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Development, democracy and forest trends

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Abstract

Global forest trends are analysed in relation to indicators of economic, social and political development. The richest and most democratic countries are characterised by stable or expanding forests, while poor and despotic countries tend to experience rapid forest loss. The conclusion is that a high level of development is beneficial rather than detrimental to the sustainability of forest area. This conclusion is discussed briefly in relation to the relationship between the human and environmental dimensions of sustainable development.

1. Introduction

The fate of the global forest is an issue of current concern, especially in relation to biodiversity and global warming. Tropical deforestation is proceeding at a rate which alarms many, and its causes have been the focus of much attention in recent years. The view that economic growth is a powerful driver of deforestation and other forms of environmental degradation is widespread, but in this paper evidence is presented to show that stability or expansion of the forest area is associated with high levels of economic, social and political development. The corollary is that development, at least in the long term, is beneficial rather than detrimental to forest trends, if it is assumed that stability or expansion of the global forest is preferable to contraction.

In a field where there is much generalised theoretical debate, this paper seeks to review the relationship between recent forest trends and various indicators of development, using empirical national data at the global scale. Several caveats are necessary at the outset. Firstly, forests are only a sub-set of 'nature' (although some regard the former as a proxy for the latter; e.g. Easterbrook, 1995): the conclusions reached about forests are not necessarily applicable to other environmental elements. Secondly, trends in forest areas cannot be regarded in themselves as sole criteria for forest sustainability (although areal trends are often used as indicators; Lanly, 1995; DoE, 1996). No claim is made, therefore, that the conclusions reached in this paper can be extrapolated to wider issues of forest sustainability. Thirdly, the statistical relationships between forest trends and individual variables representing development are generally weak or of limited strength. It is not asserted that such variables in themselves are necessarily the primary drivers of forest trends, or that other factors are irrelevant: development is viewed as a fundamental or underlying factor, rather than as a proximate cause. Fourthly, it is acknowledged that forest trends may initially become more 'unfavourable' during the early stages of development, before improving later. It is contended, however, that 'favourable' forest trends are in general correlates of growth rather than stagnation. 'Favourable' is used as a shorthand term for near-stability or expansion of the forest area, whereas 'unfavourable' relates to (rapid) deforestation. It is used in preference to 'positive' as it can, as thus defined, be applied to trends characterised by near-stability. It is not implied that positive forest trends are invariably perceived as favourable in any general sense, nor that strongly negative trends are invariably perceived as unfavourable. In general, however, rapid deforestation is widely regarded in the literature as an unwelcome environmental trend, while expanding forests are seen by some as beneficial in relation to issues such as carbon sequestration and global warming. Trends in forest area are, of course, amongst the criteria and indicators of forest sustainability developed under the Montreal and Helsinki processes.

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The Brundtland Report (WCED, 1987) asserts that sustainable development, embracing socio-economic and environmental dimensions, is possible: this paper demonstrates that it is achievable, at least by one indicator of one environmental element. Optimism, however, needs to be tempered by caution: the pattern of forest trends is asymmetrical, with net deforestation outweighing net reforestation, and far more countries experience the former than the latter. It must also be acknowledged that there is little practical prospect of favourable forest trends being achieved globally in the near future as a result of trends in development.

2. Development, democracy and the environment

Growth and development are widely regarded as enemies of the environment, in terms of its use both as a source of resources and as a sink for wastes. Especially from the early 1970s, neo-Malthusians envisaged economic growth to be harmful to the environment in the same way as population growth had been perceived by their predecessors. As Bernstam (1991) observes, almost all the relevant literature concludes that economic growth increases environmental disruption. In particular, environmental impact has been seen as a function of growth in population, consumption or affluence, and technology (I = PAT) (Holdren and Ehrlich, 1974; Ehrlich et al., 1977). It was recognised that synergetic effects could exist, but it was assumed that adverse impact would increase with continuing growth in these variables. The suggestion by an eminent economist that "As total world population grows and *incomes rise*, net global environmental degradation is likely to worsen" (Todaro, 1994, p. 329, emphasis added) reflects a widespread and deep-seated belief.

Nor has concern been directed only at economic development. During the 1970s, several authors, including Heilbroner (1974) and Ophuls (1977), considered that the need for self-discipline in the face of what they saw as resource scarcities and environmental crises was greater than was likely to develop voluntarily in democracies. The grim alternative to democracy was authoritarianism. Indeed several commentators have noted the apparent enthusiasm for coercion on the part of some environmentalists (e.g. Passmore, 1974; Pepper, 1996).

More recently, the notion of more positive relationships between 'development' variables (both political and economic) and environmental conditions has attracted increasing attention. For example, O'Riordan (1996) asserts that sustainability cannot be guaranteed by coercion, and that moves towards it depend on popular acquiescence if not outright support. Beckerman (1992), a long-term critic of the 'anti-growth' school, contends that while economic growth usually leads to environmental deterioration in its early stages, in the longer term environmental conditions improve as development proceeds. An optimistic stance is also adopted by Easterbrook (1995), who argues that the worst of pollution is now over in the West, and that further environmental improvement may be expected in the future. The *World Development Report for 1992* took as its theme 'development and environment' (World Bank, 1992). In the year of UNCED, it reviewed the impact of economic growth on the environment. The conclusion was that some indicators worsened with rising income, some improved, and some were characterised by initial deterioration followed by improvement (i.e. by Kuznets-type curves).

In general, there is now evidence to suggest that environmental conditions *can* improve with development. Some air-quality trends are one indicator: it is well known, for example, that levels of smoke and sulphur dioxide in British cities have declined in recent decades. There are various other indicators, including, for example, improving wildlife conditions in some developed countries. Comparatively little attention has been focused on forest environments, although the concept of the forest transition has been put forward by Mather (1992) and Grainger (1995). This concept refers to the shift from declining to expanding forest trends that has characterised many developed countries over the last two centuries. Much of the limited work that has been undertaken on forests has been on tropical deforestation, rather than on more general trends at the global scale. The wider picture may thus have been overlooked.

The general character of the literature on trends in deforestation is reflected by Ekins (1997), who concluded that evidence for decelerating deforestation rates with increasing income is unconvincing. Cropper and Griffiths (1994) tested a model of a quadratic relationship between deforestation and per capita GDP for tropical countries experiencing deforestation. They found that there was some evidence for a 'hump-shaped' relationship between per-capita income and deforestation in Africa and Latin America (with turning points around $5000), but not for Asian countries. They are careful to add a note of caution: most of the countries they considered were characterised by rapid deforestation, and they suggest that it might be more accurate to say that rates of deforestation level off as income increases. Some other work is even less conclusive: for example, Shafik (1994) found that per-capita income had an insignificant effect on deforestation rate, with R^2 values close to or at zero depending on the functional form employed (linear, quadratic or cubic). On the other hand, Panayotou and Sungsuwan (1994) concluded that an increase in forest cover was correlated with an increase in provincial GDP in northeast Thailand. On the basis of cross-sectional analysis of tropical countries, Rudel (1994) suggested that variation

in GNP could explain a substantial amount of variation in deforestation only if countries were weighted by size. The picture is further complicated by results quoted by Capistrano (1994), who sub-divided the period between 1967 and 1985 into four periods of 4–5 years. In some of these periods, significant correlation was established between per-capita income and deforestation, and in others it was not. This was attributed to fluctuations in the global economy.

In relation to political 'development', an emerging consensus is easier to identify. Several workers, including Deacon (1994) and Didia (1997), have pointed to a relationship between rates of tropical deforestation and political climates. In general, high rates of deforestation have been associated with regimes in which democracy is poorly developed. The present paper contends that this pattern is confirmed at the global scale, and also suggests that a direct relationship exists between forest trends and development in general, including its economic, social and political dimensions. In comparison with Deacon (1994) and Didia (1997), the present paper eschews reliance on regression analysis alone in favour of a more broadly based approach using several techniques. It also expands the scope from the developing world to the global scale, and in so doing includes reforestation as well as deforestation. It emphasises relationships between forest trends and indicators of economic and social development as well as indicators of political climate. It also reports clearer and stronger relationships between forest trends and political indicators than were established by Deacon and Didia.

3. Approach

Most attempts to identify the roles of economic and political factors on forest trends have relied on some form of regression analysis, but many problems confront such work. These include technical difficulties arising from the mixing of stock and flow variables, from combining absolute and ratio variables, and from a variety of other sources including questions of normality of error-term distributions (e.g. Lambin, 1994, Firebaugh and Gibbs, 1985). Such problems may contribute to the diversity of results that characterise attempts at modelling deforestation: there is only limited agreement about the direction and strength of influence of hypothesised drivers. Another problem is that of collinearity. This problem is especially acute for variables relating to development, many of which are mutually correlated. The thrust of this paper, however, is that high levels of development in general (and not just its individual aspects or dimensions) are associated with favourable forest trends, and thus the isolation of the role of individual narrowly defined variables is less critical than it might otherwise be.

Problems of data on forest trends also arise. The analyses reported here are based on FAO Agrostat-PC, which offers coverage dating back to 1961. An evaluation of these data in comparison with other sets such as FAO's *Forest Resource Assessment* 1990 (FAO, 1995), which gives figures for change in forest area in the 1980s, is given in Needle (1995): the conclusion is that there is a strong degree of correlation between Agrostat and FRA90 data ($R^2 = 0.923$, $p = 0.000$, $n = 157$), and that no systematic bias exists. In addition to this check at the level of the data set as a whole, individual relationships were examined on a comparative basis, using Agrostats and FRA90 data: in other words, sensitivity analysis was employed in order to check whether an apparent relationship was simply a function of the data set employed. Examples of the comparative measures of the relationships using the respective data sets are discussed at the appropriate points in the text: the general outcome was corroboration. Nevertheless, it is acknowledged that data quality is sub-optimal.

In order to exclude the effects of countries with small forest areas (where small absolute changes could mean large proportional changes), countries with less than 1 million ha of forest and woodland were excluded. The dataset employed contained some 104 countries (pre-1990), which account for three-quarters of the world forest area (Appendix A). (Most of the remainder lies in the former Soviet Union, which was omitted because of the problems of data availability for its constituent post-1989 parts). It should be noted that the conclusions reached in this paper relate only to this 'population' of countries: they cannot necessarily be extrapolated to very small states or other excluded countries. In some of the analyses, the effective number of cases is slightly smaller because of lack of data for economic and political variables. The analyses reported in this paper are based on percentage change in forest area over a defined period (usually 1980–1990): positive changes indicate forest expansion, while negative changes relate to deforestation. This point is emphasised because 'deforestation' is a positively signed variable in many analyses reported elsewhere in the literature (i.e. high positive values indicate strongly negative trends). The use of percentages obviates some of the problems encountered in using absolute areas, including for instance those of scaling for size of country. (For example, Didia, 1997 attempted to adjust for variations in size of country by dividing the absolute deforested area by GNP and by population: the results of his analyses depended on which divisor was used, and serious conceptual issues arise from the use of each of the divisors.)

Problems of data and techniques are clearly acknowledged. The approach adopted in this paper is characterised by a search for corroboration: that is the robustness of results is checked by employing different techniques, by re-running analyses for different periods, and by using

alternative indicators of development. Because of the technical problems inherent in regression analysis in this context, reliance has not been placed on it alone. Instead, it has been complemented by other (usually simple) techniques that are discussed subsequently. Greater significance has been placed on the cumulative weight of evidence relating to development and forest trends than on relationships involving individual variables.

4. Developed world, developing world and forest trends

The developed and developing worlds have been characterised by contrasting trends in forest area over recent decades. Table 1 summarises the pattern: more than three-quarters of the developing countries experienced forest loss during the 1980s, while nearly three-quarters of the developed countries saw an expansion of their forest areas.

Relative proportions of urban and rural populations are one distinguishing feature of the developed and developing worlds. Favourable forest trends are associated with heavily urbanised countries (i.e. with low levels of rural population), as cross-tabulation (Table 2) and, to a lesser degree, regression analysis suggest. Overall, the inverse relationship between relative rural population and forest trends is weak ($R^2 = 0.066, n = 101, p = 0.009$) but it accords with the pattern indicated in Table 2. (It should be noted that adjusted R^2 values are used throughout.)

Several factors probably contribute to the explanation for the association of favourable trends with degree of urbanisation. One may be the lower degree of dependence on fuelwood; another is perhaps the lower likelihood of forest clearance for purposes of subsistence agriculture. While urban populations obviously require both food and fuel, their supply is likely to involve market mechanisms, and hence uncontrolled forest clearance and harvesting for purposes of subsistence are perhaps less likely than in the case of rural populations. In addition to these direct influences, however, there may well be other more indirect ones, connected to the relationship between urbanisation and the general process of development. As will be discussed in later sections of this paper, several variables representing economic, social and political development appear to be correlated with forest trends, and the role of urbanisation may well simply be as a proxy for development in general.

Table 2
Forest trends 1980–1990 and relative rural population, by country

Rural population (%)	Mean forest change (%)	Median forest change (%)	Number of countries
0–24	1.49	1.01	12
25–49	− 3.05	− 0.74	28
50–64	− 7.14	− 2.36	23
65–74	− 3.84	− 3.95	17
75 and over	− 6.66	− 7.07	22

Source: Forest trends compiled from FAO Agrostat-PC (please see text); rural population (1990) from UNDP (1992). Mean change is unweighted.

5. Forest trends and levels of economic growth

The relationship between forest trends and indicators of economic development is characterised in the literature by a degree of uncertainty and ambivalence. Nevertheless, the pattern summarised in Table 3 suggests that a positive relationship does indeed exist. Net reforestation is restricted to the richest group of countries. The table also suggests that rates of deforestation may at first rise with increasing income, before decreasing later. Deforestation rates peak in the income range $1000–1499, and relatively few countries with incomes of over $5000 experience forest shrinkage.

The relationship between forest trends and real GDP per capita is illustrated in Fig. 1. Regression analysis confirms the existence of a statistically significant relationship ($R^2 = 0.140$, $p = 0.0004$, $n = 87$). When forest-change data for the same set of countries are taken from FRA90 instead of FAO Agrostat, a similar R^2 value of 0.136 is obtained.

A similar pattern also emerges when per capita GNP (market exchange rates) is used as the indicator of income in place of GDP (purchasing power parity), and again confirmation is offered by regression analysis ($R^2 = 0.117$, $p = 0.0012$, $n = 87$). Very similar values are

Table 1
Forest trends 1980–1990 (% change): developing and developed countries

	Mean	Median	No of countries	% countries with net reforestation	% countries with net deforestation	% countries with zero change
Developing	− 6.19	− 3.98	80	8.8	77.5	13.8
Developed	+ 2.20	+ 0.84	24	70.8	20.8	8.3

Source: Compiled from FAO Agrostat-PC (please see text). Mean change is unweighted. (Developed and developing countries as defined by FAO (see Appendix A).)

Table 3
Forest trends (% forest change 1980–1990) and real per capita GDP (ppp), by country

Real GDP pc (US$) 1990	Mean	Median no	No. of countries	No. with net deforestation	No. with net reforestation	No. with zero change
< 750	− 6.76	− 4.20	15	13	1	1
750–999	− 5.29	− 3.26	8	7	0	1
1000–1499	− 9.86	− 7.82	14	12	1	1
1500–4999	− 4.94	− 1.25	28	21	4	3
5000–12499	− 1.79	− 0.68	8	4	4	0
12500 & over	+ 1.97	+ 0.23	14	4	8	2

Source: Real per capita GDP from UNDP (1991); forest data from FAO Agrostat-PC; (means unweighted).

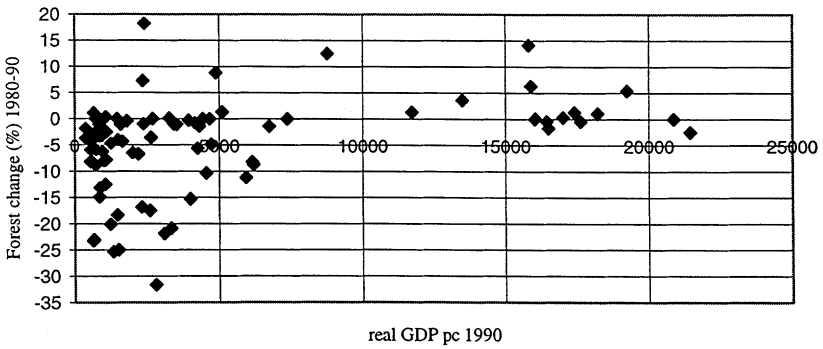

Fig 1. Forest change and real GDP per capita ($) 1990.
Source: real per capita GDP from UNDP (1991); forest data from FAO Agrostat-PC.

obtained when 1985 data for GDP and GNP are substituted for 1990 data. In short, the conclusion is that forest trends tend to become more favourable with increasing income: in other words, for environmental impact in the sense of deforestation, it can be argued that the sign of the 'affluence' factor in the Holdren–Ehrlich equation should be reversed. It should be noted that the argument that rich countries enjoy favourable forest trends because they import their forest products from other lands is unconvincing overall, even if it is more plausible in some cases. Of the 12 richest countries, as measured by real GDP in 1990, six were net importers of forest products and six were net exporters (by 1992, the ratio was five to seven, as USA had switched from importer to exporter) (data from FAO Agrostats).

6. Forest trends and rates of economic growth

If richer and poorer countries are associated, respectively, with net reforestation and net deforestation, what is the nature of the relationship between *rates* of economic growth and rates of change in forest area? It is sometimes suggested that the relative contribution of natural resources to economic growth is greatest in the early stages of economic development (e.g. Chenery, 1965), and that short-term economic growth (as indicated by conventional measures such as GDP) can be achieved through the non-sustainable exploitation of forests and other resources or the conversion of natural capital into income (e.g. Repetto, 1992). On this basis, therefore, we might expect countries experiencing rapid economic growth to be characterised by rapid loss of forest area. There is little evidence, however, for such a hypothesised relationship: indeed there is some support for the converse. Countries enjoying rapid growth appear also to have generally more favourable trends in forest area than their slower-growing counterparts. Analyses relating to different time periods and different indicators of economic growth support this view. For the period between 1960 and 1990, rate of growth in real per capita GDP is positively correlated with forest trends ($R^2 = 0.133$, $p = 0.0008$, $n = 81$). For the period from 1980 to 1990, growth in per capita GNP is also positively correlated with forest trends ($R^2 = 0.119$, $p = 0.0013$, $n = 84$). There is little support, therefore, for the view that rapid economic growth is linked to rapid forest loss, and more support for the opposing view that it is associated with slow forest loss or with forest expansion. Deacon (1994) found that the relationship between deforestation rate and income growth was extremely weak (with correlation coefficients of 0.1 or less, depending on how the model was specified (i.e. corresponding to R^2 values of 0.01)) and statistically insignificant, but that the signs were

negative. In other words, his results were partly in agreement with those of this paper: rapid deforestation tended to be accompanied by slow or negative economic growth, rather than by rapid growth. This in itself does not necessarily mean that consumption of natural (forest) capital plays no part in income growth: it may do so, but the positive effects of other factors correlated with economic growth are apparently stronger.

The notion that rapid growth can be achieved by converting forest capital into income has an attractive simplicity, although it is not supported by the evidence just presented. Explanation of the opposing view is more difficult, and may involve a variety of factors. One may be the substitution of fossil fuel for fuelwood and charcoal, with a corresponding reduction in direct demands on the forest. A second may lie in the increasing urbanisation of the population as economic development proceeds. Such a process might not only favour the adoption of fossil fuels in place of fuelwood, but might also result in the abandonment of some areas of cropland, and subsequent reforestation through regeneration or planting. While the distribution of the population between urban and rural areas does not affect total demand for food, it may have an effect on how the food is procured. Urbanised populations are likely to depend more strongly on market sources. With growth in the relative importance of commercial agricultural and the development of transport links to urban markets, areas of marginal cropland may be abandoned (Mather and Needle, 1998). An example of this general principle has recently been reported from Malaysia by Vincent and Ali (1998): as rural youth migrated to the cities, some marginal land has been taken out of production and has begun to revert to secondary forest.

A growing urban and middle-class segment of the national population could also mean changing perceptions of the forest (and increasingly positive views of it in relation to wildlife conservation and recreation). There is some evidence that such a trend has been underway in recent years in some southeast Asian countries such as Thailand (e.g. Hirsch and Lohmann, 1989) and Indonesia (e.g. Cribb, 1988), just as it operated a century ago in the United States (Williams, 1989). The effects of these changes in perceptions and lifestyles, would, of course, be mediated through political channels, which may themselves evolve as development proceeds.

Before we consider the relationship between forest trends and political settings, another aspect of development is reviewed. Table 4(1) summarises the pattern of forest change analysed by type of economic system, using the classification of Gastil (1979).

Only the briefest outline of the categories of economic systems can be given here: for further discussion please see Appendix B and Gastil (1979). 'Inclusive capitalist' countries are states that rely on the operation of the market, with government involvement limited to regulation and subsidy. In contrast, 'noninclusive capitalist' countries had (at the time of classification) not more than half of their population in a modern capitalist economy, with the remainder of the population living traditionally. The direction of change as development proceeds and new areas are integrated into market economies is capitalistic.

Market integration is sometimes cited as a major factor in environmental degradation (e.g. McNeill, 1992). As an area is integrated into a wider economy for the first time, pressures on the local environment increase with the concentration of large-scale, specialised production. The high rates of forest loss associated with this group of

Table 4(1)
Economic systems and forest trends 1970–1990, by country

Economic system	Mean forest change (%)	Median forest change (%)	Number of countries
Capitalist inclusive	− 3.40	+ 0.32	18
Capitalist noninclusive	− 16.40	− 11.96	23
Capitalist – statist	− 9.41	− 8.34	20
Capitalist – socialist	− 1.14	− 2.16	21
Socialist	− 5.84	− 4.83	19

Source: Economic system as classified by Gastil (1979); please see text. Forest data from FAO Agrostat-PC. (means unweighted).

Table 4(2a)
Distribution of countries, by economic system and forest trends 1980–1990. Forest trends 1980–1990 (%)

	> 0	− 4.9–0%	< −5%	Total
Capitalist inclusive	9	5	4	18
Capitalist noninclusive and statist	5	17	21	43
Socialist and capitalist–socialist	10	20	10	40
Total	24	42	35	101

Chi-squared = 13.83, df = 4, contingency coefficient 0.347, significance 0.0079.

Table 4(2b)
Distribution of countries, by economic system and forest trends 1970–1980

	> 0	− 4.9–0%	< − 5%	Total
Capitalist inclusive	8	5	5	18
Capitalist noninclusive and statist	3	23	17	43
Socialist and capitalist–socialist	13	17	10	40
Total	24	45	32	101

Chi-squared = 13.06, df = 4, contingency coefficient 0.338, significance 0.011.
Source: Economic system as classified by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

countries also accords with the view that deforestation rates may peak during early stages of development. One contributory factor may be the existence of what Parnwell and Bryant (1996) describe as 'crony capitalism', whereby 'cronies' of the political élite benefit from government decisions and actions. More generally, neocolonialism may also be a significant factor in some cases. By implication, colonialism was associated with much 19th century deforestation in what is now defined as the developing world (e.g. Tucker and Richards, 1982), and it has also been implicated in the earlier deforestation of Ireland (e.g. Neeson, 1991). The distinctive feature of capitalist–statist countries is the existence of major government involvement in the economy, including the running of productive enterprises by governments. Capitalist–socialist states are characterised by more extensive government involvement in social spheres.

If the data from which Table 4(1) is compiled are reworked in grouped form and then cross-tabulated as in Table 4(2a) and (2b), an apparent association is confirmed for both 1980–1990 and 1970–1980. Capitalist inclusive countries stand out in terms of the relative numbers undergoing reforestation, while the other groups are characterised by deforestation.

Type of economy is obviously not the only variable affecting forest trends: as usual in this field, any attempt to hold all other factors constant in order to isolate its influence is frustrated by the very small numbers of countries that inevitably result in each category, and the consequent impossibility of generalisation. Tables 4(1) and 4(2) do suggest, however, that wide variations in forest trends are associated with different types of economy, and that these trends are more favourable (i.e. less unfavourable) in capitalist–socialist and capitalist inclusive economies than in other types. Johnston (1996) suggests that 'The fundamental question that we face is whether equilibrium with the environment is possible within the capitalist mode of production' (p. 244). At first sight, Table 4(1) offers no clear evidence that it is possible: all systems appear to be associated with deforestation and none is wholly associated with stability or expansion of the forest area. Table 4(2), however suggests, that around half of the 'capitalist–inclusive' countries have positive forest trends.

7. Human development and forest trends

The contention that development cannot be measured by income alone was acknowledged by the United Nations Development Programme when it introduced a new human development index (HDI) in its *Human Development Report for 1990* (UNDP, 1990). The HDI is a composite, synthetic indicator based on the three components of longevity, knowledge and income. Longevity is measured by life expectancy at birth. Measurement of knowledge is based on two factors, adult literacy (weighted two-thirds) and average number of years of schooling (one-third). Income is measured by 'adjusted' GDP per capita, on a basis which assumes diminishing returns from rising income: that is, an extra dollar to a rich person has less effect than to one on the poverty line. For each country, each of the three variables is quantified in manner that relates the country to the highest and lowest values in the respective ranking, and a composite index is then obtained. This index (HDI) is relative rather than absolute, in that it relates each country to its global context. Full accounts are given in UNDP (1991 and subsequent years).

An enormous literature has been generated on the HDI and its validity (see, for example, Hopkins, 1991; Kelley, 1991; Lind, 1992; and McGillivray, 1991 for initial reactions, and UNDP, 1993; Streeten, 1995 for subsequent reviews). The focus of this paper is not on HDI per se, but on the relationship between it, as a well-known indicator of development, and forest trends. HDI is correlated with per capita GDP (e.g correlation coefficient for 1990 is $+0.804$), and it is therefore not surprising that a positive relationship can be demonstrated. Countries with high HDI values in general have favourable forest trends (Table 5).

When HDIs for 1990 are employed in place of those for 1985, the picture of decelerating deforestation with rising HDI becomes even clearer (for countries with 1990 HDIs between 0.750 and 0.899, the mean and median are respectively -1.88 and -1.40%). Regression analysis confirms the pattern, with $R^2 = 0.106$ ($p = 0.0008$, $n = 102$) for the linear relationship. Using HDI data for 1985, instead of 1990, the result is almost identical: $R^2 = 0.105$, $n = 85$).

The relationship between forest trends and HDI is slightly weaker than that between forest trends and GDP. One possible reason is that the social variables incorporated in the HDI tend to change more slowly than GDP. Forest trends are correlated separately with each of social variables contributing to HDI, but in each

Table 5
Human development index and forest trends 1980–1990, by country

HDI 1985	Mean forest change 1980–1990 (%)	Median forest change 1980–1990 (%)	Number of countries
0–0.149	− 3.97	− 3.23	4
0.150–0.249	− 7.87	− 5.26	12
0.515–0.499	− 6.24	− 4.29	19
0.500–0.749	− 9.42	− 6.63	15
0.750–0.899	− 8.92	− 8.50	8
0.900 and over	+ 2.02	+ 0.74	24

Source: HDI from UNDP (1991); forest trends from FAO Agrostat-PC (unweighted means).

case the relationship is weaker than that with GDP (life expectancy $R^2 = 0.073$, $p = 0.006$, literacy $R^2 = 0.045$, $p = 0.03$ and mean years schooling $R^2 = 0.093$, $p = 0.002$, $n = 102$ for all three). It may be noted also that the relationships between forest trends and raw and adjusted GDP figures (i.e. GDP as adjusted for HDI) are almost identical ($R^2 = 0.129$ and 0.127, respectively). Overall, the introduction of social indicators alongside GDP per capita does not increase the level of statistical explanation of forest trends.

It has been shown that forest trends are positively correlated with trends (i.e. change in time) in GDP. The relationship between forest trends and trends in HDI is weaker: the relationship between the respective trends for the period 1970–1990 is not statistically significant. While it cannot be concluded that forest trends are positively correlated with trends in HDI, there is no evidence to support the converse notion that rapid development is associated with extensive forest loss.

Overall, this section of the paper presents some evidence to suggest that favourable forest trends are associated with higher levels of economic development (as defined by income) and of other dimensions of human development. Individual indicators of social development are also correlated with forest trends, but their relationships are weaker than those involving economic development. The indicators of social development employed in these analyses are personal (e.g. literacy) rather than structural, and although they may be correlated in general terms with the development of societal and political institutions, they do not necessarily represent that development directly. In the next section, the relationship between forest trends and various dimensions of political development is considered.

8. Type of government, political development and forest trends

Forest trends are associated with various political factors, including type of government and the general political climate. Table 6 gives the results of an analysis of forest trends in relation to political systems, using a classification suggested by Gastil (1979) (see Appendix B) and based on number of political parties as an indicator of democracy.

Table 6(1) clearly suggests that forest trends are more favourable in countries with multiparty political systems than in other countries. A similar pattern emerges when the data are reworked and cross-tabulated in a different form (Table 6(2)).

It also pertains when forest trends from 1970–1980 are used, emerges when a different and independent classification is used, based on the authors' interpretation of recent yearbooks (RIS, 1994). For the period from 1980 to 1990, the mean and median forest changes in

Table 6(1)
Forest trends (1980–1990) and political system, by country

Political system	Mean forest change (%)	Median forest change (%)	Number of countries
1 Multiparty	0.057	0	36
2 Dominant party	− 11.22	− 7.44	8
3 One party	− 5.10	− 2.84	39
4 Nonparty	− 8.68	− 4.80	18

Source: Political system as classified by Gastil (1979); please see text. Forest data from FAO Agrostat-PC (means unweighted).

Table 6(2)
Distribution of countries, by political system and forest trends 1980–1990

Political system	> 0	− 4.9–0%	< − 5%	Total
Multiparty	15	15	6	36
One or dominant party	7	20	20	47
Nonparty	2	7	9	18
Total	24	42	35	101

Chi-squared = 13.100, df = 4, contingency coefficient 0.339, significance 0.011.
Source: Political system as classified by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

'democratic' countries thus defined are − 2.45 and − 0.93% respectively, compared with the corresponding figures for countries under military governments of − 9.46 and − 7.48%. Corruption is, of course, not peculiar to any one type of political system. There may, however, be greater opportunities for it in some systems than in others, and in particular in nondemocratic systems. Its role in the forest-products industry in southeast Asia in particular has attracted much attention (e.g. Cameron, 1996; Dauvergne, 1993; Kummer, 1992a, b).

A similar pattern emerges in Table 7(1), which relates forest trends to political rights. Again a classification devised by Gastil (1979) is employed. The scale (1–7) encompasses countries with 'fully competitive electoral process' at the high end (1), and those with 'political despots at the top [who] appear by their actions to feel little constraint from either public opinion or popular tradition' (7) (p. 19). Again, the pattern survives the reworking of the raw data in a different form, as Table 7(2) confirms.

Again the countries with the highest level of development of political rights tend to have the most positive forest trends. (The substitution of Gastil's (1989) classification data for those of 1979 yields a similar outcome, as does the use of forest-trends data for 1970–1980 instead of those for 1980–1990 (chi-squared = 22.86, contingency coefficient 0.4314, significance 0.0002.)

The relationships between forest trends and the extent of civil liberties and freedom status are summarised in

Table 7(1)
Political rights and forest trends (1980–1990), by country

Political rights	Mean forest change (%)	Median forest change (%)	No. of countries
1	+ 0.15	+ 0.05	12
2	+ 1.42	0.00	16
3 & 4	− 5.98	− 4.88	9
5	− 9.77	− 6.63	19
6	− 6.07	− 3.04	20
7	− 4.47	− 2.18	24

Source: Political rights as classified by Gastil (1979); please see text. Forest data from FAO Agrostat-PC (means unweighted).

Table 7(2)
Distribution of countries, by political rights and forest trends 1980–1990. Forest trends 1980–1990 (%)

Political rights	> 0	− 4.9–0%	< − 5%	Total
1–2	12	12	4	28
3–5	3	10	15	28
6–7	8	20	16	44
Total	23	42	35	100

Chi-squared = 13.69, df = 4, contingency coefficient 0.347, significance 0.008.
Source: Political rights as defined by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

Tables 8 and 9, and again the patterns are similar to those previously described. Forest trends appear to be correlated with well-developed civil liberties and free status, but it is noticeable that the most adverse trends are again associated with the intermediate (rather than the lowest) categories.

For 1970–1980, the association is even stronger. Almost two-thirds of the countries in the top civil-liberties group had positive forest trends, while almost 90% of those in the lowest group had negative trends (Chi-squared = 28.07, df 4, contingency coefficient 0.468, significance 0.00001).

In his 1989 volume, Gastil introduced a numerical indicator of freedom in place of his simple threefold classification as shown in Table 9. The indicator was the sum of the separate indices of political rights and civil liberties. As might be expected from the relationship between forest trends and these variables, the relationship between forest trends and freedom rating was positive: countries that were highly rated in terms of freedom tended to have favourable forest trends.

If there should be any remaining doubt that more favourable forest trends are associated with countries with relatively benign political climates, much of it should be dispelled by Tables 10(1) and 10(2). Here forest trends are analysed by countries grouped on the basis of level of political terror (as defined by Gastil, 1979: please

Table 8(1)
Civil liberties and forest trends (1980–1990), by country

Civil liberties	Mean forest change (%)	Median forest change (%)	No. of countries
1	+ 0.73	0.00	11
2	+ 1.02	+ 0.02	12
3	− 4.54	− 4.59	9
4	− 8.70	− 8.11	12
5	− 7.85	− 2.88	20
6	− 3.49	− 2.57	18
7	− 5.55	− 3.47	18

Source: classification of civil liberties as defined by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

Table 8(2)
Distribution of countries, by civil liberties and forest trends 1980–1990. Forest trends

Civil liberties category	> 0	− 4.9–0%	< − 5%	Total
1–2	11	10	2	23
3–5	6	15	20	41
6–7	6	17	13	36
Total	23	42	35	100

Chi-squared = 15.35 df = 4, contingency coefficient 0.365, significance 0.004.
Source: Civil liberties as defined by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

Table 9(1)
Status of freedom and forest trends (1980–1990), by country

Status of freedom	Mean forest change (%)	Median forest change (%)	No. of countries
Free	+ 0.09	0.00	28
Partly free	− 9.11	− 6.63	33
Not free	− 4.30	− 2.29	39

Table 9(2)
Distribution of countries, by status of freedom and forest trends 1980–1990

Status of freedom	> 0	− 4.9–0%	< − 5%	Total
Free	12	12	4	28
Partly free	4	11	18	33
Not free	7	19	13	39
Total	23	42	35	100

Chi-squared = 15.40, df = 4, contingency coefficient 0.361, significance 0.005.
Source: Civil liberties as defined by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

Table 10(1)
Level of terror and forest trends (1980–1990), by country

Level of terror	Mean forest change (%)	Median forest change (%)	No. of countries
A	+ 1.09	0.00	20
B	− 5.53	− 4.06	18
C	− 5.53	− 4.29	33
D & E	− 6.74	− 3.47	26

Source: classification of level of terror after Gastil (1979); forest trends from FAO Agrostat-PC.

Table 10(2)
Distribution of countries, by level of terror and forest trends 1980–1990

Level of terror	> 0	− 4.9–0%	< − 5%	Total
A	9	10	1	20
B	6	4	8	18
C	6	12	15	33
D + E	3	13	10	26

Chi-squared = 15.638, df = 4, contingency coefficient 0.373, significance 0.015 (the corresponding figures for forest trends for the period from 1970 to 1980 are 30.00, 4, 0.486, 0.0004).
Source: Level of terror as defined by Gastil (1979); please see text. Forest data from FAO Agrostat-PC.

see Appendix B). Level A relates to secure rule of law, and includes countries where people are not imprisoned for their political views. At the other end of the spectrum, Nazi Germany and Stalinist Russia would exemplify Level E (Gastil includes only five countries in Level E: in this analysis E has therefore been grouped with D). Little difference emerges between the countries on Levels B–E, but Level A countries, with arguably the most highly developed political systems, stand out in having the most favourable forest trends.

Corroboration of the patterns outlined in this section of the paper comes from examination of the relationship between the human freedom index (HFI) and forest trends (Table 11). The issue of human freedom and its measurement is discussed in the *Human Development Report for 1991* (UNDP,1991), where HFI data for 1985 are presented for some 88 countries. UNDP (1991) reviews the problems encountered in measuring human freedom, and concludes that such measurement 'will always be a precarious exercise' (p. 19). It is noticeable that subsequent volumes of the *Human Development Report* do not contain data on HFI. On its own, the relationship between HFI and forest trends should be viewed with caution, but it is apparent that similar patterns emerge in relation to several indicators of political development.

Countries with a high freedom ranking (HFIs over 30) tend to have favourable forest trends, while the converse is true of countries with medium and low rankings. Some

Table 11
Human freedom index and forest trends (1980–1990), by country

Human freedom index	Mean forest change (%)	Median forest change (%)	No. of countries
31 & over	+ 0.96	+ 0.04	13
16–30	− 3.72	− 1.68	13
11–15	− 5.28	− 5.62	11
6–10	− 5.32	− 2.84	19
5 & under	− 3.67	− 2.76	10

Source: Human freedom index from UNDP (1991); forest trends from FAO Agrostat-PC

east European countries are anomalous, in the sense that they have more favourable forest trends than might be expected from their very low (1985) freedom rankings. When these countries are excluded, a weak relationship that is statistically significant at the 5% level emerges between forest trends and HFI ($R^2 = 0.088$, $p = 0.02$, $n = 60$). It is noticeable that the exclusion of these countries from analyses using Gastil's data also has the effect of apparently strengthening the relationship: in other words, they are anomalous in the sense of having more favourable forest trends than would be expected from their political climates.

9. Discussion

The *Human Development Report for 1991* concludes that the promotion of human development does not require the sacrifice of freedom: indeed UNDP (1991) perceived a high correlation between human development and human freedom, although it was uncertain about the nature of any causal link. Similar conclusions might be reached on the relationship between forest trends and political development: the achievement of the latter, including its dimension of freedom, apparently does not preclude the achievement of favourable trends in the former.

The results presented in this paper accord with some of those for comparable work reported in the literature. For example Deacon (1994) concluded that deforestation (for his study period 1980–1985) was correlated with insecure property rights, as well as with population growth. He considered that insecure property rights were, in turn, linked to unstable political environments, and employed a range of indicators such as guerrilla warfare and revolutions as proxies. In most cases, he found that deforestation was correlated, albeit weakly, with these indicators. In other words, deforestation rates were lower in politically more stable countries. Didia (1997) reports a R^2 value of 0.13 for the relationship between his measure of average annual deforestation in 55 developing countries (1981–1985) and a synthetic 'democratic' index. He considers the conclusion that 'as a country becomes

more democratic, we can expect a reduction in the rate of tropical deforestation' is 'quite logical' (p. 71), as the growth of democracy is likely to be accompanied by the evolution of favourable structures, institutions and political processes. He includes in these the activities of environmental interest groups, market mechanisms, elections and a free press: in other words, the influences range beyond the security of property rights on which Deacon focused.

At first sight, authoritarian regimes might seem more favourable to positive forest (or other environmental) trends than democratic conditions. But history records few environmentalist dictators: authoritarian regimes may have the power of coercion, but tend to lack the motivation to direct it to environmental ends. In some cases there may also be an awareness of the impermanence of an authoritarian regime, and a corresponding desire to convert forests to other forms of capital before power is lost. On the other hand, many problems of forest management are incremental in nature, and their long-term character does not seem congruent with the short terms of office of most democratic governments. Nevertheless, the flourishing of civil society under democratic climates may be an important factor, as it can bring pressure to bear both on the state and on economic actors through protests, campaigns and boycotts (e.g. Dryzek, 1996). There is little doubt that such pressure has been significant in now-developed countries, and the recent growth of environmental groups and the championing of environmental causes by the media in some southeast Asian countries (e.g. Parnwell and Bryant, 1996) are encouraging signs. Furthermore, environmental issues in many countries have led to an expansion of democratic institutions and an opening of bureaucratic decision-making to public participation (Paehlke, 1988): for example, the environmental movement is considered by Gadgil and Guha (1994) to have added a new dimension to Indian democracy and civil society. In other words, the relationship may be two-way and mutually reinforcing. And even if public opinion is ill-informed, ambivalent or complacent, democratic governments may be accessible to 'functional élites' (Lafferty and Meadowcroft, 1996), including groups such as the scientific community or land owners, and hence may be persuaded to take effective action on matters of forest policy. There is supporting evidence for the operation of this process in countries such as Denmark, France, Switzerland and the UK, where positive trends in forest area became established in the 19th or early 20th centuries (e.g. Mather et al., 1998).

10. Conclusion

This paper has sought to demonstrate that favourable forest trends (defined as stable or expanding forest areas) are associated with high levels of economic, social and political development. The presence of multicollinearity means that the relative contribution of different development variables is difficult to isolate: the theme of the paper is that development, as a multifaceted process, is the key factor. Hirsch (1987) argues that deforestation in Thailand can only be understood in relation to the overall process of development in that country. This paper presents a similar argument in relation to favourable forest trends, of which reforestation is the clearest expression.

Economic development, political evolution and environmental relations are closely intertwined: cause and effect cannot easily be separated. Environmental issues can stimulate political development, as has been indicated. Economic and political dimensions of development are also linked: for example Barro (1991) concludes that indicators of political turmoil are inversely correlated with rates of economic growth. Scully (1988), using the same political data from Gastil as this paper, suggests that politically open societies have grown at up to three times the rate of those in which freedoms are limited. Affluent societies have been able to provide both the funding and the knowledge that may be required for the kind of forest policy and management necessary for favourable forest trends, and the democracies with which they are associated can provide the setting in which that policy and management can be implemented.

Development, it seems, should be viewed as a positive influence on forest sustainability rather than as a negative factor. There may be some evidence of a strengthening of unfavourable trends in forest areas during early or intermediate stages of development, and to this extent the conclusions of this paper are not in conflict with those of Hirsch (1987). Much clearer than the evidence for Kuznets-type curves, however, is that for the association of favourable trends in forest area with high levels of economic, social and political development. It does not follow, of course, that everything that happens in the course of development necessarily leads to favourable trends, or that a sprint for development will ensure forest stability. The evidence suggests, however, that there is no fundamental contradiction between development and forest sustainability (at least on the criterion of areal trends). On the contrary, it would seem that human capital and natural capital can grow concurrently. Daly (1995) emphasises the complementarity of human and natural capital. The evidence presented in this paper points to another dimension of this complementarity: favourable trends in human 'capital' (in the widest sense, including political and institutional factors) are accompanied by favourable trends in forest 'capital', at least in terms of area.

The notion that the welfare of humans and nature is linked in not new: for example, Kay (1988) reviews it in the context of the Hebrew Bible. It is a notion, however,

that is not prominent in modern discourses of development and sustainability, where assumptions that environmental goals are incompatible with goals of human development are deep-seated. The evidence relating to forest trends would suggest that the achievement of the welfare of nature does not necessarily involve the sacrifice or surrender of human welfare. In essence, the conclusion is that conditions that are favourable for humans are also favourable for forests.

Appendix A. Dataset countries

(please see text for criteria)

Afghanistan
Albania
Angola
Argentina
Australia*
Austria*
Bangladesh
Belize
Benin
Bhutan
Bolivia
Botswana
Brazil
Bulgaria*
Burkina Faso
Cambodia
Cameroon
Canada*
Central African Rep
Chad
Chile
China
Colombia
Congo
Costa Rica
Cuba
Czechoslovakia*
Côte d'Ivoire
East Timor
Ecuador
Equatorial Guinea
Ethiopia
Fiji
Finland*
France*
French Guyana
Gabon
Germany*
Ghana
Greece*
Guatemala
Guinea
Guinea-Bissau
Guyana
Honduras
Hungary*
India
Indonesia
Iran, Islamic Rep
Iraq
Italy*
Japan*
Kenya
Korea DPR
Korea Rep
Laos
Liberia
Madagascar
Malawi
Malaysia
Mali
Mauritania
Mexico
Morocco
Mozambique
Myanmar
Nepal
New Zealand*
Nicaragua
Niger
Nigeria
Norway*
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland*
Portugal*
Romania*
Senegal
Sierra Leone
Solomon Island
Somalia
South Africa
Spain*
Sri Lanka
Sudan
Suriname
Sweden*
Switzerland*
Tanzania, United Rep
Thailand
Togo
Turkey*
USA*
Uganda
UK*
Venezuela
Viet Nam
Yugoslavia SFR*
Zaire
Zambia
Zimbabwe

*classed as 'developed' by FAO

Appendix B. Categories employed by Gastil (1979) (definitions paraphrased)

B.1. Economic systems

Inclusive capitalist: Generally developed states that rely on the operation of the market; government interference generally limited to subsidy and regulation.

Noninclusive capitalist: As above, but not more than 50% of population are included in a capitalist modern economy (the remainder continue to live traditionally); the direction of change is capitalistic.

Capitalist–statist: Characterised by large government productive enterprises, either because of an elitist development philosophy or major dependence on a key resource such as oil.

Capitalist–socialist: Characterised by provision of social services on a large scale through governmental or other nonprofit institutions; private control of property sacrificed to egalitarian purposes.

Socialist: Characterised by striving to place national economy under direct or indirect government control.

B.2. Political rights

(1) Fully competitive electoral system and those elected clearly rule.
(2) Electoral process works but impaired by extreme economic equality, illiteracy or intimidation.
(3–5) (progressively) Less effective implementation of democratic processes. Governments of states rated 5 sometimes have no effective voting processes, but strive for consensus among a variety of groups in society in ways weakly analogous to those of democracies.
(6) Competitive electoral processes not permitted. Rulers of states at this level do, however, respond to popular desire in some areas, or respect societal belief system (e.g. Islam).
(7) States with political despots who feel little constraint from popular opinion or tradition.

B.3. Civil liberties

(1) Publications are not closed because of expression of rational political opinion; courts protect the individual and persons are not imprisoned for their opinions.
(2) Similar to (1) but with more authoritarian traditions and less institutionalised set of liberties.
(3–5) *States at these levels may have varying forms of censorship and political prisoners.*
(6) States at this level almost always have political prisoners; the media are under government supervision, and there is no right of assembly.
(7) As for (6), but in addition there is pervading fear and little independent expression takes place even in private.

B.4. Freedom

(synthesised from political rights and civil liberties).

Free: States in classes 1 and 2 of political rights and civil liberties.
Partly free: States in classes 3–5.
Not free: States in classes 6 and 7.

B.5. Terror

Level A: Secure rule of law; people are not imprisoned for their views; no detention without trial, and laws protect individual and group rights.

Level B: Limited amount of imprisonment for non-violent political activity; few persons are affected, torture and beatings are exceptional, and psychiatric institutions are not used to silence political opponents.

Level C: Extensive political imprisonment; executions and brutality are common and go largely unpunished; ubiquitous security police; incarceration in mental hospitals may supplement imprisonment.

Level D: As for Level C, but practices are extended to greater numbers; murder and torture common; large-scale incarceration of ideological opponents (but terror mainly restricted o those who interest themselves in politics or ideas).

Level E: Terrors of Level D extended to the whole population.

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