, since its greatest value may be as insurance against future uncertainty[136]. These methods may help introduce environmental values into government decision-making, as illustrated by the case studies from Thailand (Box 5). But neither the information nor the insurance value of biodiversity is accounted for by current market or government institutions[137].

Although these valuation techniques may be useful in designing solutions to biodiversity loss, they do not reach or examine the root causes of the problem. They are built on the premise

[133] Southgate 1988
[134] Perrings et al. 1995
[135] For summaries and explanations of valuation techniques, see Munasinghe (1992 and 1993), World Bank (1994), and Pearce and Warford (1993).
[136] Perrings et al. 1995
[137] McNeely 1988, Perrings et al. 1995

that conservation is best promoted through economic incentives[138]. Because they look strictly at markets, they do not take into account the political structures which lie behind market structures. Nor do they reflect the political difficulty of imposing a cost on use of resources that are usually free and often perceived as valueless. Various economic tools have been designed for incorporating these values into market decisions, but their application has been rare. To understand this failure, one needs to consider the role of power in shaping institutions, including the market structures that shape the treatment of biodiversity.

Box 5
Incorporating Natural Resource Values: Cases from Thailand

Incorporation of environmental values into analyses of development or conservation projects can substantially change their apparent profitability. Three case studies from Thailand illustrate this. A study looking at the costs and benefits of the establishment of the Khao Yai National Park measured both the losses to local villagers and the benefits to park visitors. The villagers have lost between 10,000 and 20,000 *bhat* per family per year in forgone income from collection of timber, fuelwood, fruits, vegetables, medicinal plants, wildlife, and aromatic wood from the forest. The net present value of foregone harvests for the 200 villages in the area was estimated to be 1.65 to 3.3 billion *bhat*. Using a "willingness to pay measure", the value of the protected area for urban Thais was estimated. This value was calculated at 30 billion *bhat*. By this calculation, protection of the area is cost effective.

Another case study looked at the construction of a dam in the Phrae Province; the dam would flood what may be the last remaining golden teak forest in Thailand. Many factors were incorporated in the cost-benefit analysis: the cost of dam construction, the cost of evacuation and resettlement, the loss of forest-based income to local people, and the cost of mitigating environmental damage, including watershed protection, carbon sequestration, and establishing *ex situ* gene banks for biodiversity. Accounting for all of these factors, most of which were ignored in the government's decision to build the dam, revealed a very low net benefit of construction.

A final study looked at the consequences of treating water as a free good, or open-access resource, in the Mae Taeng watershed management area. Many of the benefits of an irrigation project were lost to lowland farmers because water was being diverted upstream. Urbanization and irrigation in the highlands substantially depleted water supplies in the lowlands, forcing lowland farmers to change crops or abandon farming. Proper pricing of water could improve distribution and increase the benefits of the irrigation works.

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*This is a summary of Mingsarn Kaosa-ard, "Valuation of Natural Resources and Environmental Degradation: A First Step to Conflict Resolution," Paper presented at the Chiang Mai University Symposium, Montane Mainland Southeast Asia in Transition, Thailand, 1995.

[138] McNeely 1988

Most market-failure and valuation approaches are optimistic about the feasibility of compensating for market failures and imposing values on biological resources. A more pessimistic view [139]asserts that sustainable or prudent use of environmental resources is likely only when the resource base is small, possibilities for substitution are limited, and control over resources is tight. Some traditional societies fulfill these conditions, but few still maintain strong control over their environmental resources. New users of environmental resources, such as colonists, are unlikely to meet these conditions, given the insecurity of tenure, the apparently extensive frontier, and open access to resources.

Short-term Views:

Biodiversity has little or no perceivable short-term value for most resource users. Biodiversity is essentially an open-access resource, as are many habitats important for biodiversity conservation[140], in part because of the breakdown of common property institutions. Responsibility for and rights to biodiversity are unclear and rarely recognized[141]. Most institutions assigned responsibility for conserving biodiversity have lacked sufficient resources or incentives to do the job. The financial or market incentives therefore are for short-term exploitation.

The rationale for conserving biodiversity has often pointed to the medium- and long-term global benefits of keeping a broad range of species alive. More recently, strong arguments[142] have been put forward that the greatest value of biodiversity is local: ecosystems will be more resilient and adaptable in the face of climate change or other ecological disruption if local biodiversity has not been depleted. While this argument should provide local users with some incentive for conservation, the perceived short-term value of biodiversity often remains nil.

Trade-offs are required for conservation. Better valuation of biodiversity, including recognition of its long-term value, may reduce the apparent "cost" of conservation. Nevertheless, conservation will require a reduction in current resource use. The contradiction between the current development paradigm and the requirements for biodiversity conservation have resulted in a failure to give priority to conservation and an inattention to biodiversity loss, in favor of current production. Market failures are inherent in market structures. Inequality, discussed above, and market structures both promote a short-term environmental and economic view; long-term values, even once recognized, are unlikely to be incorporated into decision-making at any level, because of the present political, social, and economic costs entailed.

Politics: Underlying Causes of Policy and Market Failures

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[139] Gadgil 1993

[140] Sedjo and Simpson 1995

[141] Most discussions of rights to biodiversity have focused on intellectual property rights; a different concept of biodiversity rights must be developed, however, if its primary value is *in situ*, maintaining the resiliency of ecosystems.

[142] See Perrings et al. (1995) and Barbier et al. (1994) for summaries of this issue.

Although government and market failures account for many poor incentives for sustainable resource use and conservation, the reality is often more complex than the literature on policy failures suggests. Laws, policies, and institutions[143] are a product of political, social, and economic forces; they also play a key role in shaping those forces. They reflect and often reinforce the power relationships and inequities in society. Policy and market "failures" are rarely accidental. Policies, laws, and formal and informal institutions are established and maintained because they benefit, or are intended to benefit, some sector or class of the economy or society. Resource exploitation provides immediate benefits for someone; political power generally underlies resource allocation patterns. Resources are distributed as a result of, and as a means to, political and economic power.

While some policies may simply facilitate resource appropriation by powerful groups, others are part of a coherent development effort[144]. The prevalent development paradigm views natural resources as a cheap way to support economic growth, which is considered synonymous with development. Environmentally perverse policies often serve traditional development goals. These include such goals as industrialization, export expansion, increased food production, and poverty relief. However, many development efforts do not serve the poor or the environment. The overlap between development policies on the one hand, and policies and institutions that allow politically powerful groups to appropriate resource benefits and perpetuate inequitable distribution on the other, is considerable.

Policies that fail the environment and stymie conservation efforts are often successful in achieving intended goals that are unrelated to conservation. While the environment may "win" from a change in policy, someone will lose. In the Petén[145], for example, colonists and commercial outfits alike see too many short-term benefits to consider alternatives. In Indonesia, where traditional communities lose because of laws allowing logging operations, the government and logging companies are "winning" (Box 6). A complete model must look not only at the results of policies and market structures, but also at the reasons why those policies and market structures persist. It must look at who are the winners and who are the losers, at how national policies and institutions are used by the economically and politically powerful.

Allocation of Resources and Costs:

The distribution of political and economic power will shape policies that affect the environment. Various political actors will be able to shape markets, policies, and institutions to their own benefit. Patterns of governance will reflect the relative power of various groups in society. Inequality of political power will be reflected in inequality of resource distribution and undemocratic decision-making about resource use. Political institutions and structures very often

[143] The term institutions is used here to mean not only established organizations and government agencies, but also institutionalized patterns of behavior based on accepted norms, rules, and standards. This includes legal and illegal institutions, such as government corruption or criminal organizations, and formal and informal institutions. Markets are usually a mixture of all of these.

[144] See section on Social Change and Development Biases.

[145] Schwartz 1995

favor environmentally perverse economic policies. While the wealthy appropriate the most valuable resources, the poor are placated with marginal and frontier areas. Too often, these are areas essential for biodiversity conservation.

> ... power in both public and private spheres (determines) the distribution of assets.... Political institutions mirror to some extent the allocation of power in society itself, so that asset distribution by the public sector reflects the values dominant in economic society.[146]

Examples of legal and illegal, but uncontested, appropriation of resources by the wealthy and powerful are numerous. Market structures, including black-markets, credit policies, tenure institutions, and institutionalized corruption that keep small producers in poverty while providing profits for middlemen and large producers have been implicated in many studies of environmental degradation. The maintenance of these structures is facilitated by political power. The expansion of high input-, low-labor agriculture provides a prime example of the (ab)use of legal, political, and market structures for resource appropriation. Expansion of commercial agriculture has been supported by a variety of government policies for the benefit of exporters and urban consumers, without regard for the impact on subsistence farmers or the environment (Diagram 8). Support for export agriculture, for example, in Honduras (Box 8), has routinely jeopardized both the poor and the environment for the benefit of the wealthy and development plans. In Indonesia, the government has promoted the claims of commercial logging companies to forest resources over the traditional claims of forest communities. Clearly the economically and politically powerful groups have government policy on their side.

Governments distribute resources to rich and poor, though usually in grossly unequal shares, to maintain themselves in power. Making cheap natural resources available, whether it be land at the frontier for landless farmers made available by road construction, or low stumpage fees for logging companies, strengthens political power and reduces pressures for redistribution that are politically destabilizing. Allowing or promoting settlement on marginal or frontier lands is one way of providing cheap resources without taking resources away from other groups in society. It is also a way of promoting "development" of undeveloped lands.

> Land tenure reform has been implemented for purposes of redistributing the productive assets of the countryside, without any particular regard for conservation, either of land cover or of flora and fauna. Quite often ... land reform is undertaken through colonization for the explicit purpose of agricultural frontier expansion.[147]

In Brazil and other Latin American countries, colonization schemes aimed to relieve population and economic pressures in other regions. In Indonesia, the Transmigration Program was intended to reduce the potential for urban violence and produce a change in the ethnic balance of the Outer Islands, as well as reducing population pressure on resources.

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[146] Sanderson 1994, 334

[147] Sanderson 1994, 348

In countries with an open frontier, as is common in Latin America, undeveloped lands are left to the poor in the hope that both will develop[148]. In countries with a closed frontier a similar

Box 6
Forest Rights in Indonesia's Outer Islands

According to Indonesian law, state rights to forest resources take precedence over traditional tenurial rights. Since the beginning of the logging boom in the late 1960s, the state has granted extensive forest concessions to large logging companies, without regard for the community-based rights of local forest communities in the Outer Islands. The insecurity of tenure has led to rapid degradation and deforestation, both by logging companies and local communities. The state's authority over the forest is used to grant privileges to logging companies.

Legal authority over forest resources and management practices is centralized. 143 million hectares are classified as public forest land. Activities within this area include authorized and unauthorized logging, swidden agriculture, and small-scale gold mining. None of the forest users have secure rights to the resources they are exploiting, nor can they effectively exclude others. While the state is prepared to enforce the tenurial rights of wealthy logging firms and concession-holders to particular areas and resources, traditional forest dwellers do not have state support in guaranteeing their community-based rights.

Traditional tenurial rights of millions of forest-dwelling and forest-dependent people in the Outer Islands have been routinely overridden to create forest concessions and protected areas. The Ministry of Forestry grants 20-year exploitation rights to commercial firms or state corporations, which lead to widespread dispossession, particularly of indigenous people. Concessions now cover more than 60 million hectares, and an additional 4.4 million "unproductive" hectares are expected to be allocated for plantation forestry. Within the 30 million hectares of protected forest, the only legally sanctioned activity is rattan collection.

Legally, customary community rights apply only when they do not "contradict national and State interests." Since local communities have few options under national law to legitimize their tenure claims, they often opt for a strategy of forest clearing to strengthen their claims and prevent others from clearing their land first. Neither the legislative branch nor the judicial branch of government effectively limits the power of the oligarchic executive branch. Government policies promote the subordination of traditional rights in various ways. Legally, forest communities are categorized in two groups: forest squatters who are recent arrivals, and isolated communities which are traditional communities who "should" be incorporated into the mainstream economy and society. The agrarian law requires that customary rights be registered, which few communities do since they are unfamiliar with the law. Logging companies sometimes negotiate claims with local landowners, but rarely abide by their agreements.

* This is a summary of a case study presented in Owen J. Lynch and Kirk Talbott, Balancing

[148] Swanson 1995

pattern occurs, with the poor forced onto marginal land, where the prospects for development appear to be even slimmer. Those who are forced to the frontier, termed "ecological refugees"[149] and "shifted cultivators"[150], have neither the knowledge nor the capital to use the land sustainably[151]. Governments do not invest sufficiently in human capital and agricultural extension efforts, and may remain unwilling to spend funds as long as undeveloped land and natural resources provide a temporary substitute. Expenditures favor the politically more powerful urban areas. Failure to invest in human capital and in increasing agricultural yields has meant that increased commodity demand has been met by extensification, and that the number of rural poor forced to the frontier has increased[152]. In this way, governments effectively shift economic, social, and political problems to the frontier, creating conservation problems in the process.

Short-term Views:

Like market structures, political structures also promote a short-term view on resource use and environmental degradation. Both democratic and undemocratic governments seek to maintain themselves in power by meeting the immediate, short-term demands of their constituents. Governments with a tenuous hold on power may be more likely to distribute resources to their supporters and to take a short-term view on environmental issues. Governments with a stronger hold on power are free to take a more balanced and long-term view. As discussed above, inequality probably promotes resource pillaging and degradation. A study relating type of government to deforestation rates found that dictatorial governments had a worse record on deforestation than democracies, where power is relatively evenly distributed[153]. The need for broad public support, rather than just the support of the powerful classes, may reduce the opportunities for plundering the environment. Dictatorial governments were more likely to plunder forests because of their short-term perspectives and the lack of public opposition. In Indonesia for example, traditional forest communities have had little voice in determining tenure over forest resources. Inequality of access to justice and political systems creates legal systems that are biased *de facto* and often *de jure* against sustainable development.

The model in Diagram 8 is offered as an example of the complexity of physical, policy, and political "flows" in a national system that includes commercial and local producers. Policies in the illustrated system favor commercial, export producers. Environmental resources provide subsistence to small producers and inputs to commercial producers, at low cost to them and the government. The commercial producers in this system have the power to demand subsidies from

[149] Gadgil 1993
[150] Myers 1992
[151] See section on Inequality and Poverty.
[152] Southgate 1988
[153] Didia 1997

the government for themselves, as well as policies to ensure the continuing contribution of local producers to commercial production.

Breakdown of Traditional Institutions:

The breakdown of common property institutions, often induced by government policies or by in-migration, creates new open-access resources[154]. Local political arrangements, which had ensured equitable distribution of resources and costs of conservation, give way to uncontrolled or inequitable resource appropriation and use. Centralization of resource ownership in the government has played a critical role in the breakdown of these institutions. National governments have frequently taken responsibility for resource management away from local people, from those likely to be most concerned and knowledgeable about maintaining the productivity of resources, often encouraging poaching and encroachment. The costs of conservation are generally borne by the local, rural people who might have benefited most directly from the resources[155]. Government policies in Rajasthan, India (Box 10) and in the Outer Islands of Indonesia (Box 6) have done exactly this.

In other cases, the breakdown of traditional institutions precedes the intervention of the state. Market, demographic, and social pressures make traditional political arrangements regarding resource use obsolete.

> ... the state is pulled into a vacuum created by pressures of the market, and the dissolution of informal, traditional, local authority ... the problems which small farmers and pastorilists face today are an overlapping but different and shifting set from those which [traditional] land management set out to solve[156].

Traditional societies with well developed resource management systems find these systems inadequate to address new demographic, market, and political pressures[157]. This issue is examined further in the section on Social Change and Development Biases.

Insert Diagram here: 10: Public Policies, Markets, and Politics

Table 5: Public Policies, Markets, and Politics

Pressures on Biodiversity	Public Policies, Markets, and Politics
Source:	• markets, policies and institutions for resources are shaped in the political arena • governments allocate resources to reinforce power

[154] Southgate 1988
[155] McNeely 1988
[156] Blaikie and Brookfield 1987
[157] Redford and Mansour 1996

	• political and economic structures reflect and reinforce inequities in society • biodiversity not valued in markets • markets promote short-term views
Effects:	• public policies and markets promote resource use and consumption, and frontier expansion • perpetuation of inequality: poor bear the costs of degradation; wealthy benefit from resource exploitation • failure to account for biodiversity values • government policies and markets promote breakdown of traditional management systems
Sample Questions to Consider in a Case Study:	• who has the power to shape policies and markets? • who is benefiting from policies and markets? • are any costs imposed on the consumption or degradation of natural resources? who bears the costs? • whose access to "cheap" resources is favored? • what values of biodiversity and natural habitats are ignored by markets? • does government policy favor increased exploitation and/or commercial production? where are funds for development concentrated?

D. Macroeconomic Policies and Structures: Linking the National and International

In several respects, biodiversity loss is a result of distant forces, particularly the structure and behavior of international and national markets and government policies, that shape local resource use decisions. The role of national and international goods and financial markets in shaping production patterns and resource use patterns through prices is enormous. International markets determine the prices of traded commodities. Exchange rates shape the relationship between national and international prices. Governments have often sought to mitigate some of the effects of relations with international markets through macroeconomic policies that alter prices, including controls on trade, capital flows, exchange rates, and national markets. Neither the effects of international markets nor those of national macroeconomic policies on biodiversity and habitats, however, has been a concern of governments. Moreover, current trends toward liberalization and globalization of markets is reducing the impact of government interventions[158].

The current shift toward market liberalization has increased the role of international markets while decreasing that of government policies. **Structural adjustment programs**, supported by the IMF and World Bank, have promoted this shift in recent years. Adjustment has been essential to regaining macroeconomic stability and promoting economic growth in many countries. However, the relative positions of developing and developed countries in international goods and capital markets favors the transfer of environmental (natural-resource based) goods,

[158] Stedman 1994, 1997

including agricultural commodities and extractive products, from the developing to the developed countries. Demand for foreign exchange, needed to support imports and debt repayments, and the lack of other market opportunities provides impetus to developing country natural-resource based exports. Demand in international markets favors consolidation and uniformity of production, without offering economic stability or accounting for effects on biodiversity. International trade agreements, such as the GATT and the new WTO, have little to say about environmental issues. Nor have public or private financial institutions evinced much concern for the environmental impact of financial and investment flows.

The role of macroeconomic factors in biodiversity loss is particularly difficult to measure, given the large number of intervening variables between global or national economies and local decisions about resource use. Despite extensive theoretical work, empirical evidence is scarce. Two broad theoretical camps have emerged which attribute a critical role to macroeconomic factors in driving local resource use patterns, and which present very different models of that role. Traditional neoclassical economic theory focuses on international and national macroeconomic **policies**[159]. Political economy theory focuses on macroeconomic **structures**[160]. The neoclassical view posits that "improvements" in a government's macroeconomic policy, such as trade liberalization and exchange rate deregulation, will improve resource use patterns. The political economy view posits that changes in macroeconomic policy, without changes in the underlying political and market structures, may worsen resource use patterns. Both theories reveal some of the mechanisms linking macroeconomic factors to use of resources. Empirical work seems to show that both have some truth[161].

Government Policies

Government policies that shape the macroeconomic situation, particularly the relationship of the national to the international economy, include trade, exchange rate, investment, and fiscal policies[162]. The 1980s and early 1990s have seen some drastic changes in policies in some countries, moving towards market liberalization for goods and capital and cutbacks in government regulation and intervention. Economic arguments in the neoclassic mold hold that these changes will improve the efficiency of resource use by introducing competition, reducing government protection, and increasing investment. Trade restrictions, exchange rate controls, and government ownership of industries and productive resources distort prices and so produce incentives for unsustainable resource use. In Tunisia, for example, the government goal of achieving self-sufficiency in livestock products, supported by price interventions to promote cattle raising, has led to degradation of rangelands[163]. Restrictions on imports of basic foodstuffs, often imposed to promote self-sufficiency, raise the local prices of agricultural products and can lead to use of marginal lands for production.

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[159] See World Bank (1992, 1994), Munasinghe (1993), and Serageldin (1996).

[160] See Sanderson (1994), Reed (1992, 1996), Redclift (1987), and Stonich (1995).

[161] Reed 1996

[162] These macroeconomics policies are closely linked with sectoral policies, such as market controls, subsidies, and pricing policies.

[163] World Bank 1994

Policy measures that improve macroeconomic stability and economic growth are also environmentally beneficial, according to the logic of the neoclassical framework, because they lead to lower inflation rates, better price signals, and longer term views[164]. The environment will benefit too as economic growth provides funds for environmental protection and infrastructure. The short-term impact of stabilization may include a worsening of poverty and unemployment, which puts greater pressure on natural resources. However, the long-term effects will include economic growth and improved efficiency of resource use. In particular, trade reform, privatization, and the withdrawal of governments from markets will promote efficiency. The impact of growth through trade and private sector investment is complex because of changes induced in the sectoral composition of production, production techniques, input use, and the location of production. On balance, however, the impact is held to be environmentally beneficial as long as sectoral policies or uncorrected market failures are not promoting inefficient resource use[165].

According to this model, the adverse impacts of some economy-wide reforms occur, or are magnified, when sectoral policies or market failures favor resource exploitation[166]. In other words, economic reforms fail when they are not sweeping enough. For example, a change in exchange rate policy that promotes exports in combination with uncorrected low stumpage fees in the forestry sector will lead to overharvesting. Likewise, because of the failure to properly value biodiversity, any macroeconomic change that favors increased production or consumption will have adverse impacts on biodiversity (see section on valuation). The impacts of macroeconomic policy on the environment are contingent on the regulations or institutions governing resource use[167]. Especially important in mediating between economy-wide policies and the environment are tenure and use rights over natural resources, including land and water, that is, control of habitat. If tenure rights are not adequately defined, economic liberalization and growth will promote over-use or inappropriate use along the lines of the tragedy of the commons. The cases of Rajasthan and Indonesia provide examples (Boxes 10 and 6). These policy "failures" are discussed in the previous section.

The impact of the recent wave of structural adjustment programs on the environment and biodiversity is clearly mixed. Macroeconomic improvements have been achieved in many countries, as measured by traditional economic indicators such as GDP growth, and are bringing some environmental benefits. Exports have been increased, often at an environmental cost, and the record of privatization is mixed[168]. Privatizations, and cuts in credit, subsidies, and extension services, as part of overall fiscal reforms, may improve budgets but have negatively affected many producers. Poverty and inequity have worsened in many countries, in large part because of cuts in social services and safety nets that have been central to budget-cutting efforts. This has increased short-term and probably long-term pressure on marginal areas. Market structures that often

[164] World Bank 1994
[165] World Bank 1994
[166] World Bank 1994, Maler and Munasinghe 1996
[167] World Bank 1994, Maler and Munasinghe 1996
[168] Stedman 1997

promote environmental degradation and loss of biodiversity have been strengthened, while governments' capacity for intervention has been reduced.

Macroeconomic Structures

Conditions in developing countries that promote biodiversity loss–including poverty, inequality, development biases, and political structures–are closely linked with economic structures that favor the developed countries at the international level, and favor large-scale producers at the national scale. The political economy framework is based on the premise that political and economic power, including control over resources, are perpetuated by political and economic class structures. As long as fundamental inequities exist within and among nations, the wealthy will continue to appropriate and exploit resources at the expense of the poor and the environment. At the national level, government interventions in markets[169] generally favor the wealthy; resources offered to the poor are insufficient to reduce inequity. At the international level, integration into international markets on the terms of the developed world reduces the possibility for developing countries to limit their dependence on resource exports, particularly in the current context of globalization.

Box 7
Exchange Rates and Land Use in Cameroon*

In Cameroon, agriculture and extraction of renewable and nonrenewable natural resources generated revenues for strong economic growth from the 1960s through the mid-1980s. Economic crisis in the mid-1980s, fueled by falling petroleum revenues and worsening terms of trade for agricultural commodities, led to an increase in the exploitation of natural resources, which was already occurring at unsustainable rates. Structural adjustment programs, implemented in 1989 and 1994, have contributed to degradation of habitat and loss of biodiversity without resolving underlying economic problems. Deforestation is proceeding at 100,000 ha per year, with slash-and-burn agriculture replacing forests; soil erosion is becoming an increasingly serious problem; and protected areas are suffering from agricultural, logging, and hunting pressures.

The impacts of structural adjustment reach the environment via economic pressures manifested through changes in the government budget and policy, in trade, and in the exchange rate. Fiscal austerity measures in Cameroon included cuts in rural credit and agricultural support services, which discouraged intensification of land use and encouraged extensive land use; cuts in public services and in parastatals, which aggravated rural poverty by releasing workers to agriculture; and cuts in the forestry service, which allowed an increase in unsupervised logging.

The response of agriculture to structural adjustment has been governed largely by the exchange rate. Devaluation was delayed until the adjustment program was well underway. Appreciation of

[169] See section on Public Policies, Markets, and Politics.

the CFA franc in the late 1980s squeezed the export sector. The consequent neglect of cocoa plantations in eastern Cameroon and shift into subsistence farming, logging, and hunting have promoted deforestation and loss of timber species and wildlife. As poverty worsened, production of subsistence crops rose, often through expansion onto steep slopes and other marginal lands.

Devaluation of the CFA franc in 1994, along with other liberalization measures affecting agriculture, has increased incentives for exports, including environmentally preferable tree crops as well as damaging crops such as cotton. Because two of Cameroon's main export crops, coffee and cocoa, are tree crops, this shift in production from subsistence to export crops will probably be environmentally beneficial on balance. However, food crop production may be driven increasingly to marginal lands. Logging activity increased dramatically in the forested areas of southern Cameroon as prices for timber remained strong through the structural adjustment period. Environmental damages from logging are extensive, because of immediate damage to trees and because logging roads provide access to farmers and hunters.

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* This is a summary of a case study found in David Reed, Structural Adjustment, the Environment, and Sustainable Development. London: Earthscan, 1996.

At the national level, government policies, based on trade, capital, and exchange rate regulations, as well as a host of sectoral polices, have generally favored urban areas over rural areas, and large producers over small producers (Diagram 8). Politically, urban areas and the wealthy have enjoyed more clout. This bias has driven the poor to increasingly marginal areas and destructive resource use, and has promoted extensive use of resources by the wealthy. In the case of Honduras (Box 8)[170], for example, both national policies and international investment have promoted production for export, without regard for the environmental damage done by cotton, cattle, or shrimp production. Expansion of export crops has come at the expense of subsistence farmers, who have contributed to environmental damage because of their limited access to resources.

At the international level, current reforms that are giving global markets and international companies a central role in determining local resource use patterns are not likely to reverse this bias. Export booms in Honduras, as throughout the world, are made possible by rising demand in international markets and the availability of capital for international investment. Almost inevitably, the boom is followed by a bust as productivity falls or international markets collapse. International markets favor concentration of resource holdings and uniformity of production; they cannot be expected to play a significant role in poverty reduction or conservation. Moreover, in the absence of government intervention, markets do not provide the stability required for long-term protection of biodiversity. Cutbacks in the role of the state, which have been central to

[170] Stonich 1995

recent reform programs, have greatly reduced the capacity of the state to temper the impacts of globalization on national and local communities and environmental resources[171].

Linking Local Resource Use to International Structures

The following sections review some linkages between the shape of international markets, local resource use, and environmental impacts, largely from the perspective of a political economy framework:

Trade and Exchange Rates:

Trade and exchange rate liberalization, introduced under adjustment programs, sufficiently alters prices in many countries to increase the production of exports[172]. Incentives for exports have also been introduced to improve trade balances. Economic and political pressures to ensure a supply of imports and foreign exchange, particularly since the debt crisis, have led to government policies that support export producers, often at the expense of small-scale local producers. Origins of these policies are illustrated in Diagram 8. Many of these export-promotion policies, including subsidies, infrastructure programs, privatization, and exchange rate policies, increase environmental transformation and aggravate economic inequality. In extractive economies[173], such as mineral producing countries, structural adjustment has promoted production for export. In agricultural economies, commercial production for export is likewise increasing in response to devaluation and trade liberalization.

Under adjustment programs, the poor, particularly the rural poor, have faced deteriorating economic and social conditions. In response, they have increased informal sector activities, such as hunting and fuelwood collection, and have extensified agricultural production. Pressure on frontier lands and marginal lands has intensified. In Tanzania[174], for example, improved market opportunities have encouraged production of both food and cash crops. Expansion, rather than intensification, of production is favored because of the high price of inputs. Production of cotton, an erosive export crop, has been bolstered additionally by government export incentives. However, the poor have been disadvantaged by the reduced availability of credit and inputs, as well as loss of social services.

Exchange rates are central to the shape of international markets[175]. Liberalized in many countries in recent years, exchange rates are determined in part by a country's export options, demand for foreign exchange, including funds for debt repayment and for imports, perceptions of the country's economic strength, and fiscal balance. The lending boom of the 1970s left many

[171] Stedman 1997

[172] For summaries of the arguments about the impact of trade on the environment, see Dean (1992), Ropke (1994), and the debate between Bhagwati and Daly (1993) in Scientific American. For specifics on agriculture, see Lutz (1990).

[173] See Reed (1992, 1996) for case studies which led to these conclusions.

[174] Reed 1996

[175] For discussion of the relevance of exchange rates, see Krueger (1991).

developing countries with high levels of debt and devalued currencies in the 1980s. While efforts to link high levels of indebtedness to high levels of resource exploitation empirically have not been successful, deforestation rates have been linked to exchange rates[176]. Devaluation and liberalization of exchange rates lowers the cost of a country's products on international markets, thus giving the country a competitive edge. However, falling profits mean the volumes of production and exports must be increased simply to maintain earnings. In the case of timber, developing country exports appear to have increased as exchange rates have been devalued.

Agricultural production for export, as in the case of Tanzania, is promoted by devaluation. At the same time, the price of imported inputs rises, creating incentives for expansion of land in use for commercial agriculture. Tanzanian commercial farmers and timber exporters have benefited from strong markets since the implementation of structural adjustment[177]. In Cameroon (Box 7), where devaluation followed only belatedly on other adjustment measures, export markets were restricted and farm laborers increased logging, hunting, and subsistence farming activities to compensate for limited employment in commercial agriculture.

Box 8
Export Driven Production in Southern Honduras*

In southern Honduras, investment and production have shifted rapidly from one export crop to another for decades, imposing high environmental and social costs. International markets have been a primary determinant of production patterns in the region. Despite escalating food deficits and a growing dependence on international food aid since the mid-1970s, the government continues to promote the expansion of export agriculture in order to generate foreign exchange. The volatility of international markets is reflected in frequent shifts in production. Each new agricultural boom has increased land concentration and contributed to rural inequality and environmental degradation. The current shrimp and melon booms promise to do the same.

The series of agricultural boom-and-bust cycles in southern Honduras dates back at least to the cotton boom of the 1940s and 1950s. To make way for large-scale cotton producers, small farmers were driven, by legal and illegal means, to less suitable agricultural land in the north. Production was highly mechanized and depended on heavy use of chemical inputs. Continuous production contributed to soil degradation and erosion, the spread of insect pests, and land and water contamination from pesticides. Changes in world prices have since led to large fluctuations in cotton production, which has now fallen to 1950 levels.

The cattle boom of the 1960s and 1970s was funded in part by international investment, including funding from the World Bank, intended to boost regional exports. Cotton lands and forests were converted to pasture as cattle stock rose rapidly. Large commercial farms became more capital

[176] Capistrano and Kiker 1995
[177] Reed 1996

intensive, while expanding the land-extensive system of cattle ranching. The low-labor, extensive production systems increased the number of rural landless and rural poor. Rising population densities and falling incomes for most rural households forced more intensive use of smallholdings and promoted further migration to marginal areas. Production of basic food crops plummeted. Clearing of marginal land continued, contributing to deforestation, soil erosion, and watershed degradation, even as livestock markets contracted.

The latest export booms in the region are in shrimp and melons, both supported by policies favoring "non-traditional" exports. National coastal land, including mangrove ecosystems and communally held resources, have been appropriated for shrimp farming. The five largest producers control 70% of the area used for shrimp farming. Expansion of the industry is destroying habitats, blocking estuaries, and rechanneling rivers. At the same time, melon farming appears to be contributing further to the concentration of landholdings, to contamination of land and water resources through heavy pesticide use, and to depletion of the coastal aquifer.

In every boom, the uneven growth of exports, supported by the state and international development organizations and determined largely by international demand, has created large-scale producers with superior access to natural and financial resources. Small producers are continually displaced and impoverished. Intensive use of resources by the poor, and extensive, capital-intensive use of resources by large producers are both contributing to habitat destruction and degradation. Both are driven by national and international incentives for export production.

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* This is a summary of Susan C. Stonich, "Development, Rural Impoverishment, and Environmental Destruction in Honduras," in Michael Painter and William Durham, eds. The Social Causes of Environmental Destruction in Latin America. Ann Arbor: University of Michigan Press, 1995.

Uniformity:

The shift toward production for large, often global, markets has changed the shape of production[178]. These markets create pressures for large-scale, uniform production. Monocropping, mechanization, and increased use of chemical inputs, often a prerequisite for participation in these markets, replace more diverse ecosystems and small-scale farming methods. This process is driven by the profits that accrue to uniformity[179]. Uniformity of biological assets make them compatible with other factors of production, such as capital equipment and chemicals, and facilitates sales in international markets; they are part of a package of technology. These changes alone may cause substantial changes in habitats as small-scale subsistence farms are replaced by large modern operations. The problems of specialization at the regional and national level, which has long been a feature of developing export-oriented economies, may be aggravated

[178] For discussion of the trend toward uniform production standards, see Sanderson (1994) and Swanson (1995b).
[179] Swanson 1995b

by this trend. The case of Honduras clearly illustrates the cycles of boom and bust, accompanied by environmental degradation, that are often the consequence of over-specialization (Box 8).

Concentration:

The spread of large-scale commercial operations has not replaced but *displaced* other resource users, primarily small farmers. Commercial agriculture has greatly reduced the availability of good agricultural land for small farmers while mechanization has often reduced the labor requirements of large farms. Economic opening has largely benefited medium and large producers. Small farmers are often unable to produce for international markets, in part because of state cutbacks, and farm laborers are left under- or unemployed. The result is migration and increased use of marginal lands. Studies of migration reveal the pressures from commercial operations. In Honduras, each new export boom has contributed to further concentration of land and marginalization of the poor.

Volatility:

Liberalization of trade and exchange rates does not change the shape of international commodity and capital markets. Producers are subject to rapid price fluctuations, poor terms of trade, and severe competition, which are worsened by the withdrawal of government support systems. These conditions promote a short-term view and extensive use of resources. Economies dependent on commodity markets, with the exception perhaps of oil producers, have little hope of achieving sustainable economic growth through exploitation of natural resources. Poor terms of trade for most commodities mean imports and debt are very costly. The volatility of international markets contributes to concentration of resource holdings through instability and fierce competition that drive out small producers, and even small economies. The mobility of commercial investment and production, enhanced by the liberalization of goods and capital markets, compounds the problem.

Markets and Biodiversity:

Markets take no account of biodiversity loss. Biodiversity, like many environmental goods, is not valued or exchanged in the marketplace apart from a few exceptional cases. The prices of many commodities remain low in part because they do not include the environmental costs of production[180]. The view that economic growth will reduce degradation of the environment has been central to neoclassic thinking about the environment[181]. It has been supported by evidence that, in the developed countries, 67% of wealth is derived from human capital and 17% from natural resources; in the less developed countries which export raw materials, the share from natural resources is 44%[182]. The heavy reliance of developing countries on natural resources is apparent from this data. It follows then that development (i.e., economic growth) will reduce the dependence on natural resources. However, what is neglected is, first,

[180] The question of valuing biodiversity is taken up in the previous section.

[181] See Bhagwati (1993) and Anderson and Blackhurst (1992), for example.

[182] Serageldin 1996

the fact that developed countries have not reduced the absolute reliance on natural resources (just the share in GDP) and, second, that imported natural resources are crucial to the developed country economies.

Developed country citizens and the wealthy of developing countries consume and degrade resources from sources far from the ecosystems in which they live. They are able, because of economic and political power, to shift the negative consequences of their resource consumption to distant areas[183]. Markets, policies, and institutions have been shaped by the politically and economically powerful to promote this consumption and displacement of costs. Pressure on resources eventually creates ecological refugees, further promoting degradation as the poor are forced to overuse resources. The response of developed countries to biodiversity problems has often been to create parks and *ex situ* storage for biodiversity, rather than address their over-consumption. Globalizing markets continue to promote increasing resource use and consumption.

Weighing the Impacts

The complexity of links between macroeconomic policies and the environment makes it difficult to define their effects systematically. For the resource user or producer, these macroeconomic polices are largely felt through changes in social services and changes in prices, including prices of inputs, availability and cost of credit, and sales prices. Depending on the specific reform, the economic context, and production possibilities, impacts may be positive or negative, or a mix of the two. The environmental impact of a price change that favors exports, for example, will depend on such factors as whether export crops are more or less environmentally damaging than domestic crops, whether input prices favor extensification or intensification of production, and whether export crops are labor-intensive or tend to increase rural unemployment. In Cameroon, for example (Box 7), structural adjustment has promoted increases in a variety of export crops, some less environmentally damaging than domestic food crops, some more damaging. Despite an increase in some less damaging crops, habitat destruction continues as marginal lands are increasingly brought into use.

As shown in Diagram 8, which illustrates some of the possible relationships, international markets play a critical role in determining prices for commodities and production patterns–what is produced and how. Government efforts to promote growth in an economy short of foreign exchange lead to supports for commercial export production, at the expense of the poor. Environmental resources are drawn on by both the poor and wealthy producers without regard for the real costs entailed.

Macroeconomic stability is a necessary, but not sufficient, condition for sustainable resource use. It does not lead to internalization of environmental costs into markets nor, more importantly, resolve the problems of socioeconomic inequality. Privileged access to natural resources is often untouched by structural adjustment. Fiscal policy changes, generally intended

[183] These people have been termed "biosphere people" (Gadgil 1993), because they are able to draw resources from many ecosystems, avoiding degradation of the ecosystem in which they live while maintaining high levels of consumption.

to reduce government deficits and promote economic stabilization, have had severe effects on producers through reduction in credit and extension services. Particularly in Africa, reductions in government employment have increased rural populations substantially, increasing pressure on resources. Cutbacks in the state have decreased its capacity for regulation and monitoring of economic activity, including activities that contribute to biodiversity loss. The possibility of incorporating the costs of biodiversity loss into markets is diminished as the leeway for state intervention declines[184]. This failure to address biodiversity loss at the national level compounds the problem at the global level.

Table 6: Macroeconomic Policies and Structures

Pressures on Biodiversity	Macroeconomic Policies and Structures
Source:	• weak position of resource producers: limited trade opportunities; poor terms of trade; volatility of markets • liberalization and structural adjustment programs promote role of markets • pressures for exports: exchange rates; government policies; developed country demand
Effects:	• increasing resource exploitation for exports • displacement of subsistence producers • transfer of resources, but not environmental costs to developed countries, wealthy • pressure for large-scale production, uniformity, concentration of resources • no account taken of biodiversity
Sample Questions to Consider in a Case Study:	• have economic policy changes altered resource use patterns? • what is the relation of production patterns to national and international demand and investment? • what are the positions of small- and large-scale producers in markets? • what forms of natural resource use do policies on trade and investment favor?

E. Social Change and Development Biases

The failure of the current development paradigm to incorporate sustainability, much less biodiversity conservation, as a central goal is widely acknowledged. Development remains widely understood as synonymous with an increase in consumption and the transformation of natural resources. This understanding of development is deeply entrenched in many economic and political systems. In addition, a social or cultural preference for this type of development has

[184] Reed 1996

become widespread. Preferences, policies, and actions favor transformation of resources at local, regional, and national levels, largely because transformation increases incomes, but also because resource transformation and exploitation conform to existing development ideals. Farmers clear land, loggers fell forests, and governments build infrastructure to facilitate resource use and promote access to international markets, all in the name of development of natural resources. In this process, traditional cultures that are less destructive of environmental resources are being lost, and insufficient effort is being made to redirect development toward sustainability.

This section addresses two central, related, issues. The first is the relationship between culture, or social patterns, and the development model. The second is the apparent conflict between development and conservation. Development patterns are inextricably linked to economic and political factors; they are also embedded in social structures. The development model, as discussed in the introduction to this paper, is part and parcel of all of the "root causes" of biodiversity loss presented here.

Culture and Biodiversity

The relationship between culture and land use or other forms of resource use that affect biodiversity is a two-way street. Resource use affects culture and vice versa[185]. Although many anthropological case studies look at the relationship between cultural ideas or social structures and resource use patterns[186], no strong generalizations can be made about the relationship. Nevertheless, both direct and indirect linkages are apparent between a people's culture and their resource use patterns[187]. In many places, for example, there is a cultural bias against natural areas, which are seen as uncivilized or undeveloped. The enormous land-clearing that has taken place in the Americas since European settlement began provides the most obvious example[188]. Forests are cleared not just to provide land for farming or other economic activity, but because forests themselves are seen as undesirable. The development of Ecuador's Amazon (Box 9), in order to incorporate the region into the national economy, is but one current example. A similar cultural outlook sees indigenous peoples, and their resource-use practices, as being in need of development or civilization, which often has led to complete destruction of traditional societies and the protection they afforded to biodiversity[189]. In the case of Rajasthan (Box 10), a well-meaning effort to promote development and reduce poverty has destroyed traditional social institutions for regulating land use and promoted unsuitable land-use practices. A similar pattern is evident in development efforts in Indonesia's Outer Islands (Box 6).

The indirect effects are more difficult to trace or measure[190]. Culture has a direct bearing on population, economic activities, settlement patterns, political structures, and so forth. Culture

[185] Rockwell (1994) provides a valuable literature survey and critique. His complaint that there is little or no quantitative work in the field is unjustified, given the inherently unquantifiable nature of the subject.
[186] For example, Painter (1995) and Schumann and Partridge (1989).
[187] Rockwell 1994
[188] Crosby 1986
[189] Davis and Wali 1994
[190] Rockwell 1994

also affects attitudes towards outside groups and institutions, often in ways that limit conservation interventions. It also affects the division of labor and resources among men and women, which may have important implications for the ways in which resources are used. Through these it has an indirect impact on biodiversity. For example, cultural factors may lie behind the belief that natural resources should be exploited; culture has a direct impact on demand and consumption; and cultural norms affect the expected standard of living. The danger lies in attributing too much of resource use patterns to cultural factors, which can be linked to all human activities.

Development and Culture:

Despite great differences among the societies of the developed world, broad similarities appear in their approaches to resource exploitation and consumption. This cultural bias toward exploitation and consumption of resources underlies the current development model. The expansion of Western culture has had a clear impact on traditional and indigenous societies, inducing social change around the world. The bias of many developing country governments in favor of urban areas over rural areas, and in favor of industry over agriculture, reflects this socially biased understanding of development. The enormous environmental transformation that took place in the Americas following the arrival of Europeans[191] included not only decimation of native peoples, but also widespread land-clearing, introduction of new species, and extensive exploitation of native species. A similar pattern of change, with serious implications for biodiversity, continues in many frontier areas. The "modernization" of traditional societies not only introduces these peoples to markets and rising consumption levels. It also leads to loss of traditional knowledge about sustainability, and to the disruption and loss of traditional institutions for managing resources. For the indigenous population of the Ecuadorian Amazon, traditional production systems are becoming increasingly inappropriate as population pressures, reduced access to land, and increasing material needs accompany colonization of the region[192]. In Rajasthan too, change in access to lands, aimed at development, has rendered traditional grazing patterns inappropriate[193].

The idea that improvements in environmental quality and concern about conservation will naturally accompany development has received much attention recently. Development in this model is equated with a reduction in poverty and an increase in political democracy. This view, however, neglects the close links among social development, economic growth, and increases in consumption. It also ignores the fact that many societies outside of the developed world do manifest environmental concern. Economic growth allows countries to appropriate resources and environmental services from other regions of the world. Biodiversity has little or no value within this development paradigm, which emphasizes immediate growth and consumption. Equating economic growth with improved sustainability ignores the fundamental characteristics of current patterns of economic growth.

[191] Crosby 1986
[192] Uquillas 1989
[193] Blaikie and Brookfield 1987

> Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth–the composition of inputs (including environmental resources) and outputs (including waste products).[194]

The prevalent development strategy stresses liberal markets, reduced government interventions, and private property. The model justifying this economically focused strategy claims a linkage among developed economic (capitalist) and political (democratic) structures and concern for conservation. They are presented as a package[195]. Economic growth is expected to induce the social and cultural change required to engender environmental concern. On the basis of this understanding, privatization of resources is often touted as the most effective means for ensuring conservation. Land tenure, but also tenure over forests and other natural resources, are promoted as a means to improve resource management. The discussion above has pointed to the problems with reliance on markets. More convincingly, arguments hold that stable democratic institutions, which permit and encourage open and equitable participation of all sectors of society, will create the necessary social conditions for sound resource management. Social structures that promote conflict or monopolization of power are unlikely to promote sound resource use. Inegalitarian social, political, and economic structures lead to monopolization of environmental benefits and high environmental losses.

Recently, particularly among conservationists, more attention has been focused on the role of community ownership and management of resources. While traditional community management institutions may have worked for many generations, these systems are breaking down under pressures from population growth, market integration, and development efforts. Attempts are being made to restore and strengthen traditional systems, in order to improve resource management for sustainability and biodiversity conservation[196]. However, socially or culturally marginalized groups may be unwilling to cooperate with conservation programs, especially if these appear to limit their options for development.

Box 9
Indigenous Populations in the Ecuadorian Amazon*

Indigenous populations of the Amazon Basin in Ecuador, as in other countries in the region, are altering traditional resource use patterns in response to pressures of modernization and new opportunities. Ecuador has been actively "developing" its Amazon region since the discovery of oil in the late 1960s. Populations have been shifted from the highlands and the coastal region in order to integrate the Amazon region into the national economy. While the Indian struggle for community land rights has had some success, new settlers and large companies have had policies

[194] Arrow et al. 1995
[195] See, for example, Vincent and Panayotou (1997) and Serageldin (1996).
[196] See Lynch and Talbott (1995); Ganjanapan (1995); Redford and Mansour (1996);or Western and Wright (1994).

and knowledge on their side. These groups have appropriated the most fertile areas and the areas with best access to markets. Criteria for legal allocation of land have favored intensive agriculture and commercial production, rather than traditional land-use patterns.

The traditional production system is a mix of hunting, fishing, gathering, and shifting cultivation. The shifting cultivation system included slash-and-burn or slash-and-mulch on rotation plots, with one or two years of cultivation followed by fifteen to twenty years of fallow. This system is disappearing rapidly in the face of colonization and modernization efforts, and is being replaced by market-oriented farming that destroys and degrades forest habitats.

The traditional subsistence production system of indigenous groups is changing in response to new conditions. These include growing indigenous and settler populations, the formation of settled communities, and restricted availability of land. Pressure on land and official policies favoring land-clearing and settlement for development have encouraged indigenous communities to become sedentary farmers and livestock owners. Contact with settlers has led to rising material demands and increased participation in markets. The introduction of new tools such as the chain saw has also affected traditional resource use, allowing indigenous groups to clear larger areas of forestland for cultivation. Semi-nomadism, essential to traditional subsistence production, is disappearing as new models of resource use are adopted.

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* This is a summary of Jorge Uquillas, "Social Impacts of Modernization and Public Policy, and Prospects for Indigenous Development in Ecuador's Amazonia," in D.A. Schumann and W.L. Partridge, eds. The Human Ecology of Tropical Land Settlement in Latin America. Boulder: Westview, 1989.

Traditional Cultures:

Traditional or indigenous cultures are widely discussed in the literature on biodiversity because of the very different relationship that many traditional societies have with resources. Sedentary peoples, in particular, have developed elaborate, socially embedded, systems of taboos and prescriptions related to resource use that both protect and enhance biodiversity[197]. Many of these social institutions are reinforced by religious beliefs. Great store has been set by the traditional knowledge of these cultures, in the belief that traditional knowledge provides a key not only to sustainable use of resources and conservation of biodiversity, but also that it may reveal some of the "undiscovered" values of biodiversity, such as medical cures. Studies of indigenous use of resources[198] are revealing a wide range of social and cultural approaches to resource use and cultural knowledge and beliefs about nature and species.

[197] Gadgil et al. 1993

[198] See, for example, Browder (1989) and Western and Wright (1994).

A cautionary note is needed here, however, because of the tendency to over-romanticize the relationship of indigenous peoples with nature[199]. Not all traditional societies have lived, or are living, in a sustainable way. Probably, many societies have lived sustainably simply because small populations and low technology did not offer the opportunity for more extensive resource exploitation[200]. While conservation of a large number of species may be desired in traditional cultures, conservation of biodiversity in the scientific sense is not a value of traditional societies. Moreover, the readiness with which many of these cultures have accommodated themselves to market opportunities suggests that the cultural limitations on resource use are not always strong. In Ecuador, indigenous groups are fighting for traditional land rights, but contact with colonists, new material demands, and access to markets have altered their social structures and resource use patterns (Box 9). A study of root causes must look not only at changes in resource-use patterns that are forced by development pressures, but also at the cultural changes that promote acceptance of new resource uses.

Development and Biodiversity Loss

The social structures and culture of the developed countries have not promoted biodiversity conservation. Swanson[201] presents the apparent conflict between development and biodiversity loss in terms of two views. One view holds that biodiversity loss is occurring because we have chosen a poor development path. The other, more extreme, view holds that biodiversity loss is inextricably linked with development; a sustainable development path does not exist. From the first standpoint, the choice about how much biodiversity to retain has been made in a haphazard fashion leading, unintentionally, to unmanaged depletion[202]. Once the first societies have chosen a path of increasing consumption, others tend to follow the same path, with serious consequences for biodiversity. For economic, institutional, and cultural reasons, the choice of the developed countries to convert land prompts developing countries to follow suit. Policies and markets, which fail to recognize the value of biodiversity, push for certain types of development that are viewed by very diverse countries as desirable[203]. The result is substantial uniformity in the impact of the development process on biodiversity across many societies[204].

The other standpoint views biodiversity loss as an unavoidable result of development efforts. Development, if it bears any resemblance to its current form, will cause biodiversity loss.

> The human species pursues development strategies rooted in self-interest and in fundamental conflict with other species' interests .... Development and conversion go hand in hand, and conversion is the process by which natural habitat and its resident species are lost...[205]

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[199] Redford and Mansour 1996
[200] Rockwell 1994
[201] Swanson 1995
[202] Swanson 1995
[203] Gadgil 1993, Swanson 1995
[204] Swanson 1995
[205] Swanson 1995, 44

The only way to reduce biodiversity loss, according to this view, is to end the expansion of both human populations and economies[206]. This view is highly critical of efforts to temper the effects of development with minor changes in institutions and policies, calling for a complete rethinking of our relationship with the environment.

Box 10
Degradation of Common Property Resources in Rajasthan, India*

In western Rajasthan, institutions for common property resources (CPRs), including grazing and water supplies, have been destroyed by well-intentioned government efforts to develop the area. Privatization of land and access to markets have put severe pressure on former and remaining common areas, and left the poor with decreased and degraded resources. Most grazing, including sheep, buffalo, and goats, takes place on common lands. When common grazing lands were plentiful, livestock farming was economically more attractive than cropping. Vast areas of common grazing land allowed livestock to move freely in response to fluctuations in availability of forage and water. These areas had remained common property despite a growing population.

Land reform was carried out in the early 1950s and efforts were made to provide infrastructure for economic development. Land reform replaced a system of feudal landlords and high rents and taxes. This system had institutionalized controls for maintaining and regulating use of CPRs. Over the period 1953-1964, much of the common property land, traditionally used for grazing and unsuited to cultivation, was distributed as private croplands.

Land reform substantially changed the economics of the use of submarginal land for crop production. Infrastructure development increased the participation of the area in the money economy and the commercialization of local production. The value and marketability of products from the common areas increased substantially, leading to the expansion of CPR-based enterprises and over-exploitation. The availability of tractors has promoted a decline in fallow periods and the conversion of CPRs to croplands.

Common areas have shrunk and their use is no longer regulated. People's contributions to maintenance and reinvestment of CPR revenues, traditional before the land reform, had disappeared by the early 1970s and are only partially compensated for by government relief grants. Grazing areas have been degraded by overstocking. Common water supplies have declined as the catchment areas have been degraded and regulations on their use have been abandoned. In the past, some private lands were treated as common lands when there were no standing crops. These too have declined with shortened fallow periods and the elimination of bushes, shelter belts, and other trees, which supplied feed, to allow for large-scale use of tractors.

Short-term consequences of the changes include a decline in livestock holdings, and a decline in

[206] Smith et al. 1995

reliance on CPR grazing areas. The shift towards livestock farming based on private resources is disadvantageous to the landless or land poor who must rely on the remaining CPRs. Long-term consequences include increased soil erosion, because of more intense use and mechanization. While some poor people may have benefited from the distribution of common lands, the bulk of privatized lands went to those who already had some land. The decrease and degradation of CPRs has caused a disproportional loss to the rural poor.

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*This is a summary of case study presented in Piers Blaikie and Harold Brookfield, Land Degradation and Society. New York: Methuen, 1987.

Efforts to Reconcile Development and Biodiversity Conservation:

The division presented above is false insofar as it is completely dependent on the definition of development. As yet, we have failed to adequately define a form of development that would not cause biodiversity loss but which would still entail sufficient qualitative change in lifestyles on a global scale that it could be considered development. Work on sustainable development has been grappling with the issue of defining a new form of development but has made little progress beyond defining sustainability at a local, micro-scale.

Various approaches and disciplines have made efforts to pinpoint shortcomings or failures in the current development approach that can be compensated for by policy or science. The lack of scientific understanding of ecosystems and of sustainability has been one point of emphasis. From our lack of knowledge come calls both for much more research and for a cautionary approach to development. Biologists warn that many environmental changes, among which species extinction is a clear-cut case, are irreversible. Development efforts, therefore, must recognize that transformation and degradation of resources may have serious long-term consequences and should proceed cautiously[207].

Economic apologies for the environmental failings of the current approach to development are numerous. The bulk of economic explanations for biodiversity loss are based on market failures and the closely related concept of externalities[208]. Economists have pointed out that many environmental resources, such as clean air, are open access resources which no one pays to use or to degrade. Government policies are recommended to compensate for these market failures. In this category we can include efforts to measure and value natural capital, including biodiversity; to impose taxes and charges for use of environmental services; and to adjust national accounting systems to include natural capital.

Failings of the Development Model:

[207] On calls for additional scientific work, see WRI (1992), Perrings et al. (1992), and Stern et al. (1992); on the precautionary principle, see Myers (1993) and Perrings et al. (1995).
[208] See Pearce and Warford (1993); McNeely (1990); Schramm and Warford (1989); or Munasinghe (1993).

These explanations–the need for more scientific study and better government policies–share a basic acceptance of the current development path. Changes in policies on valuation of resources and increased scientific research do not constitute a fundamental rethinking of our development path. Measures of development are still largely based on indicators of economic growth, income, and consumption. In other words, the standard of development remains increased resource use. Sustained growth, rather than sustainable development, is the basis of the reigning development model. Economic expansion based on resource throughput had been central to development achievements to date. But development achievements have been insufficient, and further progress through expansion of resource use jeopardizes biodiversity. The problems inherent in the current model include increasing inequity and reinforcement of the political and economic structures that promote poverty and inequity; and dependence on ever greater resource use because of population growth and consumption patterns. The failure of the development model to resolve the problems of poverty and inequity, rapid population growth, and inattention to the value of environmental resources, is at the root of its impact on resource use and biodiversity.

Table 7: Social Change and Development Biases

Pressures on Biodiversity	**Social Change and Development Biases**
Source:	• strong belief in growth-led development paradigm • development understood as increasing consumption and transformation of natural resources • preference for private property, market systems • breakdown of traditional cultures
Effects:	• growth of consumption • political and economic structures favor resource transformation • failure to value biodiversity; inattention to biodiversity loss • loss of sustainable management systems
Sample Questions to Consider in a Case Study:	• does government policy favor frontier expansion and resource transformation? • do rural people see alternatives to current land uses? • what is happening to traditional social and cultural mechanisms for regulating resource use? has social change promoted the breakdown of traditional resource use and consumption patterns? • what social or cultural pressures are contributing to changing patterns of resource use? • what social or cultural changes are promoting acceptance of new resource uses?

Concluding Notes

This paper is a first attempt to bring together in one place the wide range of models and explanations of biodiversity loss that have been discussed in recent years. While this paper seeks to be comprehensive, in that it covers a broad spectrum of ideas, it is impossible to discuss all of the relevant literature in a summary of this type. References cited should direct interested readers to more in-depth sources.

Few methodologies for such comprehensive approaches to understanding environmental problems have been tested. The methodological guidelines offered here will be tested by the case studies. Given the diversity of case studies planned, the guidelines are necessarily general. They are intended to provide some direction for case studies that seek to reveal the linkages among socioeconomic factors and biodiversity loss. Recognizing the complexity and the multiplicity of causes and the mechanisms through which causal factors work is essential to understanding biodiversity loss. Interdisciplinarity, qualitative methods and understanding, and careful use of quantitative methods to create conceptual models are not only applicable but essential approaches for all case studies of these issues.

A series of case studies conducted along similar methodological lines will allow for comparison across the diversity of socioeconomic situations and ecosystems, and will greatly enhance our understanding of root causes. The close links between biodiversity loss and other forms of environmental degradation suggest that biodiversity is a useful proxy for other environmental goods and services. Expanding our understanding of the root causes of biodiversity loss will expand our understanding of degradation of all natural resources and ecosystems and pave the way for a move toward sustainable development.

DEFINITIONS OF KEY TERMS

Biodiversity: The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity with.....
in species, between species and of ecosystems (WWF).

Carrying Capacity: The maximum population of a species, including humans, that a specific ecosystem can support over long periods of time (Art 1993).

Common Property Resources: Land or other resources set aside for community or public use (Art 1993). Use is often restricted to a well defined community, and use and management are governed by the community.

Externality: Harmful or beneficial social or environmental effect of producing and using a resource that is not included in the market price of the good. The social or environmental cost generated by the producer or consumer of a resource is not paid for by him. For example, the cost of logging a hillside will be borne by downstream farmers, rather than the logger. When an eternality is quantified in money terms and included in market transactions, through such mechanisms as taxes, it is said to be internalized (McNeely 1988).

Extensification: In agriculture, an increase in the area of land used for production. This may include incorporation of land at the agricultural frontier or unused land within the frontier.

Institutions: The rules, conventions, and forms of organization of society that govern human social behavior and interactions with the environment. These include both formal and informal, governmental and non-governmental rules, conventions, and forms of organization (Barbier et al. 1994)

Intensification: In agriculture, the increased use of inputs, including capital, labor, mechanization, and chemical inputs and/or the decrease in fallow periods to increase output from a plot of land.

Market Failure: The failure of market prices to reflect the full value to society of a commodity because of imperfections in market mechanisms. Because the value of most ecological resources, including biodiversity, is not automatically reflected in markets, prices do not reflect their use or relative scarcity (Barbier et al 1994).

Open-Access Resources: A property rights regime where access for resource use is effectively unrestricted; use is free and open to all (Barbier et al 1994). This is the property rights regime described by the tragedy of the commons thesis.

Policy Failure: A situation in which: 1) the policy interventions necessary to correct market failures are not taken; or 2) government policies themselves lead to perverse allocation or unsustainable use of resources, including biodiversity and other natural resources.
Structural Adjustment: Structural adjustment programs seek to restructure national economies to correct for economic imbalances and improve economic efficiency. Reforms under these programs commonly include a shift from inward- to outward-oriented economic growth strategies; reduction in the role of the state in economic affairs, particularly as a direct economic agent; privatization of major sectors of the economy; liberalization of imports and exports, often backed by export promotion programs; liberalization of capital markets and strengthening of domestic capital markets; and deregulation and reform of domestic labor and goods markets (Reed 1996).

Tenure: Property rights, for land or other natural resources, including the rights, privileges, and limitations to use of a resource. These include *de jure* and *de facto* rights to use and sale of a resource.

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