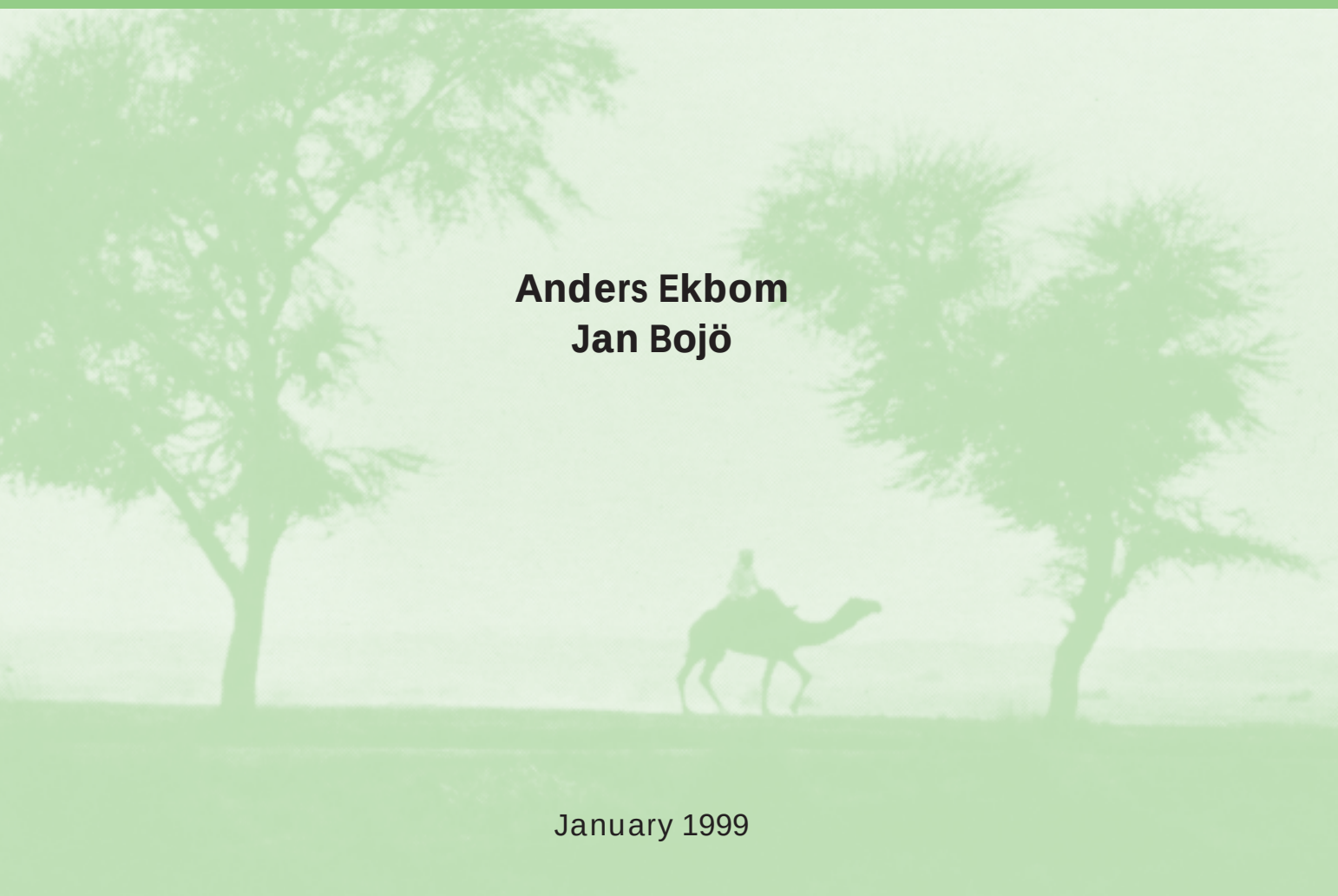
Poverty and Environment:

Evidence of Links and Integration into the Country Assistance Strategy Process



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Introduction

"*Poverty*[ii] *is a major cause and effect of global environmental problems*" stated the influential Brundtland Commission (WCED, 1987; p. 3) in a sentence that captures widely held beliefs: Poor people are often seen as compelled to exploit their surrounding for short-term survival, and are assumed to be the ones most exposed to natural resources degradation[iii]. Despite these intuitively plausible statements, the debate on the characteristics of poverty-environment interaction has been likened to a puzzle (World Bank, 1997), where we possess several pieces, have identified some crucial links and features, but still lack the entire picture.

The **aims** of this paper are hence to (i) specify the main hypotheses on how poverty and environment are linked, (ii) examine empirical evidence linked to each one of them, and (iii) provide good examples of joint poverty-environment analyses in the World Bank's Country Assistance Strategies (CASs) and Poverty Assessments (PAs).

This report is a continuation of a previously published Discussion Paper from the Environment Group in the Africa Region of the World Bank (No. 1) entitled *Mainstreaming Environment in Country Assistance Strategies* (Ekbom and Bojö, 1997). The previous study was based on a global review of 34 CASs which showed that CASs could substantially improve their analyses of poverty and environment. Our previous work has been applied to many country contexts, where we have worked with Environment Group colleagues and other Country Team-members to put lessons into practice. In the ensuing debate, considerable interest was expressed to further elaborate the central theme of poverty-environment linkages; poverty alleviation being the generally accepted core of the World Bank's work. This debate brought about this paper.

The **target group** of the paper is primarily World Bank staff involved in the CAS process, but we hope that a wider group of readers interested in the general topics of poverty alleviation and environmentally sustainable development (ESD) will find something of interest.

The **structure** of the paper is as follows: Section 2 presents some arguments on how poverty and environment impact on each other, including key references and some empirical evidence. Section 3 presents some good examples from existing CASs and PAs of country-specific poverty-environment interactions. The section also presents some suggestions on how to address the issues jointly in the CAS process.

We see this document as a contribution to a process. Its effectiveness will mainly depend on its usefulness in successfully integrating poverty and environment in the CAS process. Ways to achieve this include working upstream in the CAS process, linking up early with poverty experts in the Country Team and others inside and outside the Bank, identifying key areas where a joint poverty-environment approach would be useful, and pursuing synergies and win-win solutions by e.g. including poverty alleviation components in Environmental Support

Programs or, conversely, including environmental management components in poverty alleviation projects. Obviously, it is also useful to consult the poverty documents such as Poverty Assessments (PAs), Participatory PAs, and Living Standard Surveys to identify the entry points for poverty-environment integrated work. In cases with limited evidence of poverty-environment links, further analysis may be necessary. The need for such analysis can be identified through Economic Sector Work (ESW) or through monitoring of selected performance indicators and evaluation criteria which link poverty and environment.

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Poverty-Environment Interactions

Below we specify a set of hypotheses (Hn) of how poverty and environment are linked, and examine available empirical evidence.

H1. Poor people are the main victims of a bad environment

We will refer to this as the "victims" hypothesis, advanced by, for example, the influential Brundtland Commission. Some common but general observations that underpin this hypothesis are the following: Poor people are commonly bound to reside in areas with poor environmental quality. Defining "the poorest" as the poorest 20 percent among the total population of all developing countries, Leach and Mearns (1991) have shown that 60 percent of them live in "ecologically vulnerable areas", including rural areas of low agricultural potential and squatter settlements within urban areas.

Poor people lack resources to relocate from these areas and to adopt defensive measures against negative exposure. Lower education increases their vulnerability to health risks. The associated political marginalization decreases the opportunities for environmental protection and provision of basic services such as safe drinking water, access to clean air, functioning sewerage and waste collection. Urban squatters are commonly exposed to polluted air, contaminated water, and hazardous and solid waste. Rural landless people are forced for their survival to settle on marginal lands, and cultivate poor soils. Whether it is steep slopes, arid or semi-arid lands or river deltas, they are all subject to aggravated risks such as land slides, soil degradation, drought or floods.

The empirical example from Ghana in Box 1 below brings out this hypothesis in statistical numbers.

In conclusion on this point, the results of this study confirm the hypothesis that poor are victims of a degraded environment, deprived of resources to escape the situation, and Songsore and McGranahan (1993, p. 33) conclude that: "environmental risks go hand-in-hand with socio-economic deprivation". Turning this into a constructive point, the opportunities are there for "win-win" investments in a better environment for the poor.

H1a: Poor people are more vulnerable to loss of biological resources. An aspect of the "victims hypothesis" is that poor people are more directly dependent on **biological resources** for their livelihood than richer people. Loss of flora and fauna is thus relatively more costly to poorer segments of society. Furthermore, poor people often are compelled to settle close to these resources commonly found in open access areas, to be exploited at family-labor costs only.

People particularly dependent on biological resources include (i) small-scale farmers, who often derive additional sources of income from wild fruits, nuts, berries, herbs, medicinal plants, bushmeat and roots, (ii) trans-humant pastoralists, who derive essential nutrients from similar wild flora and fauna in marginal areas such as drylands, and (iii) artisanal fishermen, who derive a variety of coastal and marine resources such as shells, seaweed, coral and fishes, which provide

Box 1: Environmental Risks and Living Standards in Ghana

In a study of 1000 randomly selected households in Accra, Ghana, Songsore and McGranahan (1993) analyze the links between local environment, wealth and health. Wealth is measured in terms of possession of certain consumer durables and frequency of meat, poultry or fish consumption. The poorest and richest quintiles are singled out for comparison. The study focuses on diarrhea and respiratory diseases. Principal analytical methods are bi-and multivariate regression analyses.

The poorest households show higher incidence of diarrhea, especially among children: 22% of the children in the poorest quintile, but only 9% in the richest were subject to diarrhea in the two weeks prior to the interview. The links between respiratory diseases[iv] and wealth are weaker, but suggest a negative relationship for women and children. The poorest enjoy significantly less environmental services (safe water, sewerage). They lack knowledge or means to efficiently prevent diseases, are exposed to more health hazards, and are subject to more crowding, i.e. more people share pots, toilets, living room etc. Poverty is statistically related to higher prevalence of parasitic and diarrhea infections.

Specific explanations for some of the symptoms are that poor food handling, storage and hygiene practices transmit diseases, especially parasitic and diarrhea infections. Here, local food vendors are a potential source of contaminated food; 61% of the poorest, but only 33% of the wealthiest households in Accra depend on food vendors for daily intake. Water provided to poorer households is not safe and supply is often interrupted.

Some 83% of the richest, but only 3% of the poorest stored food in refrigerators. Similar disparities were reported for other hygiene practices (e.g. low frequency in hand washing prior to meals). Measures of crowding indicated that 71% of the poorest households, but only 34% of the richest occupy less than $4m^2$ per person in the sleeping room. Likewise, 69% of the poorest, but only 12% of the richest share toilet with more than 10 persons. Further, pests are also key transmitters of diseases. The poorest households reported a very high prevalence of flies (95%), cockroaches (66%), and rats (56%), respectively. The corresponding figures for the top quintile were 22%, 30% and 15%.

food, building material, ornaments, cultural artifacts and cash income. The case study in box 2 looks more closely at the dependence on biological resources among different income segments.

In conclusion, this well-documented example suggests that (a) poor people may be *relatively* more dependent on biological resources found on commons, but (b) that better off people actually consume a greater amount of them, in absolute terms, per household. This lends some support to the hypotheses as stated, but it complicates matters somewhat. The policy implication is that biodiversity conservation might benefit the poorest, but it could be a blunt instrument. To target interventions effectively, we need to know more about what specific resources the poor utilize the most, not only that they are biological resources. Particularly in cases where local resource use would be limited, it is important to understand how the local population is affected, and what compensation might be warranted.[v]

H1b: Extreme environmental stress can force the poorest to migrate. Another corollary to the "victims hypothesis" states that the poor, although less empowered to relocate from inhospitable surroundings, are often forced to long-range **migration** due to environmental hardship. Their choice of settlement will still be constrained, as indicated by the overall "victims" hypothesis, and the two hypotheses are mutually compatible. Natural and man-made disasters often force the poorest to temporarily or permanently leave their homestead to seek survival elsewhere. The associated environmental stress and resource scarcity has resulted in widespread displacement of poor people. This resource-induced migration has become so pertinent that the victims have been labeled "environmental refugees" and subject to specific assessment and action.

It should be recognized that migratory patterns are traditionally part of the coping mechanisms of, in particular, nomadic pastoralist societies. In such cases, it could represent a well-established, risk-minimizing and functional relationship with a fragile but dynamic environment. This type of migration would not fall under the definition of "environmental refugees" and is not our concern here.

In conclusion, while not all environmental refugees are poor, and while many poor do not migrate, it is evident that poor people have less resources to adapt to inhospitable environments, and are therefore forced to migrate in substantial numbers, as Myers and Kent (1995) have documented.

Box 2: Use of Biological Resources in Zimbabwe

A detailed survey in Zimbabwe of 213 rural households' use of several hundred non-marketed ("wild" or "environmental") goods collected at local commons, shows that these goods account for a substantial share of poor people's household budgets, and a significantly larger share than in richer households. Value derived from environmental goods constitute as much as 40% of the total household budget in the lowest income quintile, but only 25% among the top quintile.

Ordinary Least Squares (OLS)- and Tobit-regressions show that all but one of the income elasticities for "wild" goods are positive but mostly low. This indicates that as incomes rise, the relative budget share of wild goods decreases but—contrary to the H1a hypothesis—that total demand for wild goods increase, albeit at a slow pace. The study also identifies that the elasticities vary widely *between* individual species: increasing incomes result in substantially larger consumption of e.g. fish, game meat, and local pottery, moderate increase of e.g. mice, and wild fruit, and decreased consumption of some e.g. household utensils. Hence, some wild goods are complements and some substitutes to purchased goods. Cavendish concludes that the common notion of a single poverty-environment relationship is not supported by his evidence.

Source: Cavendish (1997).

Box 3: Environmental Refugees

Myers and Kent's (1995) comprehensive study "Environmental Exodus—An Emergent Crisis in the Global Arena" indicates that there are approximately 25 million environmental refugees in the world. For comparison, the number of traditional (political and war) refugees are estimated at 22 million. The report defines "environmental refugees" as "…persons who can no longer gain a secure livelihood in their traditional homelands because of environmental factors of unusual scope, notably drought, desertification, deforestation, soil erosion, water shortages and climate change, also natural disasters such as cyclones, storms and floods" (p. 19).

Many of these refugees are located on the Horn of Africa and in the Sahelian region, but a large portion also resides in the Indian sub-continent, China, Mexico and Central America. Based on six regional case studies, the report states that "poverty, and especially absolute poverty, works in conjunction with environmental factors and population pressures to produce sizable numbers of refugees who are driven by all three factors working in conjunction" (Ibid., p. 49).

Box 4: Inequality and the Environment

A notorious example of inequality and its effect on environment and health is South Africa's former Homelands—one of the major legacies of Apartheid—where many of the black Africans reside. Due to crowding, poverty, neglect and past policies of institutionalized inequity, they are now subject to extremely poor health and environmental conditions. Around 1/3 of the children of the black majority suffer from chronic malnutrition, only around 25% have electricity and running water, and less than 20% have modern sanitation. At the same time most whites enjoy "first world" conditions in all respects. Consequently, infant mortality rate is about 7–13% for black Africans, but only 1.2% for whites, and whites live 11.5 years longer on average. (World Bank, 1994).

H1c: Inequality reinforces environmental pressure. A skewed distribution of wealth and income has implications for environmental pressure. For example, if small-scale farmers are compelled to utilize marginal areas because large-scale landowners occupy the best agricultural land, the inequitable land distribution may be an important driving force behind deforestation and land degradation. Along this line, Dasgupta and Mäler (1994) argue that poverty and many environmental problems stem from, or are exacerbated by, inequality. They also emphasize that in the presence of inequality, many local common property management schemes break down. This, in turn, results in negative impacts on the most vulnerable.

A corollary to the hypothesis above is that average GDP growth does not by definition imply simultaneous poverty alleviation and environmental improvements. The effect can in fact be the opposite or mixed, if growth plays into the hands of a privileged elite.

For a full account, the effects of economic growth on poverty and environment need to be evaluated at household level. The effect on individual household members of a deteriorating environment can vary widely. In particular, children are the most vulnerable to poverty and environmental degradation: for instance, children inhale greater quantities of air-borne pollutants relative to their body weight because of their

higher activity levels; they contract diarrhea more frequently due to higher exposure to vectors; infants in particular are exposed to higher health risks as they have not fully developed their immune system. There is also a gender aspect to the poverty-environment linkage (Agarwal, 1997). Thus, it is imperative to develop the understanding of poverty-environment interactions among sub-sets of poor people.

H1d: Governmental policies can create or reinforce a vicious circle of poverty-environment interaction. Governments do this through policy failures, including failure to address market failures, imposing negative externalities with particularly severe impacts on the poor. Market failures are exemplified by missing or incomplete markets for environmental goods and services (clean water, air, biodiversity resources, wetlands etc.). In the context of this paper, policy failures can be described as policy makers' actions or failures to act, which results in environmental degradation or pollution. Examples include subsidies to polluting industries and tenure insecurity, which encourage poor people to engage in non-sustainable resource use. It also includes corruption contributing to environmental degradation: "The existence of large resource rents from harvesting mature timber has attracted politicians as well as businessmen to the opportunities of immediate gain" (Repetto & Gillis, 1988, p. 388).

The example from Brazil in Box 5 below describes how government policies have contributed to environmental degradation in the Amazon and reduced the chances of the poor to become farmers, which have left many of them landless or unemployed.

Structural Adjustment Policies (SAPs) promoted by IMF and the Bank represent a subset of governmental policies. Their effects on social welfare and the environment have been subject to much debate and some analysis (see e.g. Munasinghe and Cruz, 1995; Reed 1992, 1996). Few reliable empirical studies exist, mainly due to insufficient environmental data fed into weak analytical frameworks, difficulties in establishing the counterfactual, and the fact that SAPs often are only partially implemented. Timing and sequencing often deviate from the original policy package, which makes it difficult to disentangle the (often lagged) effects. While the need for adjustment of economic policies in Sub-Saharan Africa is clear and increasingly beyond controversy, analyses of SAPs have shown both positive and negative impacts on the environment.

Box 5: Policy Failures, Environment and the Poor

Mahar (1988) and Binswanger (1989) analyze the impact of Brazil's government's policies on the forest resources of the Amazon region and conclude that they have contributed to large-scale deforestation. An area of more than 600,000 km^2 has been cleared, 80% of which has occurred since 1980. The government's role in this massive loss of natural capital has been one of biasing the allocation of land and agricultural credits towards the rich, promoting environmentally hazardous road developments, concessioning settlements in ecologically sensitive areas, and encouraging livestock development through grazing-area expansion.

Specific policy failures include substantial agricultural tax exemptions for large-scale farmers, public-land allocation rules of differing claim security as well as land taxes which provide incentives for land clearing and conversion to crop land or pasture, tax credit schemes favoring livestock ranching on cleared forest land, and subsidized credits to corporate livestock ranches.

A review of studies from ten countries (Bojö, 1997) covers Côte d'Ivoire, Cameroon, Ghana, Mali, Mexico, Philippines, Tanzania, Thailand, Zambia, and Zimbabwe, which all have been subject to structural adjustment programs (SAPs). The implementation of SAPs has been erratic, which, compounded by insufficient data and analytical methods, have made it difficult to identify the specific effects of SAPs. However, the study of Thailand, based on an extensive Computable General Equilibrium model of 90 sectors and 5 policy scenarios, reports that SAPs have contributed to reduced pollution and resource depletion per unit of GDP, but due to economic growth they have also led to an overall decline of environmental quality.

A result common to several of the studies in Sub-Saharan Africa is that reduced subsidies on fertilizers and pesticides combined with currency devaluation, reportedly have contributed to agricultural encroachment into forests and increased timber exports. On the positive side, the increased costs have decreased the use of polluting agro-chemicals. A general conclusion from the studies is that SAPs have been necessary to bring fundamentals in order, but that there is a need to deploy complementary measures to minimize the negative environmental effects.

Box 6: Structural Adjustment and the Environment

Holden (1997) analyzes the impact of Zambia's SAPs on the Chitemene slash-and-burn shifting cultivation system, which requires large amounts of woody biomass for crop production. The adjustment policies included (i) introduction of a market-based exchange rate; (ii) removal of price controls, leading to regional and local price differentiation, (iii) removal of food and fertilizer subsidies, leading to higher consumer food prices and higher fertilizer prices for farmers, (iv) reduced government involvement in production and marketing, and (v) reduced government expenditure.

Based on Ordinary Least Squares (OLS) and Tobit-regressions of cross-section data from 1992/93, Holden concludes that removal of fertilizer and transport subsidies resulted in substitution from maize to local crops (such as finger millet, groundnut, beans and cassava), expansion of shifting cultivation and thus increased deforestation. Deforestation has had limited negative environmental impact, however, mainly because the miombo woodlands in northern Zambia are still abundant, the biodiversity value is relatively low, local externalities such as soil erosion and water contamination are not yet disturbing, and other use and non-use values of the forest resources are limited. Hence, the opportunity cost of burning the forest is still small, but Holden cautions that if population growth continues and current policies are pursued, deforestation may become a serious environmental and economic problem.[vi]

H2. Poor people are agents of environmental degradation

This hypothesis is not about "putting the blame on the poor," but to state that the rural poor are often compelled to exploit marginal areas, such as steep hillsides, or derive resources from protected areas. Compounded by the impact of population growth, they often lack the incentives or means to intensify their production and are forced to exploit new, fragile lands. The urban poor unwillingly contribute to a different kind of environmental degradation, resulting in poor health, which can further reduce income opportunities.

World Bank (1992, 1995) elaborate on some of the links between poverty and environment. It is stated that a declining natural resource base, largely caused by poor people deprived of access to other resources, exacerbates the conditions of the poor by limiting their already restricted production possibilities. This applies in particular to rural water, soils and energy. One of the basic forces behind the vicious circle between poverty and environment is thus suggested to be that poverty limits people's options and induces them to deplete resources faster than is compatible with long-term sustainability. Hence the poor themselves will aggravate the process of environmental degradation.

Dasgupta (1993) describes how closely dependent poor people are on their surrounding environmental resource base for their livelihood, and how poverty can be a driving force to environmental degradation. Based on theory and some empirical evidence he argues that poverty is both a cause and effect of resource degradation or lack of access to resources, including natural capital. To exemplify the above arguments he describes how poor nomadic dryland herdsmen often are excluded from formal credit, capital and insurance markets and are forced to invest their capital in cattle, resulting in non-sustainable herd sizes and overgrazing.

Box 7: Poverty and Deforestation

Mexico lost some 19.2 million ha of forest between 1980 and 1990. Empirical evidence from the country indicate that poverty is associated with higher levels of deforestation, and that the poorer municipalities lost a greater proportion of local forest resources during this period. (Deininger and Minten, 1996).

In a two-period Cobb-Douglas production function model, Deininger and Minten estimate determinants of deforestation through Tobit-regressions applied to eight different agro-climatic regions. The socio-economic data is based on the 1991 Agricultural census and the 1990 Population census, which give information on municipality level. The bio-physical data consists of information on land use, soil type and vegetation cover. This data are based on satellite images of 22,000 sample plots, each 100m. x100m. in size, complemented by extensive ground truthing.

The study shows that the massive forest loss primarily is driven by smallholders' need for agricultural land, and secondarily driven by commercial interests. Regression analyses of deforestation rate yield positive, statistically significant coefficients for (a proxy variable of) poverty.

Plausible explanations to the hypothesis that the poor are agents of environmental degradation are that (i) poor people have shorter time horizon and (ii) higher risk-aversion and a propensity to use implicit, higher discount rates, which leads us to specify the following sub-hypothesis:[vii]

H2a: Poor people have shorter time horizons, which exacerbates environmental degradation. Allegedly, poverty often results in myopic production and consumption decisions, and precludes longer term investments in preservation and accumulation of natural capital (Holden et. al., 1996; Prakash, 1997). Consequently, poor people's limited economic options and low savings rates cause them to deplete and degrade their immediate environment (soils, forest, fisheries), and impose externalities on future generations.

However, Ostrom (1990), Rhoades (1988), Prakash (1997), Jodha (1986), and Bromley (1992) support the alternative hypothesis by suggesting that poverty does not necessarily imply short time horizons and environmental degradation. They argue that locally designed and governed resource management institutions provide resilience towards risks and exogenous shocks, and facilitate sustainable use over time. Accordingly, poor people do not inherently have relatively shorter time-horizons. They are forced to diminish their time horizon only when subject to external shocks or extreme events, it is argued. Prakash (1997, p. 7) summarizes: "*…it is not short time-horizons so much as exogenous factors and misguided policy and administrative mechanisms that are primarily responsible for the environmental degradation attributed to the poor.*"

Ostrom observes that neither the state nor the market has been uniformly successful in enabling individuals to sustain long-term, productive use of natural resource systems in many locations. Instead, communities of individuals have relied on institutions resembling neither the state nor the market to govern resource systems with considerable degrees of success over long periods of time. Long-time neighbors, driven by maintaining their reputation as reliable members of the community and recognizing the need for sustained future resource availability, expect also their offspring to be subject similar conditions. Hence, people have developed, independent of the market and the State, sustainable CPR management institutions, which facilitate access to essential resources across time.

Box 8: Time Horizon and the Environment

Ostrom (1990) shows how poor people indeed can utilize fragile ecosystems and common-pool resources sustainably over long time periods, even centuries in some cases, if some specific conditions or, in her terminology, "design principles" are fulfilled. Her global review draws on evidence from cases such as communally managed high mountain meadows and forests in Switzerland and Japan, basin water resources in south-western USA, and irrigation-water schemes in Spain and the Philippines.

Based on the empirical survey, the conditions she identifies as essential for long-term, sustainable management of common pool resources (CPRs) are: First, the geographical boundaries of the CPR must be clearly defined. Second, appropriation of CPRs, provision rules for CPRs and the local socio-economic and environmental conditions must be congruent and coherent. Third, consensus-like collective-choice arrangements for managing the CPRs must exist; in other words, most individuals who are affected by the operational rules can participate in modifying them. Fourth, adequate monitoring of the use of the resource must be developed and function over time, i.e. monitors who actively audit CPRs and the appropriators are accountable to the appropriators or are the appropriators. Fifth, graduated sanctions must be imposed on those violating the rules. The sanctions are preferably assessed by other appropriators, by officials accountable to the appropriators, or both. Sixth, cost-efficient conflict-resolution mechanisms (e.g. low-cost local courts) must be developed and utilized. Seventh, stakeholders' rights to organize themselves in CPR-management schemes must obtain (at least minimal) recognition by the Government. Eighth, based on the subsidiarity principle, the above design principles should be coherently tied together locally, regionally and nationally, and implemented (in "nested enterprises") at the lowest appropriate level of decision making.

In conclusion on this point, we can observe that poor people, under certain conditions, enter into activities of a long-term, sustainable nature. Again, we are led to search behind the hypothesis to explain particular behavior, and Ostrom's "design principles" point in a very interesting and plausible direction.

H2b: Poverty increases risk-aversion and discount rates, aggravating environmental pressure. It is often

assumed that poorer people have higher discount rates than richer people. For example, the World Bank's Forestry Policy (1991, p. 11) cites high private discount rates, especially among poor people who depends on the forests, as a driving force behind deforestation.

Pearce and Warford (1993) identify a vicious circle between poverty, high discount rates and environmental degradation by arguing that: "*High discount rates are one cause of environmental degradation because they encourage individuals to opt for short-term measures that satisfy immediate needs or wants and to ignore more environmentally appropriate practices such as planting trees. In turn, this environmental degradation leads to the poverty that causes high discount rates*" (p. 72). They also argue that poverty-induced high discount rates not only delay pay-offs and prevent investments in physical and natural capital, but also discourage investments in human-capital such as children's schooling. This would be particularly pertinent where mortality is high and prospects for formal employment limited. While higher discount rates among the poor could be explained by simple lack of resources which creates an urgent need for immediate gains, there is also the fact that poor people often have to borrow in informal, high-interest rate markets, as documented by Leach and Mearns (1991).

Rhoades (1988) describes how poor farmers respond to enhanced levels of risk of crop failure by diversifying land allocation and scattering parcels over a larger area in consent with other farmers. By cultivating lands of different soil types, quality and altitude, they manage to reduce their risks from pest or climate variability in a cost-effective way.

These results have important policy implications. For instance, farmers with differing levels of wealth would have different willingness and ability to undertake long-term investments. For instance, a flat (uniform) subsidy of e.g. soil conservation to individual farmers would induce some (presumably the rich) to act on the incentive whereas others (the poor) would fail to act, due mainly to poor people's lower valuation of future benefits. Although poor people often have lower opportunity costs, and thus would be expected to invest in labor-intensive activities, their limited ability to await distant, uncertain benefits—driven by high discount rates—would counteract such behavior.

Even if it is plausible that poorer people have higher discount rates, the problem remains that this would deter them not only from conservation investments, but also from investments with a detrimental environmental impact. The same argument can be advanced with regard to risk-aversion; it deters people from behavior that

Box 9: Poverty, Risk-aversion and Discount Rate

In a study of 240 households in the semi-arid, tropical rural areas of India, Binswanger (1980) uses an experimental, sequential gambling approach with real pay-offs to identify attitudes toward risk. The households in the sample are predominantly poor, but with considerable variation. He finds that relatively poorer people tend to be slightly more risk-averse. Although the estimated coefficients are largely consistent for the poverty variables (salary, assets and net transfers) across all sub-sets (villages) of respondents, the results are in several instances not statistically significant. The study does not extend to capture environmental impacts of differing risk aversion at different poverty levels. Without explicitly translating his findings into implications on discount rate, Binswanger (1982) summarizes in a discussion paper based on broader empirical evidence: "Farmers in developing countries are almost universally risk averse when confronted with prospects with significant outcomes." and …"every local measure of risk aversion on a utility function would differ according to wealth unless very restrictive utility functions are chosen." [p. 392].

Based on an empirical assessment of farmers' discount rates in Costa Rica and a review of 14 other empirical studies, Cuesta et. al. (1997) conclude that "[T]here is some evidence of declining discount rates with increasing income, time frame, and size of investment" (p. 3). They show that several analytical methods can been used to measure individuals' real rate of time preference: e.g. experimental games-approaches using binary choice, actual asset-choice models based on loans and land transactions, utility maximization models reflecting valuation of inter-temporal cost-benefit streams, and Contingent Valuation (CV) using willingness-to-pay (WTP).

In their study they apply CV and asset-choice models to reveal the real discount rate among 292 Costa Rican small- and large-scale farmers. When faced with questions on past and expected price changes, and their WTP for certain farm technology, 95% of the farmers show real discount rates in an interval from 15.1% to 21.9%. The results show a negative relationship between income and real discount rate.

could be both environmentally benign, or environmentally detrimental. While the tendency to a lower investment level with higher interest rates is ambiguous in terms of environmental impacts, we can postulate (cf. Pearce, et al. 1990) that higher interest rates makes it rational:

(i) to more quickly exploit exhaustible resources (e.g. mineral deposits), as moving income forward in time is more important the higher the discount rate, and

(ii) to maintain a smaller stock of renewable resources (e.g. timber, soil organic matter), as the relative return of these (generally) decline with size and the opportunity cost is higher the higher the discount rate.

While sometimes tempered by the increased capital cost in a high interest rate economy, these forces do point in the direction of higher environmental pressure. When capital costs are low, the incentive would be for poor people to quickly exploit what is immediately available.

H3. Higher incomes increase some environmental pressure

A feature of the H2 hypothesis above is that poverty is assumed to increase pressure on **local** natural resources. But this observation immediately invites the counter-hypothesis that high income earners tend to put relatively more stress on the **national and global** environment, e.g. emission of greenhouse gases, ozone-depleting CFCs, etc. This brings us to H3, which is not merely the counter-hypothesis of H2, but an argument about the relationship between environmental degradation in poor versus rich economies. Hence, the debate is much more macro-oriented in this case.

Examples when higher incomes at some levels may increase environmental pressure include air pollution from a larger pool of motor vehicles, waste generation from greater consumption in general, and carbon emission from increased use of fossil fuels.

Some of these results are corroborated by World Development Report (World Bank, 1992), which presents positive exponential relationships between per capita income, and CO_2 emissions and municipal waste per capita, respectively. However, emission of some pollutants (notably sulfur dioxide) initially go up and then decrease with rising incomes. This bell-shaped pattern of increasing followed by decreasing environmental impact with rising income is often called the "Environmental Kuznets-curve".[viii]

Box 10: High Income and High Levels of Pollution

By using a large cross-national data set, based on 95 indicators, Easterly (1997) attempts to answer the question: will rising income over time for a given country translate into increasing quality of life? Data was collected for the years 1960, 1970, 1980 and 1990. The methodology is based on linear or non-linear econometric estimation of the pooled data, where each indicator is regressed against the logarithm of the per capita income. Environment is one of the indicators. Easterly identifies several strongly positive relationships between per capita income and emission of some pollutants, for example CO_2, NO_2 and SO_2 in tons per capita, and wastepaper production in tons per 1000 inhabitants.

Shafik and Bandyopadhyay (ibid., p. 11) identify, based on cross-country regression analyses from the 1980s, empirical evidence of an environmental Kuznets-curve for urban concentrations of sulfur dioxide (SO_2). Initially, the SO_2 levels amount to less than 10 micro grams per m^3 of air at per capita income-levels around US$100. They then increase exponentially with income and peak at 50 micro grams at US$2000 per capita, and then decline dramatically as incomes continue to increase to again achieve very low SO_2 levels, but only at per capita incomes around US$20,000-30,000.

In conclusion, it should however be noted that in cases where environmental Kuznets curves do exist, they may very well be influenced by policies, and should not be taken as an excuse for a laissez-faire attitude. It is not a given that one "must wait" for a certain income level before taking measures to mitigate environmental loss.

Furthermore, despite real decline in emission or effluent levels, environmental pressure is still positive and may be cumulative. This may have a lagged but irreversible impact on flora, fauna and ecosystem functions, for example in terms of species loss. Therefore, flow indicators of environmental pressure are not sufficient in diagnosing the level of environmental degradation.

H4. Incomplete property rights reinforce the vicious poverty-environment circle

The rural poor are normally the ones with least secure rights to their assets, and are often compelled to exploit open access resources for sur-

Box 11: Rising Income and Afforestation in Peninsular Malaysia

Between 1966 and 1981, Peninsular Malaysia lost about 236,000 hectares of forest each year and its total forest area fell from 9.65 to 6.82 million hectares. Rubber and oil palm plantations replaced much of the forest lost. However, by the late 1980s the rate of conversion slowed, as industrialization and urbanization caused the rural labor market to tighten and agricultural returns to fall. The area in agriculture grew 520,000 hectares in the seven years between 1974 and 1981, but only 160,000 hectares in the nine years that followed.

Based on a regression analysis of the region's 65 districts, Vincent and Ali (1998) found that deforestation rates increased as per capita incomes rose until districts reached an average income of 1,100 Malaysian Ringgit, after which they fell sharply. By 1987, practically all of Peninsular Malaysia's districts had income levels higher than that. Not only did deforestation rates fall, but farmers also left significant areas 'idle' and allowed them to begin to revert to secondary forest. As rural youth moved to the cities to obtain manufacturing and public sector jobs and the farm population aged, farmers apparently decided to take more marginal farm lands out of production.

Using a global pooled cross-section and time-series data set between 1961–88, Cropper and Griffiths (1994) identify a similar inverted U-relationship between deforestation rates and income in Africa and Latin America. The Kuznets curve's theoretically estimated turning point occurs at a per capita income of US$4,760 for Africa, and US$5,420 for Latin America. Since these incomes are rarely obtained throughout most of these regions (i.e. most of the observations occur to the left of the curve's global maximum), the deforestation curve is currently leveling off as income increases. The same results could not be obtained for Asia, due mainly to the region's massive effort at afforestation and the data set's blunt definition of forest (no distinction between forest plantations and natural forests), the authors conclude.

vival. The World Bank's Forest Policy (1991, p. 11) specifically cites "weak property rights in many forest and wooded areas" as a driving force behind deforestation. In urban areas, the poor—commonly squatters and migrants—often lack tenure over their land and homestead. Poor provision of public infrastructure investments in sewage, garbage collection and safe water supply are at times justified on grounds of the illegal nature of (urban) settlements. Incomplete property rights, compounded by the lack of public investment and poverty reduce the individual's incentive for, and capacity to engage in, local environmental management. Tangible effects of these conditions in urban areas include poorer health, in particular increased incidence of intestinal infections and other communicable diseases.

In summary, there are studies that support the hypothesis that tenure security (perceived rather than formal) is correlated with the quality of environmental management. A cautionary note is in order when drawing the policy conclusions from this evidence. The case described below brings out the lesson that merely privatizing the rights, which is sometimes advocated by the "tragedy of the commons" school (Hardin, 1968) in the name of environmental protection, can be a counter-productive strategy.

There are alternatives to privatization that deserve consideration. Ostrom (1990) reviews hundreds of robust schemes, in which predominantly poor communities have established self-governing systems to manage Common Pool Resources (CPRs) such as fisheries, grazing lands, fresh-water supplies and village forests. In most cases the schemes have sustained change, without involvement of the government or market transactions, over decades or even centuries. Based on the survey, the eight design principles she identifies which facilitate sustainable management of common pool resources are: (i) clearly defined property boundaries, (ii) congruence between appropriation of the CPRs, their provision rules and the local conditions, (iii) consensus-like collective-choice arrangements for using the CPRs, (iv) adequate monitoring, (v) graduated sanctions of violators, (vi) conflict-resolution mechanisms, (vii) at least minimal recognition by the government of stakeholders' rights to organize themselves in CPR management, and (viii) nested enterprises (i.e. principles (i)–(vii) coherently implemented locally, nationally or regionally).

H5. Population pressure exacerbates both poverty and environmental degradation

It is often asserted that population growth or high population density impacts negatively on the environment, and this, in turn, exacerbates poverty. Most of SSA experiences unsurpassed rates of population growth, and there is a crucial nexus of interaction between population growth, poverty and environmental degradation (Cleaver and Schreiber, 1994). But the actual, location-specific links can vary.

Box 12: Property Rights and the Environment

Saxena (1988) shows in a detailed study of forests with different property rights in Uttar Pradesh, India, how tree cover had degraded to 10% on forest lands owned by the Revenue Department, 50% in forests owned by the Forest Department, and 70% in forests owned and managed by local communities and village forest councils. The study concludes that the level of effective enforcement of property rights was crucial in explaining the level of degradation.

Hoy and Jimenez (1996) analyze the impact of incomplete property rights on urban environments in Indonesia. Given variable property rights, they estimate in a probit model determinants to the probability that households invest in local public goods, specifically the households' propensity to purchase garbage collection services. Among other results they "…find strong support for the hypothesis that reduced tenure security significantly reduces the level of local public goods", and that "…going from squatter to moderate [tenure] security increases the probability of garbage collection by 32%, while going from squatter to high security raises the probability by 44%" (p. 16). They also report an independent, statistically significant positive relationship between household income and the probability that households purchase garbage collection services.

Southgate, Sierra and Brown (1989) empirically estimate the causes of tropical deforestation in Ecuador. Based on data from eastern Ecuador's twenty cantons and statistical Ordinary Least Squares (OLS)-regressions to explain deforestation, they come to the conclusion that it is negatively correlated with land tenure security.

Box 13: Privatization of Common Property Resources in India

Jodha (1986) shows that Common Property Resources (CPRs) provide a significant contribution towards employment and income generation for the rural poor in India. Based on data from 80 villages in 21 districts in dry regions of seven states in India, he shows that the dependence of richer households on CPRs is much less. Further, the area of CPRs has decreased dramatically during the last three decades, ranging between 26–63% in the studied districts.

Privatization of CPRs was introduced to support the poor, but the result was the reverse: 49–86% of the privatized CPR areas ended up in hands of non-poor, and CPRs held by poor were eventually sold to richer people to facilitate short-term survival. Jodha concludes: "Thus the rural poor collectively lost a significant part of the source of their sustenance through the decline of CPRs. This loss does not seem to be compensated by privatized CPR lands given to (or retained by) them. The situation calls for greater attention to CPRs as a part of the anti-poverty strategy" (Ibid., p. 1169).

There are several driving forces behind the population-poverty-environment nexus. Although many poor people are old people or single mothers, many poor households are poor because they are large, and large because they are poor. Poor parents tend to produce many children to secure income at old age, and provide labor to collect essential goods such as water, firewood and fodder. Children also play an important role in attending grazing animals, do other household chores and earn incomes by e.g. selling crops or other household produce. Further, poorer households are large due to lack of knowledge or means to sufficiently protect themselves against unwanted pregnancies. Family size is also determined by social norms and cultural traditions. In some societies adults are also expected to have many children as a sign of wealth or fertility, or both.

Mink (1993), for instance, argues how the poor's living environment—characterized by low quality and access to water—poor sanitation and polluted in-door air, and production practices impact negatively on themselves and others. It is among others manifested in lowered household productivity, which further exacerbates the environmental degradation and provides incentives for households to raise large families. This would further contribute to pauperism in an adverse, dynamic pattern. Mink makes the case that alleviating poverty is a win-win strategy with respect to population growth, the economy and the environment.

Lacking the means to move to a better environment, large households suffer from their own (and others') resource degradation. The mutual interdependence between these factors sets off a negative spiral: the poorer a household is, the more children are needed to secure current and future livelihood. The larger the family is, the more resources it needs. The higher the resource demand, the larger the pressure on the scarce or fragile surrounding natural-resource base. The more degraded or depleted the environment, the more children it has to have to secure old age and provide essential goods and services. The

more time spent on collection, less time is available for education and human-resource development. Less time for education will perpetuate poverty into next generation.

Boserup (1965, 1986), however, has become the principal representative of the contesting view. She argues that resource scarcity and population growth jointly induce technological change, innovation and intensification, which does not necessarily impact negatively on the environment. Hence, poverty and population growth become positive agents of change in a dynamic interplay, which often results in introduction of more efficient production techniques.

In fact, empirical studies of the population-poverty-environment links indicate validity of each of the contesting views, as shown in box 14.[ix] Hence, it might very well be, as argued by Heath and Binswanger (1996), that the final outcome can go either way and is essentially driven by policy; i.e. whether growing population pressures induce positive or negative environmental change is ultimately and fundamentally driven by the overall policy framework.

In a summary view, Prakash (1997) who exemplifies Boserup's school of thought, states that based on empirical studies in Kenya (Tiffen et. al., 1993; Bradley, 1991; Ferguson-Bison, 1992) and the Himalayas (Ives and Messerli, 1989), …"there is no fundamental relationship between population density and environmental degradation. The assumption that high population density will necessarily cause greater anthropogenic degradation is exceptionally difficult to justify given the available evidence." [p. 12].

Based on the above arguments and empirical evidence, it seems clear that it is not possible, a priori, to say that population growth or high density will result in environmental degradation. Clearly, population growth plays a crucial role in determining the quality and stock of natural capital, but in many instances it is not the root cause of environmental degradation. Rather than embarking on massive population-control programs, underlying policy and market failures should be scrutinized and corrected first and foremost. Good economic policies, secure tenure rights, political stability and a dynamic economy can all contribute to alleviate the pressures from population. Again, this reinforces the complementarity between different types of operations.

Much of this complementarity appears obvious: market-oriented reforms that stimulate urban job growth can attract surplus labor out of a sensitive forest zone, and so forth. However, one type of complementarity that has been given little notice is one between community-based population control and environmental management (CBPE) activities. The interesting research by Population Plan International (Engelman,

Box 14: Population and the Environment

Pearce and Warford (1993) argue that there is strong evidence of negative environmental impacts of increasing populations. They exemplify by referring to the strong negative relationship identified between forest coverage and population density in 72 tropical countries.

Cropper and Griffiths (1994) state that: "…there is no question that population growth contributes to environmental degradation…" (p. 250). They confirm this by estimating statistically the impact of increasing population pressure (defined as the rural population density), population growth rate and increased per-capita income on deforestation, respectively. They use data from 64 developing countries between 1961–1988. Their results indicate that population pressure as well as population growth are generally positively correlated with deforestation. In Africa, for instance, the deforestation rate would increase 0.33% as population-density increases with one person per 10 hectares. These effects are to some extent offset by increasing GDP and GDP/capita.

Filmer and Pritchett (1997) assess the existence of a vicious circle between environmental degradation and fertility. Based on data from Pakistan, they conclude that (i) firewood availability seems to be negatively correlated with fertility, and (ii) households living far from firewood have more children. Filmer and Pritchett also present a model of population-forest cover interaction. It identifies distinct stages (or phases) across time, in which population and forest cover alternately correlate positively or negatively depending on the population growth. They cautiously conclude: "A claim that these results confirm the existence of a vicious circle between environmental degradation and demand for children is clearly far too strong. The results, however, are supportive of the notion that there is a stage in time in the relationship between environmental degradation, fertility, and land ownership rights during which children are in relatively high demand" (p. 31).

1998) provides a synthesis of the experience so far. From a population perspective, the experience of several NGOs suggest that this approach to linking conservation and reproductive health activities, at the request of community members, can reduce costs for family planning service delivery in remote areas by taking advantage of personnel and networks already developed for conservation work. From the environmental perspective, women who manage the timing of childbearing may be better able to manage competing tasks, including the local natural resources, Engelman argues.

Concluding Note

We close this section by noting that the literature is richer in general assertions than in rigorous empirical evidence. Where evidence is available, it often points in the direction of multi-causal chains, where the influence of a single factor (tenure security, population growth etc.) is very difficult to ascertain. Nevertheless, we have gone beyond the simplified statements in our hypotheses and discovered a diverse set of conditions that will increase the probabilities of support or rejection of the hypothesis at hand. While, "it depends" is not a very forceful conclusion, it is a useful one, if we know something about "**what** it depends on."

We do conclude that "the poor as victims" hypothesis of environmental degradation appears quite plausible, and that it does open up an agenda of potential win-win operations that combine poverty alleviation with environmental management measures.

3

Synthesizing Poverty and Environment in CASs

Poverty is a frequently discussed topic in CASs. However, the sample of 34 CASs reviewed in Ekbom and Bojö (1997) shows that it is rather seldom analyzed jointly with environmental degradation. Poverty and environment are usually treated in separate sections, specifying separate activities, use separate evaluation criteria and indicators, and refer to different analytical background documents: Poverty Assessments and Living Standard Surveys address poverty, and National and Local Environmental Action Plans and Country Environmental Strategy papers address the environment.

There are however some good examples of joint analysis. Below we present some of them from existing CASs and PAs. The structure follows the hypotheses presented in section 2. More frequent analyses of this kind would greatly enhance the understanding and policy formulation of the inter-related problems of poverty and environment.

H1. Poor people are the main victims of a bad environment

The **Brazil** CAS capture the links between poverty and environment aptly: "*Since the poor tend to reside in the most polluted neighborhoods, they also suffer most from health damages and reduced quality of life caused by pollution" (p. 7). "About 20 million Brazilians lack safe drinking water and 40 million have inadequate sanitation services. These are two services where expansion of service is closely connected to improving living standards and reducing poverty, and where weaknesses have led to high environmental pollution and increasing costs in maintaining health standards in drinking water. Only about 20 percent of collected sewage is treated. Furthermore, these weaknesses disproportionately affect the poor. About 92 percent of the urban population without public sewerage services are poor*" (p. 55).

The **Senegal** Poverty Assessment elaborates on several of the hypotheses, among them the observation that the poor occupy unhealthy surroundings: "*In spite of better standards of living in urban areas on average, a substantial number of poor live in the "quartiers flottantes" or squatter area in peri-urban Dakar. Dakar serves as a magnet for the handicapped, orphans, and destitute who seek services, special care, or income from begging. Increasing rates of rural to urban migration (and migration from neighboring countries) appear to contribute to the problems of these squatter neighborhoods which have poor or nonexistent sanitation, often house up to 8 people in a room measuring 1.5 to 2 square meters, lack water or electricity, and are characterized by housing made of discarded metal or cardboard. Such environments become breeding grounds for increases in disease*" (p. 13).

The issue of **environmental refugees**, where environmental stress force the poorest to temporarily or permanently leave their homestead to seek survival elsewhere, is addressed in some Poverty Assessments. The **Kenya** PA exemplifies by stating that: "*emigration from the better endowed highlands to semi-arid districts, such as Machakos, Kitui and Kajiado, in search of land, has been a major phenomenon in Kenya in the last two decades or so.*

Without this population movement, the incidence of poverty in the better endowed areas would have probably been higher. However, this migration in search of land has had the effect of displacing nomadic tribes who historically used the land and watering holes for their cattle" (p. 19).

The **Niger** PA states that "*Migration is widespread: it is a survival strategy for individuals and households in difficulty, a relief mechanism for households and communities and a possibility of enrichment—but also of impoverishment; the poor migrate to look for food and work within Niger or to a neighboring country (usually Nigeria), often returning to the village during the period of cultivation. Some "come back only with an illness", AIDS or venereal disease. Migration of an entire family is a sign of great distress. These migrants attach themselves to urban relatives and increase the masses of unemployed*" (p. 30).

On the argument that **governmental policies** create or reinforce a vicious circle of poverty-environment interaction with specifically severe impact on poor people, the **Senegal** Poverty Assessment describes that: "*Poor incentives in the market for charcoal only serve to accelerate erosion of soil and forests. …charcoal prices are not set to reflect the full economic cost, and the permits are granted according to the amount of charcoal produced rather than the number of trees cut thus providing no incentive to manufacture the charcoal more efficiently. ….the revenues from the licensing system are controlled by the Forestry Service, and not by the local population. Local participation is thus essentially limited to serving as labor for cutting trees (a common activity of the poor). Thus rural communities have little incentive to protect this resource, and substantial incentive to cultivate land even if not optimal for the soil, simply to prevent the land from being harvested by an outsider. This, in combination with national energy policies that keep tariffs on alternatives to charcoal such as petroleum high (largely to reap tax revenue), also serve to accelerate deforestation rates*" (p. 29–30).

H2. The poor are agents of environmental degradation

The **Brazil** CAS states: "*…the increasing demand of growing urban population for sanitation and transport services remains unsatisfied, thereby generating a cycle of urban pollution, health problems, and lower quality of life for the population at large*" (p. 7).

Implicitly addressing **inequality** as a triggering factor to environmental degradation caused by poor people, the **Philippines** CAS describes how the upland areas are rapidly being populated due to lowland poverty and marginalization of small-scale farmers. The combination of poverty-driven lowland-to-upland migration, inadequate farming techniques and extensive deforestation, cause detrimental on-site and down-stream effects in terms of soil erosion, reducing agricultural productivity, and siltation of vital infrastructure such as irrigation, hydroelectric, and municipal water installations.

The **Madagascar** CAS poses yet another good example, and stresses the need to address the complex interactions between poverty, unemployment, high population growth and environmental degradation through an integrated economic development strategy. It emphasizes specifically the issue of **inequality** by stating that "*poverty and population growth are the principal causes of environmental damage, that environmental degradation leads to lower crop yields and infrastructure deterioration, and that rapid economic growth is essential to break this vicious circle*", but that …."*the **structure** of growth is as important to ensure that economic benefits are distributed equitably, and that development must foster the use of the most abundant resource of the poor-labor*" (p. 7–8).

Few, if any, CASs and PAs elaborate on the issue whether poor people have shorter **time horizons**, are **risk averse** or have **higher discount rates**, and how that would link to resource use and environmental quality. Although the discussion in the **Senegal** Poverty Assessment does not substantially address short- vs. long-term investments, it touches upon the poor's constrained time horizon by stating that: "*…recent surveys show that obtaining food and seeds are of greater concern to farmers….. These trends illustrate the current constraints faced by the rural poor—the need to choose between long-term investment in inputs versus immediate necessities, as well as the decline in cash income*" (p. 29).

H3. Higher incomes increase some environmental pressure

Interestingly enough, we note that very few CASs in our sample pay particular attention to the impact of economic growth on the natural resource base, pollution levels or the environmental sustainability of that growth in the long run. Admittedly, this is not a serious issue in some of the world's poorest countries, but in a growing number of developing countries eco-

nomic growth is major contributing factor to natural resource depletion and pollution.

The **Indonesia** CASs (1995, 1997) pursue the issue of growth and environment, and provide arguably the best examples: "*Environmental quality and sustainability are an integral part of Indonesian government's stated development concerns. The growing attention to these issues in the Government's development strategy reflects an increased awareness of the costs and risks of the worsening environmental conditions due to past growth, and the potential for continued environmental degradation in the future" (1995, p. 8). Further: "In spite of rapid growth …, Indonesia's competitive position in low-skilled labor and resource intensive industries is now being eroded…[due to] environmental degradation in areas such as forestry and large-scale mining*" (1997, p. 7) "*[T]he negative externalities of rapid growth have to be captured and mitigated through comprehensive institutional and regulatory structures*" (1997, p. 23).

It is explained that Indonesia's historically lax policies on natural resource extraction, particularly in the forestry sector, facilitated growth, but also caused a "first generation" of green environmental problems such as soil erosion. The growth initiated significant socio-economic transitions, including rural-urban migration and massive industrialization, which facilitated sustained economic growth, but also gave rise to a "second generation" of new, primarily brown environmental problems: water contamination, solid and hazardous waste, urban and industrial air pollution, etc.

H4. Incomplete property rights reinforce the vicious poverty-environment circle

On the complex issue of property rights, the **Senegal** Poverty Assessment writes: "*The current incentive system governing land and natural resource use states that land not under cultivation can be "leased" by the state to outsiders or others, without necessarily requiring permission from the local population. This practice only compounds the incentive to maximize land use, and creates a disincentive to planting forests, thus contributing to problems of soil degradation*" (p. vi).

H5. Population pressure exacerbates both poverty and environmental degradation

The Senegal Poverty Assessment elaborates on how poverty interacts, in a vicious circle, with environmental degradation and population growth: "*…In order to preserve the long-term natural resource base (and income base) in the rural sector, progress is urgently needed in controlling population pressure, and in implementing an incentive structure conducive to sound and locally-driven natural resource management. The collision course between managing the meager resource base, providing for food needs, and supporting a growing population is now at a critical stage. As can be seen …declining availability of arable land lies at the heart of this collision, and is being driven over the long-term by population growth, the increased demand for food production for an increasingly urbanized population, and declining rainfall patterns*" (p. 29).

The **Burkina Faso** CAS asserts in many sections that there is a vicious interaction between population growth, poverty and environmental degradation, and that "*regionally, there is a strong correlation between rainfall patterns, soil degradation, and the incidence of poverty*" (p. 3). It emphasizes that environmental conservation and natural resource management are critical to poverty alleviation and economic growth, and that many activities, detrimental to the environment (mining of agricultural and forest lands), are indeed poverty driven.

Concluding Note

Even though several poverty assessments deal with issues relating to environment, the focus is often too narrow. To exemplify, the **Senegal** Poverty Assessment analyzes **health issues** very well in a traditional sense. However, some aspects remain unexplained, for instance the large differences in health expenditures between urban and rural citizens in Senegal: "*it would be worthwhile to examine through rapid qualitative assessment why poor rural households spend so little on health care compared to their urban counterparts (e.g. because of income constraints, because health services are simply not available, because of low demand for modern health care, or because of the availability of low-priced generic drugs through health posts…*"(p. 36).

Here, as in many cases, the environmental dimension of the issue is overlooked. While we do not know the specific answer regarding Senegal, the importance of access to biological resources ("wild" or "environmental" goods), biological diversity and poor people's dependence on, and use of, it for good health is not considered. The option many rural poor have of

obtaining traditional medicines and many other essential goods and services from local natural resources, can provide an important additional piece in the puzzle of understanding poverty-environment links.

Our review shows that few CASs elaborate on the poverty-environment links, and we have found few examples of good PAs in this respect. As pointed out in many studies, there is an urgent need to **enhance the understanding of how poor people depend on, interact with and utilize their local environment** for survival. For instance, poor people's survival mechanisms developed in their inter-play with biological diversity and common property resources are only superficially understood.

As some of the empirical evidence corroborates the fact that poverty and environment are profoundly linked and do indeed impact on each other through various means—it is also critical to **identify and systematically use appropriate indicators** to enhance our knowledge in this realm. Ideally, these indicators should encompass *both* poverty and environment, and should capture the mechanisms through which they are linked.

What might those indicators look like? Jodha (1991) has suggested a large set of indicators covering major agro-ecological zones and the urban environment, many of which are relevant also from a poverty perspective. Similarly, the World Bank-report *Expanding the Measure of Wealth: Indicators of Sustainable Development* (1997) suggests e.g. soil-related land quality indicators for pressure, state and response, indicators of material flows, soil-nutrient balances as well as thematic environmental indicators used by progressive governments. The *1998 World Development Indicators*-report (World Bank, 1998a) and *World Resources 1998–99* by World Resources Institute (1998) present real data on some useful environmental indicators, which however are somewhat limited due to lack of coverage and reliability.

One promising attempt (World Bank, 1998b) is the joint project developed between the Bank, UNEP and regional institutions, where preliminary indicators of environmental sustainability in Central America's rural areas have been suggested. At present the indicators are preliminary and the project is in a development stage. The approach, where pressure, state, impact and response have been used as points of departure, is however promising. Some of these and other indicators are presented in Appendix 1.

To understand the interplay between the local environment and poverty, one would have to relate the data gathered in a particular context to socio-economic data from the same area. This would allow us to answer important questions like:

- to what extent are different income categories affected by natural resource degradation?
- to what extent are different income categories affected by pollution?

The answers could then guide targeted efforts to mitigate environmental pressures that have the greatest effects on the poorest people.

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Appendix 1. Selected Environmental Indicators

Variable	*Pressure*	*State*	*Impact*	*Response*
1. Population	• Population growth (% rural, urban)	• Population density (p / ha) • Population size (#)	• Population distribution (% rural, urban)	• Fertility rate (%) • Population projections
2. Socio-economic development	• GNP per capita ($US) • GNP distribution (%) • Production structure (%) • Unemployment rate (%)	• Employment structure (%) • Income Gini Coefficient • Rural population w. service access (%) • School enrollment rate (%) • Rural literacy (%, by sex) • Natural capital / cap. ($US, %) • Daily Caloric intake / cap. • Agriculture labor force (%) • Life expectancy (yrs.)	• Infant mortality rate (x1000 births) • Rural poor (%) • Malnourished children (%) • Minors in labor force (urban, rural; % of total)	• % of GNP to Education • % of GNP to Health • % of population immunized • % of women w. family-planning access • Participation in agreements, treaties
3. Land use	• Pesticide use t / ha) • Fertilizer use (t / ha) • Agricult. land per capita (ha) • Irrigated land (% of crop land • Crop prices ($US) • Input prices ($US) • Grain-fed livestock (%) • Land concentr. (Gini coeff.) • Drug cultivation areas (ha) • Charcoal production (m3 / cap) • Fuel production (m3 / cap) • Annual wood production (m3) • Deforestation (ha / yr.) • Livestock population (#) • Land-use changes (ha)	Cereal production (t) • Cereal yields (t / ha) • Roots, tuber production (t) • Roots, tuber yields (t / ha) • Food-consumption change (%) • Agriculture as % of GNP • Cropland area (ha) • Centers of crop prod'n (ha) • Wood reserve / production ratio • Forest area (ha) • Pasture area (ha) • Land use / cover area (ha) • Land use index (pot. / act.) • Net primary productivity (t / ha)	• Erosion rates (t / ha) • Soil degradation index • Cropland affected by pest and disease (%) • Food export / import ratio • Nutrient balance • Soil organic matter • Soil loss volume (t) • Soil compaction • Wood scarcity (% of pop.) • Forest fragmentation (ha) • Carrying-capacity index (AU / ha) • Erosion-affected area (ha) • Desertific.-affected area (ha) • Salinization-affected area (ha)	• Agriculture land needed to feed projected population (ha) • Agriculture research / training expenditures ($US) • Potential agriculture yields • Forest action plans • Annual reforest. (ha) • Reforest. / deforest.-ratio • Deforestation projections (ha / yr) • Restored / rehabilitated surfaces (ha) • Land-use proj. (ha)
4. Biodiversity	• Non domesticated land (ha) • Species extinction rates • Conservation condition • Species (#) used in agriculture	• % of natural areas • Threatened species (% of total) • Endemic species (% of total) • Threatened plants taxones (#) • Biodiversity distinctives • Major habitat type	• Conservation state	• Protected areas • Biodiversity inventories • Participation in agreements, treaties • Ecoregions needed for representation in bio-regions

Variable	*Pressure*	*State*	*Impact*	*Response*
5. Water and Coastal resources	• Population in coastal areas (#) • Marine and continental catch (t/yr) • Coast-tourist arrivals (p/km of coast line) • Water consumption (m3/cap.) • Annual water withdrawal (% of total)	• Mangrove, coral reef area (ha) • Annual internal renewable water resources (m3/cap.) • Sectoral withdrawals	• Mangrove, coral reef/coast line-ratio • BOD and COD in water (mg/l) • Pesticide, fertilizer concentration in water (mg/l)	• Participation in agreements, treaties • Protected coastal areas (ha) • Waters treated (%) • Rural population w. safe-water access (%)
6. Energy and Atmosphere	• Fuel, wood consumption (m3/cap.) • Hydro-power generation (total and % of capacity) • Energy consumption (J/cap.) • Global warming net emissions (t CO2 eq. C) • Net emissions due to land use change (% of total)	Hydro-power potential (G/h/yr) • Installed hydro-power capacity (G) • Energy reserves (tep) • Dam efficiency (Kw/ha) • Emissions (tC/cap.) • Agriculture emissions (% of total) • Livestock emissions (% of total)	• Traditional fuels (% of total requirements)	• Bio-energy potential (t) • Participation in agreements, treaties
7. Natural events	• Frequency of natural disasters (#/yr)	• Population affected by natural disasters	• Financial losses due to natural disasters ($US) • Lives lost due to natural disasters (#)	• National plans against destruction of natural disasters

Source: World Bank, 1998b.

Tropical drylands
- sheet erosion, wind erosion
- lowered water tables, groundwater salinisation
- growth of inferior annuals, thorny and woody shrubs (i.e. reduced availability of useful biomass)
- declining crop productivity
- declining availability of common property resources

Mountain areas
- increased landslips, gully erosion, terrace abandonment
- decline in species diversity in pastures and forests
- substitution of cattle by sheep and goats, increased seasonal migration
- substitution of deep-rooted crops by shallow-rooted ones
- persistent decline in agricultural productivity
- increased distance and time involved in gathering fodder and fuelwood
- reduced fallowing, intercropping and crop diversification

Tropical moist forests
- declining species diversity, decline in forest area
- reduction in length and deterioration of vegetation, composition of fallows
- decline in useful species present in bush and fallow
- gully erosion

Tropical wetlands
- decline in useful macrophytes through eutrophication, chemical pollution and presence of metals
- soil drying and compaction

Irrigated lands
- waterlogging, salinisation
- mining of productive soil components (organic matter, available macro-, micro-nutrients)

Rainfed cropland
- sheet and gully erosion, declining crop productivity
- increased yield variability / increasing rainfall variability
- increasing crop disease and pest damage
- reduced fallowing, intercropping and crop diversification

Urban areas
- Increased presence in human environment of health damaging pollutants and micro-organisms
- increased presence of toxic wastes in air and water
- declining availability of clean drinking water
- decreased quality and increased overcrowding of housing

Source: Leach and Mearns (1991) adapted from Jodha (1991)

End Notes

i. There are other arguments pertaining to the efforts to curb population growth, such as public health aspects. These are valid, but outside of the scope of this publication.

ii. The concept of "poverty" has been given several definitions. The most central concept is the poverty line, where the *Absolute Poverty Line* (APL) is the minimum level of expenditure deemed necessary to satisfy individual's requirement of food and some non-food necessities. The *head count ratio* measures the proportion of people (or households) whose adjusted equivalent income is below the poverty line. The *Food Poverty Line* is the minimum expenditure necessary for satisfying food needs only. *Depth of poverty*, often labeled the Poverty Gap Index, is the difference between the absolute poverty line and the average consumption expenditure of the poor, expressed as a percentage of the APL. The *Gini Coefficient* is a summary measure of inequality in the distribution of expenditure (for further reference, see e.g. Ravallion, 1992, 1998). Another set of definitions are derived in Participatory Poverty Assessments and based on local people's perceptions and characteristics of that society's poor. For the purposes of this paper, we have to accept the fact that different sources used will be based on different definitions of poverty. We do not believe that this ambiguity should stand in the way of a search a synthesis of empirical lessons.

iii. The World Development Report on poverty (World Bank, 1990) argues that poverty is an important determinant and effect of environmental degradation, and that investing in the environment is often a win-win solution with respect to poverty reduction. The reverse may also be true. The report describes how rural poor are marginalized or forced to intensify their resource use resulting in environmental degradation, which in turn exacerbates the poverty. Lopez (1997) argue that there might be a virtuous or vicious cycle of interaction between population growth, environment, poverty and institutions. The final outcome is crucially determined by policies, he argues. Sida (1991) and Segnestam (1996) adhere generally to these views but also emphasize, *inter alia*, (i) the extremely high complexity of the issue, (ii) the importance of understanding these processes as well as the local socio-economic and ecological context, and (iii) that pursuit of economic-growth policies and poverty-reduction policies without due attention paid at their environmental consequences entail serious inherent risks to the sustainability of the very same policies.

iv. This could be related to the type of cooking fuel used; e.g. fuelwood as opposed to kerosene, liquefied petroleum gas (LPG) or electricity.

v. See for example Kramer et. al. (1995) for a carefully conducted study to assess the compensation needs of local villagers in the vicinity of a national park in Madagascar.

vi. A word of caution in the interpretation of this study is in order. The comprehensive impact of

the policy reforms must be taken into account when evaluating the impact, not only the removal of certain subsidies. Thus, it would be enlightening to also include in the evaluation the impact of changed incentives on the *output* side and other relevant reforms pertaining to the profitability of Zambian small-holder's agricultural production, as well as other exogenous causes of their purported behavioral change.

This is justified based on the argument that it is not the removal of fertilizer subsidies that has made maize less profitable than other crops, increased slash-and-burn cultivation and triggered substitution towards environmentally malign local crops, but rather elimination of the pan-territorial pre-planting prices offered to farmers, which amounted to a transport subsidy to their maize production (and marketing) in remote areas. It is doubtful whether maize farmers in the relevant areas received or used much fertilizer even when it was subsidized. Moreover, the analysis gives no guidance as to whether the changed input and output prices provided, on balance, improved or worsened terms-of-trade for most of the affected farmers. Further, we do not know whether changes in forest cover were (also) due to exogenous causes such as population growth, in-migration, or abnormal climate during the survey period.

vii. While it may be difficult to separate the time horizon impacts from the discount rate impact by merely observing behavior, they are conceptually different factors. *Time horizon* refers to the fact that some costs or benefits may not enter at all into the calculation. An example would be a farmer clearing a plot of land with the perspective of harvesting for three seasons, and then to move on. Another would be a farmer within a rotational 5 or 7-year system, as traditionally practiced in parts of Ethiopia and Eritrea. While social forces are still at work to define acceptable behavior, such a system does provide a definite time horizon for investment decisions.

Discount rate refers to the conceptually distinct case of *weighing* future cost and benefits, perhaps over a considerable time horizon. It is often divided into individual or social discount rates. *Individual* or private discount rates are primarily determined by individual pure time preference ("impatience" or individuals' premium for delayed pay-off), risk and uncertainty. *Social* discount rates are either determined by the social time preference rate (STPR) or social opportunity cost of capital (SOC). STPR is based on the elasticity of marginal utility of income (or consumption) multiplied by income growth per capita plus the social rate of time preference ("impatience"). SOC is based on marginal productivity of capital.

It has been debated whether society and the social discount rate should reflect "impatience" by simply aggregating all individuals' pure time preference into the STRP and hence place different values for nominally identical costs or benefits incurred across time. Based on the goal of sustainable development and inter-generational equity, we argue that no such distinction can be justified. Society has a responsibility, which goes beyond individual preferences of the current generation, to also include future generations. Society's discounting also includes an element of risk and uncertainty, which are normally identified by multiplying (a distribution of) probabilities with utilities of various outcomes.

High discount rate are generally caused by (fear of) economic and social instability, and high real interest rates in credit markets. A further complication is the separation between risk-aversion and "pure" discount rates. Conceptually, one can separate the valuation of future costs and benefits at their expected values from the consideration of variance around those expected values. In practice, the distinction becomes blurred, and we have found it difficult to separate the two elements when interpreting empirical studies. Hence, those two factors have been lumped together. For a discussion see e.g. Bojö, Mäler and Unemo (1992, pp. 65–71); Pearce and Warford (1993, pp. 65–80).

viii. The term stems from the seminal work of Simon Kuznets, primarily in the 1950s, on the relationship between income distribution and income level. The debate about this curve applied to the environmental domain has become quite lively, and recent issues of the Journal of Environment and Development Economics (1997) and International Journal of Ecological Economics (1998) are entirely devoted to this theme, with articles covering indicators pertaining to air and water pollution, inequality, deforestation, trade, energy and traffic volumes.

ix. In addition to the studies presented in box 14, Cleaver and Schreiber (1994) find that the deforestation rate correlates positively with the total

fertility rate in a cross-section of 38 countries in Sub-Saharan Africa. However, they also report that the econometrically estimated effect of population pressure (cultivated area per person) on deforestation, having pooled the cross-country sample, yield statistically non-significant coefficients. In the simple cross-country sample, population pressure had the expected negative sign on the coefficient, but it is very small and not statistically significant. Cleaver and Schreiber conclude that "the result is therefore ambiguous and unconfirmed" (p. 72).