



## Population pressure = forest degradation: an oversimplistic equation?

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*Reconsidering the relative importance of population pressure, market forces and institutions on forest conditions, based on an analysis of village-level forest management councils in Kumaon in the Indian Lesser Himalayas.*

This article addresses one of the most controversial issues related to resource management: how and to what extent do population pressures affect resource use? The article begins by examining the often conflicting literature on the topic and then considers a regression analysis of actual data to determine the relative impact of three variables - population, market forces and institutional arrangements on forest conditions.

### The study area

The research on which this article is based was conducted in Kumaon, in the Indian Lesser Himalayas. Kumaon comprises the three districts of Almora, Pithoragarh and Naini Tal (Fig. 1) where more than 5 000 forest panchayats (village-level management councils) formally control the use of nearly 30 percent of the forests (Table 1). These forest councils are among the more autonomous village-level resource management institutions in India. They create the rules for day-to-day management of their forests in frequent meetings and officials in charge of the panchayats are elected by village residents. Data for the research were collected using a simple two-page questionnaire, mailed to 600 forest councils in the Almora and Pithoragarh districts. These districts contain more than 93 percent of the forest councils in the region and have also kept current address lists for their councils. Of the mailed questionnaires, 142 were returned by the post office as undeliverable, 145 were not returned by the *panchayats* and 34 responses were incomplete. The statistical analysis presented is based on the 279 completed questionnaires.

The forest councils came into being as a result of widespread popular demand in the early 1900s. Between 1840 and 1910, the British, viewing the forests as a valuable commercial resource, brought under their control most of the forests in Kumaon more than 60 percent of the entire land area. In the process, they proscribed and greatly limited the customary subsistence rights that villagers possessed. The colonial government's forceful change of existing property rights was perceived as theft and looting by the local communities who responded with sustained popular resistance (Guha, 1989; Rawat, 1977; Weber, 1989). In 1922, the government was finally forced to appoint the Kumaon Forests Grievances Committee to look into the demands of the local populations. Following its recommendations'

the *Van Panchayat* Act (Forest Councils Act) was passed in 1931, which permitted villagers to form relatively autonomous management committees, called *Van Panchayats* (forest councils), and restored significant areas of hill forests to their control (for a detailed discussion of this act, see Ballabh and Singh, 1988).

### [A panoramic view of a portion of Kumaon in the Indian Lesser Himalayas](#)

#### [FIGURE 1 Research area: the districts of Almora, Pithoragarh and Naini Tal in Kumaon](#)

The forest management councils of Kumaon provide an excellent opportunity to test empirically the extent to which different factors contribute to particular patterns of resource use. The villages studied are all located in the same administrative division (Kumaon) and have been subject to the same law - the *Van Panchayat* Act of 1931. Government regulations, therefore, are unlikely to have influenced the variations in village-level outcomes. The villages studied are mainly situated at altitudes of between 1 200 and 2 400 m, with similar ecological conditions as well as similar economic livelihoods. The different types of resource management outcomes, it may then be inferred, are a consequence of changing levels of population pressure at the village level, variations in the exposure of villages to market forces and local differences in institutional arrangements.

## Conflicts in the literature

### The overpopulation thesis

Concern with population pressures is ubiquitous in literature on deforestation, soil degradation, loss of biodiversity, threats to future peace and stability, food scarcities, global warming and underdevelopment. Many scholars focus on overpopulation when they analyse resource use (Abernathy, 1993; Avise, 1994; Holdren, 1992; Meffe, Ehrlich and Ehrenfeld, 1993; Wilson, 1992). According to Wilson, "the raging monster upon the land is population growth. In its presence, sustainability is but a fragile theoretical construct". A policy document from the World Bank affirms that "the causes of environmental degradation are as varied as its manifestations. But at the heart of the problem is the rapid rate of population growth in many developing countries" (World Bank in Banuri and Marglin, 1993).

**TABLE 1. Distribution of forest *panchayats* in Kumaon districts**

District	Number of panchayats	Area(km <sup>2</sup> )	Total forest cover(percentage)
Naini Tal	202	217	5.5
Almora	1719	2 959	75.1
Pithoragarh	1056	1001	30.2
Overall	2 977	4177	37.2

*Sources (following order of first column):* data on forest *panchayats* compiled by Pithoragarh District Collectorate in 1993; data on forest *panchayats* compiled by Almora District Collectorate in 1992; Ballabh and Singh (1988).

Two themes in the literature about overpopulation merit a critical focus: the concern with population growth in the developing world and concern with the activities of the numerous small producers who use land. Wilson (1988) asserts, "exploding human populations are degrading the environment at an accelerating rate, especially in tropical countries".

"Many environmental problems," Bilborrow and DeLargy (1991) remark, "including elimination of tropical forests and reductions in biodiversity, are most clearly evident in the Third World". Li (1991) claims that "the most important thing the Chinese government can do to break the

vicious circle of overpopulation and deforestation is to promote the practice of family planning and to strictly control population growth".

Yet, these same analysts also commit themselves to contradictory, incomplete and untenable claims: Bilsborrow and DeLargy concede that "while population pressure is often considered an important factor in environmental degradation, solid empirical evidence on its role is almost non-existent"; and as he blames deforestation on overpopulation, Li reveals that China's forested land area changed from 8 percent in 1949 to 12 percent in 1984 to 8.4 percent in 1988. If forest area increased and decreased while population went up each year, clearly there are other factors that are much more significant in explaining deforestation.

The second focus - the responsibility of numerous small producers and users in environmental degradation - is evident among writers such as Myers (1991) and Wilson (1992). Gathering bite from the bias against smallholders that is present among Marxist and modernization theorists alike, these writers reserve a special ire for the small-scale agricultural producer and allege that the sheer number of small producers as well as their limited options and resources force them into irrational courses of action which lead inevitably to environmental damage. Raven (1991), for instance, singles out the very poor and judges that they use natural resources very destructively. Something seems wrong with this picture, however. Raven contradicts himself by conceding in the same paragraph that it is the industrial countries that "consume 80-90 percent or more of virtually all commodities...". And, increasingly, theorists are diverting their attention to the knowledge and practices maintained by peasants and indigenous populations to learn about resource management and conservation (Gupta, 1992).

The analysis that follows examines the actions of impoverished, rural resource users in a developing world context of generalized pressure on resources. The Lesser Himalayas in India have one of the highest population densities in India, especially in view of the limited availability of arable land. While the local demand for food can be met by imports from the plains, villagers continue to depend almost exclusively on hill forests for fodder, fuelwood and construction timber (Ashish, personal communication, 1990). The constraints they have forged to restrict resource use, and the specific institutional strategies they employ therefore constitute a significant cause for scepticism towards a cause-effect relationship that analysts often postulate as being inevitable between population density and resource degradation. Micro-level research shows that people and the environment are not necessarily antagonistic (see also Arizpe, Stone and Major, 1994) and it provides a different perspective on the population environment relationship.

### [Management of forest resources, Including collection of fuelwood, is In the hands of the Van Panchayats \(local forest councils\)](#)

#### **Market pressures on resources**

Just as a vast literature asserts the importance of overpopulation in determining resource depletion, a powerful intellectual tradition, ranging from Adam Smith and Karl Marx to present-day political and neoclassical economists, emphasizes the role of markets and production forces in shaping and modifying the economic relations of production and social institutions. Both Smith and Marx were confident that capitalist economic expansion, through trade and investment, would inevitably transform pre-capitalist social productive relations. Some theorists link demographic shifts to changes in relative prices and suggest that the two may move in tandem and, thereby, influence the development of markets and patterns of resource use (North and Thomas, 1973). According to these theorists, lower prices that prevail in integrated markets, prices that come about as a result of greater specialization and the constant revolutionizing of production, create an ever increasing demand and, in turn, ever greater production. However, the integration of local resource systems into larger markets, while providing for greater economies of scale, also exposes them to demand from a larger

system and thus creates greater harvesting and degradative pressures on a finite local resource system.

In the context of the forest councils of Kumaon and, indeed, of community-man aged systems elsewhere, the above perspective from "Neo-Smithian Marxists", to use Brenner's evocative phrase, holds obvious implications. As common property systems become exposed to market pressures, local users should increase harvesting levels because, in addition to subsistence needs, they can harvest for cash incomes as well. As subsistence and market pressures drive users to extract forest products at increasingly higher rates, environmental degradation would become inevitable.

Two objections, however, render such a perspective invalid as a theory of resource degradation. First, it does not recognize that local institutions of many kinds, including social norms, guide the use of resources. Of course, institutions and systems of property rights change over time, but such changes are not the direct or linear result of particular levels of demand. Second, the perspective denies the possibility that rural users may forego cash incomes from the sale of forest products on the market. In the communities under consideration, users often desired and enforced institutional rules and requested support from higher centres of political authority in the face of noncompliance to resource management rules. They also recognized potential benefits of increased demand from the market and used it to increase revenues from the commonly owned *panchayat* forests.

### **The importance of local institutional arrangements**

While many resource management theorists and demographers assert that overpopulation and market pressures lead to overharvesting and the decline of local resource management systems, an equally vehement group of scholars champions the efficacy of local resource managers (Acheson, 1989; Chetri and Pandey, 1992; Feeny *et al.*, 1990; McKean, 1992; Ostrom, 1990). In the words, surprisingly, of a demographer (Davis, 1991). "any theory of population and resources that overlooks cultural phenomena is likely to be deficient. Yet in much of the literature, this is exactly what is done." The conceptual model employed in many of the works referred to previously often tends to ignore the manner in which the impact of population pressures and market forces on forests is mediated by local institutional arrangements.

The simple schematic in Figure 2 summarizes the position. The representation suggests that, as market and demographic pressures rise, the condition of the resource deteriorates. Technological change, on the other hand, is more complex: it functions to increase efficiency and thereby reduces pressures on resources. At the same time, however, greater efficiency leads to lower prices, greater demand and thus an indirect negative effect on the resource's condition. Figure 2 is significant primarily for what it ignores - social institutions - as it tries to explain human actions.

Institutions are human-devised constraints that shape human interaction (North, 1990). Indeed, they do not just constrain, but also soften, mediate, attenuate, structure, mould, accentuate and create impacts that lead to greater or lesser consumption. Scarcities of particular products, it can then be said, are a result of specific modes of production and consumption. The scarcity of timber, fodder or fuelwood as well as changes in land use are a consequence of particular modes of consumption which create demand; production that may be wasteful; accumulation that intensifies use; distribution that creates massive inequalities in production, consumption and accumulation; and ideologies that justify all of the above. It can be argued that scarcities are a consequence of the inability to reproduce a given mode of production and not a situation where "society runs headlong into 'nature' or natural constraints" (Collins, 1992). Under extreme deprivation resulting from famine, pestilence or war, institutions may play a much smaller role but such situations, in the context of analysis in

this article, are the exception and not the rule.

## Analysis of factors influencing the condition of local forests

The following section of this article examines the data collected to test the thesis that factors such as overpopulation and markets do influence resource use and the consequent condition of the resource, but only through institutions that help guide human activities, and that they are therefore not determinant in isolation and should not be used as indicators of forest conditions.

Figure 3 presents an analytical frame indicating the number and complexity of the factors that may influence resource use. According to the Figure, six major factors influence the condition of the resource at the local level:

- local resource management institutions;
- the social and cultural context;
- state policies;
- technological change;
- changes in market pressures;
- demographic change.

All of these factors (except local institutions) exert a weak direct effect on resources (represented by thin lines), and a more significant indirect effect, mediated by local institutions.

The Figure does not attempt to present a causal model of institution formation. Thus, arrows leading to "local resource management institutions" do not suggest that the characteristics of these institutions are a result of state policies, technological change, market pressures and so forth. While such factors no doubt influence local institutions, the precise institutional contours are better seen as a result of the actions of local populations who are as much agents in creating such institutions as they are subject to external, structural factors.

The representation also does not pretend to enumerate exhaustively the different factors that may influence resource use, nor to plot precisely the direction, magnitude or complexity of different variables that influence use of resources (forests) at the local level. It serves chiefly to indicate that strong local institutions can mitigate the influence that most structural variables have on local patterns of resource use.

The research described below used the above schematic of Figure 3 to examine the relative impact of different factors in influencing resource use. The general social and cultural context, state policies and technological variables were assumed to vary relatively little from one local context to another in Kumaon. The other three factors were assumed to vary significantly across the different observations. The empirical conditions in the Almora and Pithoragarh districts support these assumptions. The different villages in Kumaon pride themselves on their culture and, despite local differences, view themselves as distinct even from the residents of other neighbouring hill districts in Garhwal. Similarly, state policies and levels of technological change tend to differ from those in the plains but hold across the villages in the hills.

In looking at forest use in the Kumaon hills, the author explicitly analysed the effect of the local institutions of resource management - the forest councils (*Van Panchayats*) - which are directly concerned with guiding the behaviour of villagers regarding forest use and management. To be effective, local community institutions that help manage forest resources must contain four types of rule to facilitate particular tasks: rules that define the level of benefits that can be harvested from the common resource; rules that help monitor the behaviour of users and whether users are conforming to prescribed rules; rules that sanction users who violate rules; and rules that help settle disputes among users, guards, managers and outsiders (Agrawal,

1994). These four sets of rules are sequential in nature. Without rules that define how much can be extracted, there would be no violators. Without violations, there would be no need to monitor. Without monitoring, it is impossible to punish violators and, without rules, sanctions and the discipline they imply, there would be little need to arbitrate or settle disputes (Agrawal, 1992; 1994).

The forest councils have crafted all of the above four types of rule as they have tried to limit forest use and maintain their resource. But the most significant step in these four sets of sequential rules for the forest councils is the monitoring of resources and the sanctioning of rule violators by guards whom the council appoints. In the absence of a regular guard, the incidence of rule violations rises enormously. Since guards are employed only if conservation rules meaningfully constrain the consumption behaviour of villagers, and since their reports about rule-breakers are usually noted for action, the "number of months for which guards are employed" has been used as a convenient indicator of levels of enforcement and institutional effectiveness.

Another institutional variable, the number of years since the election of the current leadership, was used to investigate whether changes in leadership explained changes in the effectiveness of the *panchayats*.

Population pressure was estimated using the area of village land that is available per person. The area of village, rather than of forests alone, provides a better approximation of population pressure, since some of the products that are derived from forests, especially fodder, can be substituted with agricultural products. The strength with which market forces impact on the local village economy is measured as the distance of the village from paved roads. The condition of the forest - the dependent variable - is represented by a dichotomous variable where villagers are asked to judge whether their community forest is in a good or a bad condition. Thus, the dependent variable is categorical and, therefore, the data on the forest councils is analysed using logistic regression techniques.

### [FIGURE 2 Markets, population and the condition of the resource](#)

### [FIGURE 3 Markets, population, institutions and the condition of the resource](#)

Table 2 presents the results of the logistic regression analysis. The coefficients in the Table indicate the relative contribution of different variables towards the probability of the forest being in a good or a bad condition. The equation for the probability of the *panchayat* forest being in a good condition can be expressed as:

Prob (forest is in a good condition)

$$= 1/1 + e^{-z}$$

where

$$Z = -2.2924 - .1061(\text{Road})$$

$$+.4354(\text{Guard}) - .009(\text{Elec.})$$

$$+.152(\text{Pop.})$$

and

Road = distance of the settlement from the road (in km),

Guard = number of months for which a guard is hired for the community forest;

Elec. = number of years that have elapsed since the last election;

Pop. = village land (in ha) available per village household.

In view of the high chi-square value of the 2 LL (log likelihood) estimate, the model classifies the data well. The other indicators of how well the model fits are also all on the high side - as is evident from the high model chi-square value and the classification table (86 percent of the observations are classified correctly, whereas one would be able to classify only 50 percent of

the observations correctly at random). Of the 279 councils that responded, 142 (50.8 percent) of the forests were classified as "bad".

The regression indicates that, as the number of months for which the forest council hires a guard increases (indicating increased effectiveness of local institutions) and the availability of land per household increases (indicating low population pressure), the probability of the condition of the community forest being assessed as "good" by the villagers will also increase. The categorical value of "good" is a subjective judgement made by the villagers.

The probability of the forest being classified as "good" declines as the distance of the settlement from the road increases. This is a counterintuitive finding, since believers in the strong force exerted by markets may argue that the condition of the forest should be more likely to be "bad" the closer the forest is located to the road and is exposed more to market pressures. One reason for the unexpected finding may be that villagers closer to the road may find that higher-level government officials supervise their activities more often than they do those of the villages that are further away from roads. Proximity to roads, therefore, may be a proxy for two different forces, and the effect of higher-level supervision may be more important than the effects generated by market forces.

The coefficient for the availability of land per village household, measured by "Pop.", is relatively high (compared with "Road" and "Elec.") and statistically significant. While the variable "Elec." also contributes to a minor extent to the condition of the forest, its coefficient is statistically insignificant. The contribution of individual variables to the "Z" scores is difficult to determine *per se* since it depends on the value of each variable in a particular observation (Fiorina, 1991). However, the R statistic which can be used to assess the partial correlation between the dependent and each of the independent variables, shows that the partial correlation between "guard" and the condition of the forest is the highest of all the variables. The coefficient for the variable is also far more significant than for "Pop." or "Road".

The analysis underlines the importance of institutional arrangements, especially of monitoring and sanctioning, in ensuring that the community forest remains in a good condition. In contrast, two other variables distance from the road (indicating market forces) and availability of land per household (indicating population pressure on the forest) often highlighted in the literature as the main determinants of forest condition - emerge as relatively weak indices for predicting the condition of the forest. Indirect evidence from interviews with leaders of the forest panchayats confirms the results of the regression. When discussing the problems faced by their councils, they most often highlighted their main problem as insufficient support from government officials in apprehending rule-breakers. When asked about possible solutions, they universally desired greater monitoring and enforcement through guards appointed by the government and, in 50 percent of the cases, they demanded greater powers of local enforcement.

The results of the investigation also constitute a telling defence against arguments that attack smallholders for degrading the environment. Few residents in the hills own much land or wealth (Guha, 1989). Most households, however, recognize the significance of community-managed forests in their daily struggle to survive, and they work persistently to ensure the integrity of institutions that help manage forests.

An obvious criticism of the regression results presented in this article may be that the forest users' perceptions of the condition of their resource could have been positively influenced by the effort invested in protecting it. Two responses may be offered against such a critique. First, users, if they are relatively unsuccessful after investing strong efforts to protect their resource, are likely to judge the condition of their resource as "bad". The objective condition of the resource, that is to say, will bear a significant correlation with the perceived condition. Second, and as partial evidence, for a sample of six panchayat forests on which data were collected in

1989-1990, the coefficient of correlation between user perception and actual measures of vegetation density was computed at 0.73. Data from 35 randomly selected cases are under analysis.

**TABLE 2. Logistic regression results for pooled observations: population, market pressures and institutional arrangements as explanations of forest condition**

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
Road	-.1061	.0561	3.5809	1	.0584	-.0639	.8993
Guard	.4354	.0471	85.4223	1	.0000	.4644	1.5456
Elec.	-.0090	.0391	.0529	1	.8181	.0000	.9911
Pop.	.1520	.0508	8.9597	1	.0028	.1341	1.1642
Constant	-2.7489	.4330	40.3066	1	.0000		
-2 log likelihood 386.77264							
	Chi-square		df		Significance		
-2 log likelihood	203.101		274		.9995		
Model chi-square	183.671		4		.0000		
Improvement	183.671		4		.0000		
Accuracy of fit	282.989		274		.3415		
Classification table							
Predicted							
			0	1	Percent correct		
	Observed		0	1	87.14		
	0	0	122	18	85.61		
	1	1	20	119	86.38		
				Overall			
(N=279)							

*Note:* Road = distance of the settlement from the road (in km): Guard = number of months for which a guard is hired for the community forest, Elec. = number of years that have elapsed since the last election. Pop. = village land (in ha) available per village household.

## Conclusion

The results of the analysis indicate clearly that:

- Broad structural factors such as demographic pressures and spread of markets are not the best variables in trying to explain the condition of resources, even if they may seem to be intuitively appealing explanations of resource degradation. At the local and the micro level, a host of social and institutional variables mediate the impact of larger structural variables. Put directly, the level of institutional effectiveness is more important in determining the condition of resources than either population pressure or market forces *per se*.
- Smallholders, even under significant market and population pressures, can demonstrate the capacity to conserve forest resources. This conclusion holds true especially if the larger political and social context encourages autonomous local action and contains the right mix of institutional incentives to promote sustainable environmental use.

While this article points out one direction for possible future research - the significance of local



institutional arrangements - it also conveys a broader message. Macro-level correlations for changes in resource condition and changes in demographic or market pressures may often conceal causal processes that operate at the micro level; these must be understood to determine effective policy measures for containing resource degradation. Further research focusing on the influence of other social and cultural factors must be undertaken if we are to have an adequate understanding of the processes that influence resource use and/or degradation.

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