Pergamon

World Development, Vol. 25, No. 1, pp. 23–52, 1997

0305–750X/97 $17.00 + 0.00

S0305-750X(96)00084-8

Gender, Environment, and Poverty Interlinks: Regional Variations and Temporal Shifts in Rural India, 1971–91

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Summary. — This paper analyzes the interrelationships between gender, poverty and the environment in rural India, focusing especially on regional variations and temporal shifts over 1971–91. Briefly identifying the major factors underlying environmental degradation, it traces why and how this degradation, and the appropriation of natural resources by the state (statization) and by some individuals (privatization), tend to have particularly adverse implications for the female members of poor rural households. Regional and temporal variations in the likely intensity of these effects are traced both by examining individual indicators and through the specification of a set of aggregative indices, termed here as the GEP(V) indices. These indices measure differences between states in their gender-environment-poverty vulnerability (or what could be termed the "GEP-gap") at a point in time, and over time. Governmental and community-initiated attempts at environmental protection and regeneration are also examined, and the importance of gender-directed policies highlighted. Copyright © 1997 Elsevier Science Ltd

Key words — gender, environment, poverty, rural India, measurement indices, development

1. INTRODUCTION

A striking feature of gender bias, poverty incidence, and environmental vulnerability in India is their regional variation. Equally striking is the fact that regions of high gender bias do not necessarily coincide with regions of high poverty, or greatest environmental risk. These three elements of vulnerability constitute intersecting but not overlapping circles. While each of the elements has received attention individually, there has been relatively little focus on the interrelationships between them, and even less on the variation in these links across regions and over time.

This paper examines how gender, poverty and the environment interlink in rural India, focusing in particular on regional variations and temporal shifts over 1971–91. I outline the forms these interlinkages tend to take, and why, and develop what I term the GEP(V) indices (the Gender-Environment-Poverty vulnerability indices) for ranking states by their extent of gender bias, poverty incidence and environmental risk taken together, and changes in these ranks over time.[1] For this purpose I draw upon the methodology used to compute a Human Development Index in UNDP's annual *Human Development Report (HDR)*. Unlike the 1995 HDR, however, which focuses only on gender bias and its variation across countries, in this paper I both "gender" and "green" the index, in the context of rural India, using somewhat different indicators from those used in the 1995 HDR to measure gender disadvantage. Through this exercise, I hope to provide pointers on the regions which warrant immediate policy attention for helping the most disadvantaged sections of the population affected by environmental decline. It also highlights which regions have progressed on this count (*viz.*, reduced what I term their "GEP-gap"), and which have remained stagnant or retrogressed during 1971–91. Although focused on India, this methodology would have some relevance for other countries as well.

Section 2 of the paper gives an overview of the kinds of links that can be established between gender, poverty, and the environment. In particular, what factors underlie the declining availability of natural resources, and the implications of this decline, espe-

*This is a revised and shorter version of a paper that appeared as an UNRISD (Geneva) discussion paper in 1995, which in turn drew from a longer paper written for the World Resources Institute (WRI), Washington, DC, as part of its project on the "Second India Study Revisited." Aspects of this paper were presented at two workshops organized by the WRI, and at a lecture at the Massachusetts Institute of Technology. I am grateful to the participants at these events for their comments. Final revision accepted: July 23, 1996.

cially for women in poor rural households. Section 3, on the basis of selected indicators, outlines the broad regional differences in gender vulnerability, environmental disadvantage, and poverty incidence. Section 4 presents the results for the GEP(V) indices. Section 5 takes a brief look at grassroots and governmental responses to environmental degradation, and Section 6 offers some summary comments and policy pointers.

2. AN OVERVIEW OF INTERLINKS[2]

Both the causes and the implications of environmental change in India are structured by and in turn structure socioeconomic differentiation, most notably along class (/caste/tribal) and gender lines, as outlined below.

(a) *Causes: environmental degradation and forms of appropriation*

The availability of natural resources to a large section of the rural population, and especially to the poor, has been eroded severely in recent decades by two parallel, and interrelated, processes: first, their growing degradation both in quantity and quality; and second, their increasing statization (appropriation by the State) and privatization (appropriation by a minority of individuals), with an associated decline in what was earlier communal. These two processes, both independently and interactively, underlie many of the differential class-gender effects (that is, gender effects mediated by class[3]) of environmental degradation outlined further below. Independently, the former process is reducing overall availability, and the latter is increasing inequalities in the distribution of what is available. Interactively, an altered distribution in favor of the State and some individuals, and away from community control, contributes to environmental degradation insofar as community resource management systems have often proved more effective in environmental protection and regeneration, than systems managed solely by the State or by individuals. These two processes I term the primary factors underlying the class-gender effects of environmental change. Impinging on them are several intermediary factors, of which those especially important are the erosion of community resource management systems; population growth; consumption patterns; and choice of technology in agriculture. Most of these are detailed in Agarwal (1991) and summarized here.

(i) *Forms of environmental degradation*

Degradation in India's natural resource base is manifest in disappearing forests, deteriorating soil conditions, and depleting water resources, although there is as yet an inadequate data base to indicate the exact extent and regional variability of degradation. In 1987–89 only 19.5% of India's geo-area was forested (satellite data: GOI, 1991a). By official estimates, in 1980, 56.6% of India's land was suffering from environmental problems, especially water and wind erosion (GOI, 1980–85, p. 343). Unofficial estimates are higher. In some canal projects, as much as half the potentially irrigable and cultivable area has been lost due to waterlogging (Joshi and Agnihotri, 1984). The area under periodic floods is estimated to have doubled during 1971–81, and soil fertility is declining with overuse of chemical fertilizers. Likewise, groundwater levels have fallen permanently, even in parts of the Indo-Gangetic plains, due to indiscriminate sinking of tubewells — the leading input in the Green Revolution technology (Dhawan, 1982). As a result, many drinking water wells have dried up or otherwise been rendered unusable (CSE, 1986, p. 30). The health of soils (especially in the hills), and the availability of ground and surface water is also affected by the poor health of forests. In addition, fertilizer and pesticide run-offs into natural water sources have been destroying fish life and polluting water for human use in several areas (CSE, 1986, p. 30).

Such degradation of natural resources has gone alongside their increasing concentration in the hands of a few, as discussed below.

(ii) *Statization and privatization*

Both under colonial rule and continuing in the postcolonial period, at least up to the late 1970s, forests were viewed by the State primarily as a resource for commercial exploitation. Large tracts were cut for timber, or cleared for agriculture or (especially under colonialism) for tea and coffee plantations (Guha, 1983). State monopoly over forests, established under colonial rule, persisted after Independence, as did the practice of forestry for profit, with local villagers and forest dwellers being treated as transgressors by the forest department. Only recently has there been some shift toward a State recognition of the positive role that local communities can play in the regeneration of degraded forest land (of which more later).

Parallel to the process of statization, especially since the 1950s, has been a growing privatization of community resources in individual (essentially male) hands. Jodha's (1986) study showed a decline in village commons (VCs) by 26–63 percentage points across seven states, during 1950–84. Population pressure apart, this is attributable mainly to State policy acting to benefit selected groups over others, including illegal encroachments by farmers made legal over time; the auctioning of parts of VCs to private contractors for commercial exploitation; and the distribution of common land to individuals under various land reform and anti-poverty schemes whose stated intention was to benefit the poor, but which in practice benefited the well-off farmers. For 16 of the 19

districts in the seven states studied by Jodha, the share of the poor was less than that of the nonpoor. Hence the poor (who depend on these resources more than the affluent) lost out collectively while gaining little individually.

Similarly, in the tapping of groundwater through tubewells, there are significant inequalities in the distribution of what is effectively an underground commons. Tubewells are concentrated typically in the hands of better-off farmers, and the noted associated fall in water tables has, in many areas, dried up many shallow irrigation wells and drinking water wells used by the poor. In some regions they have also depleted soil moisture from land used by poor households (Bandhyopadhyay, 1986).

(iii) *Erosion of community resource management systems*

The statization and privatization of communal resources have not only altered the distribution of available resources in favor of a few. They have also systematically undermined traditional institutional arrangements of resource use and management which existed in many areas. Current research reveals systems of water management and methods of gathering firewood and fodder that were typically not destructive of nature.[4] While much more documentation is needed on the regional spread of these traditional systems and the contexts in which they were successful, what appears clear is that where they existed, responsibility for resource management was linked to resource use via local community institutions. When control rights over these resources passed into the hands of the State or of individuals, this link was effectively broken.[5]

The shift from community control and management of common property, to State or individual control and management, in turn, has added to environmental degradation.[6] In particular, property rights vested in individuals have proved no guarantee for environmental regeneration. Indeed individual farmers, attempting tree-planting for short-term profits in the early 1980s, tended to plant quick-growing commercial trees such as eucalyptus, which many argued to be environmentally costly.[7]

(iv) *Population growth*

High population growth has clearly impinged on environmental degradation in India, but typically not, as is often emphasized, as the primary cause. Indeed it is far from clear what threshold of population density would lead to environmentally detrimental effects in particular contexts. Although, over time, a growing population impinging on a limited land/water/forest base may be expected to degrade the environment, political economy dimensions clearly underlie the pace at which such a process may occur and how the costs of it are distributed. The continuing commercial exploitation of forests, and the increasing appropriation of VCs and groundwater resources by a few, leave the vast majority to subsist on a shrinking natural resource base. The almost unidimensional focus on population in many national and international forums has detracted attention from these and other basic causes of environmental deterioration. Moreover, it is questionable that interventions to control population growth can, in themselves, stem environmental degradation. What they can do, as Shaw (1988, p. 7) argues, is "buy crucial time until we figure out how to dismantle more ultimate causes."

In addition, any policy for reducing population growth must contend with the complexity of the relationship between environmental degradation, poverty, and people's desired family size. On the one hand, in poorer households, degradation could induce a variety of fertility-increasing responses over time. Young girls could be kept away from school to help with fuel and fodder collection, and given the negative correlation between female education and fertility, this could constrain the reduction of fertility in the long term. Again, if environmental degradation and associated poverty leads to higher infant mortality rates, parents may seek to have more children to ensure a desired completed family size. Families may also want more children to diversify incomes as a risk-reducing mechanism, in environmentally high-risk areas (Rosenzweig and Wolpin, 1985).

On the other hand, environmental degradation could encourage smaller families because of the difficulties of maintaining large ones on a limited resource base. Results from my 1993–94 survey in Rajasthan, Gujarat, and the Kumaon region of the Uttar Pradesh hills, are indicative. Women respondents (mostly 40–45 years old) typically answered as follows to the question — is it better to have many or few children to cope with the fuel/fodder/water problem?

> "Large families mean more hands, but where is the land?"
>
> "Large families need more land and food. If the family is large we will need to collect more [fuel and fodder], so that does not solve the problem."
>
> "More children will help the mother for a while, but the problem will return when the children leave home. A smaller family is better because then all the children can be cared for."

Such answers reflect an emerging recognition in these regions of the need to limit family size because of the resource crunch, especially among the less well-off households. But a wide gap still needs to be bridged in the supply of better health and contraceptive services that would enable women to make informed and safe choices. Moreover, as noted elsewhere, degradation may well lead to fertility increasing responses.

(v) *Consumption patterns*

How population size affects the natural resource base also cannot be delinked from income distribution, people's lifestyles, and associated consumption patterns. While these issues are too wideranging and complex to be detailed here, it needs mention that the question is not just one of quantity consumed but also of the nature of product demanded. This, in turn, has implications for choice of production technologies and potential for environmental degradation, including pollution, the creation of non-biodegradable waste, and so on. The costs of this, however, are borne by many whose own lifestyles have not contributed to the degradation, nor have they had a say in the decisions regarding the products produced or the technologies used.

Moreover, the question of consumption and lifestyles has not only a well-recognized class dimension but also a gender dimension, stemming, for instance, from gender differences in control over decisions about household purchases. To cite one example, it is noteworthy that even in middle peasant homes, investment, say, in a tractor (a technology which men use), has priority over the replacement of a smoky kitchen stove (a technology which women use).[8]

(vi) *Choice of agricultural technology*

Class and gender again impinge on the effects of environmental degradation associated with the Green Revolution technology. This, while dramatically successful in increasing crop output in the short run, has led to high environmental costs over time: falling water tables due to the overuse of tubewells, waterlogged and saline soils from many surface irrigation schemes, declining soil fertility with excessive use of chemical fertilizers, water pollution with pesticides, and so on. Genetic variety has also shrunk, and many of the indigenously developed crop varieties (long-tested and adapted to local conditions) have been replaced by improved seeds which are more susceptible to pest attacks. All this reflects on crop yields and growth rates. The long-term annual growth rate of agricultural production in India over 1968–85 was 2.6%, that is, slightly lower than the pre-Green Revolution (1950–65), rate of 3.08%. Crop yields are now also more unstable (Rao, Ray and Subbarao, 1988). This raises questions about the long-term sustainability of agricultural growth, and more generally of rural production systems, under present forms of technology and resource management in India. Indeed, indiscriminate agricultural expansion, with little attempt to maintain a balance between forests, fields, and pastures, assumes that the relationship between agriculture, forests and VCs is an antagonistic one, rather than one of complementarity.

Of course, it cannot be argued that rich farmers alone are responsible for the environmental ill-effects associated with the Green Revolution technology, since in many regions (especially in northwest India) adoption has been widespread among small farmers as well. But in relation to the landless and near-landless in these regions, and in relation to the small farmers in less prosperous states, the argument would still hold that the poor have been the main victims of the negative environmental fallouts from this technology, in the choice of which they have had little hand. This would hold in even greater degree in relation to poor rural women.

All the above factors have widespread implications for rural livelihoods, poverty, and gender equity.

(b) *Implications: class-gender effects*

(i) *The specificity of class and gender*

The effects of natural resource degradation, statization and privatization (and of their underlying causes) have a location, class and gender specificity. Households located in environmentally vulnerable zones are likely to be most at risk; and within these zones, the effects would be especially negative for poor households because of their particular dependence on communal resources.

For instance, a range of essential items are gathered by rural households from the VCs and forests, for personal use and sale: food, fuel, fodder, fibre, small timber, manure, bamboo, medicinal herbs, oils, materials for housebuilding and handicrafts, resin, gum, honey, spices, and so on (KFRI, 1980; Fernandes and Menon, 1987). Although all rural households use communal resources in some degree, for the poor they are critically important, given the unequal distribution of private land in the country (GOI, 1986, 1987a). In Jodha's (1986) 1980s study of 12 semi-arid districts in seven states, VCs accounted for 9–26% of the total income of poor rural households, but only 1–4% of the total income of the non-poor (Table 1). The poor were found to be especially dependent on VCs for fuel and fodder: over 90% of their firewood came from the commons, which also provided for 69–89% (varying by region) of their grazing needs, compared to the relative self-sufficiency (from private land) of the larger landed households. Access to VCs also reduces income inequalities in the village between poor and nonpoor households. In addition, there is a close link between the viability of many small and marginal farmers and their access to VCs for grazing, or for collecting fodder for their draft animals and milch cattle, or for other inputs (Jodha, 1986; Blaikie, 1985).

Forests, likewise, have always been significant sources of livelihood, especially for tribal populations, and have provided the basis for swidden cultivation and nontimber forest products. Several million villagers (estimated at about 30 million some 15 years

Table 1. *Average annual income derived from village commons by poor and nonpoor households in different regions (1982–85)*

State & districts	Per household annual average income from village commons			
	Poor households*		Other households†	
	value (Rs.)	percentage of total household income	value (Rs.)	percentage of total household income
Andhra Pradesh				
Mahbubnagar	534	17	171	1
Gujarat				
Mehsana	730	16	162	1
Sabarkantha	818	21	208	1
Karnataka				
Mysore	649	20	170	3
Madhya Pradesh				
Mandsaur	685	18	303	1
Raisen	780	26	468	4
Maharashtra				
Akola	447	9	134	1
Aurangabad	584	13	163	1
Sholapur	641	20	235	2
Rajasthan				
Jalore	709	21	387	2
Nagaur	831	23	438	3
Tamil Nadu				
Dharmapuri	738	22	164	2

*Landless households and those owning <2 ha dryland equivalent.
†Those owning >2 ha dryland equivalent.
Source: Jodha (1986).

ago: Kulkarni, 1983) depend wholly or substantially on such products for their livelihoods. These sources have been especially critical during lean agricultural seasons and acute food shortage contexts (Agarwal, 1990). The noted privatization of VCs and State control over forests have thus affected the poor in greatest measure.

Moreover, for a large percentage of rural households, water for irrigation, and for drinking and other domestic uses, comes directly from rivers and streams in the hills and plains. Richer households are more able to tap the (relatively cleaner) groundwater for drinking and irrigation by sinking more and deeper wells and tubewells, while the poor are mainly dependent on surface sources. The ill-effects of chemically polluted water supplies are thus disproportionately borne by the poor.

Focusing on the class (/caste/tribal) significance of communal resources, however, gives only a partial picture. There is also a critical gender dimension, since women and female children, especially in poor households, are the most adversely affected by environmental degradation, for several reasons.

In many parts of India, there is a systematic anti-female bias in the allocation within rural households of subsistence resources controlled by men, including resources used for food, health care, education, and other basic needs. The bias is revealed most starkly in terms of relative female survival as measured by the sex ratio (which in 1991 was 929 females per 1,000 males for all-India). These differences are especially acute in northwest India, but are found in some degree in most regions.[9] Further, where both women and men control resources, women, especially in poor households, tend to spend their incomes mostly on the family's basic needs and men in greater part on personal needs (Mencher, 1989). Hence women's direct access to resources (public and private) assumes particular importance for their own and their children's well-being.

There are significant inequalities, however, in men's and women's access to private resources. For instance, agricultural land, the most crucial productive resource in rural economies, is mostly owned by men, as is associated production technology (Agarwal, 1994). Women also have fewer employment opportunities, lesser occupational mobility, lower levels of training, and lower payments for the same or similar work.[10] Due to the greater task-specificity of their work, they face much sharper seasonal fluctuations in employment and earnings, and have less chance of finding employment in the slack seasons (Agarwal, 1984; and Ryan and Ghodake, 1980).

Given their limited rights in private property resources, common property resources, such as VCs and forests, have been for rural women and children

(especially those of tribal, landless, or marginal peasant households) among the few independent sources of subsistence. Rights in VCs have traditionally been linked to membership in the village community, and therefore women were not excluded in the way they mostly have been from the ownership of individualized private land. This acquires additional importance in regions with strong norms of female seclusion (as in northwest India) where women's access to the cash economy, to markets, and to the market place itself, is constrained and dependent on the mediation of male relatives (Agarwal, 1994).

In addition, and most importantly, there is a pre-existing gender division of labor. It is women in poor peasant and tribal households who do much of the gathering and fetching from the forests, village commons, rivers and wells. Women of such households also carry a significant responsibility for family subsistence and are not uncommonly the primary or (in most female-headed households) the sole, economic providers.

Furthermore, there is a considerable gender gap in access to decision-making authority at all levels (local and national), including decisions about resource use and management.

It is against this analytical backdrop that we need to examine what I have termed the class-gender effects of the processes of environmental degradation, statization and privatization.

(ii) *The effects*

The class-gender effects relate to at least six critical aspects: time, income, nutrition, health, social support networks, and knowledge systems. Each of these effects is important, but their intensity varies regionally, with variations in ecology, agricultural technology, land distribution, and social structures, and associated variations in the gender division of labor, livelihood possibilities, and kinship systems.[11] Although a systematic regional decomposition of the effects is not attempted in this section, the illustrative examples are regionally contextualized.

First, since rural women are the main gatherers of fuel, fodder and water, it is primarily their working day (already averaging 10–12 hours) that lengthens with the depletion of and reduced access to forests, water, and land. Firewood, for instance, is the single most important source of domestic energy in India (providing over 65% of domestic energy in the hills and deserts of rural north India). Much of this is gathered and not purchased, especially by the poor. In recent decades, in many regions there has been a notable increase in firewood collection time, in small degree in some places, dramatically in others (see Table 2). In the 1980s, in parts of Gujarat (western India), even a 4–5 hour search was found to yield little apart from shrubs, weeds, and tree roots which do not provide adequate heat (Nagbrahman and Sambrani, 1983). Local community initiatives for forest and VC regeneration in very recent years hold a potential for increasing the availability of firewood (and other gathered products), but (as discussed later) to realize this potential will need much greater efforts to ensure women's effective participation in such initiatives than made to date.

Fodder shortages are even more acute than those of firewood in most areas. My earlier-mentioned survey in Rajasthan, Gujarat, and the Kumaon region of the Uttar Pradesh hills, indicated not only an increase in the time spent in fodder collection (done primarily by women and children), but a growing dependence on market purchase. In the Kumaon village, for instance, 84% of the sample households now purchase some proportion of their fodder, compared with only 8% two decades ago. The number of large animals among the landpoor households has also fallen in all the regions surveyed, with the decline in grazing lands and hike in fodder prices. Moreover, where grazing is still possible, while 20 years ago boys and/or men usually took the animals out, now (as in the Kumaon village) girls are often sent for grazing while their brothers attend school. Over time this could widen the gender gap in literacy in such areas. Similarly, any drinking water shortages arising from wells drying up or going saline (say, near irrigation works) aggravate the burden on women and young girls.

Second, the decline in items gathered from forests and VCs has reduced incomes directly. In addition, the extra time needed for gathering reduces that available to women for crop production, and can adversely affect crop incomes, especially in hill communities where due to high male outmigration women are often the primary cultivators.[12] Similar implications for women's income arise with the decline in village grazing land and associated fodder shortage. Many landless widows I spoke to in Rajasthan (northwest India), in 1987, said they could not take advantage of the government's poverty-alleviation scheme of providing subsidized credit to the poor for purchasing a buffalo, as they had nowhere to graze the animal, nor cash to buy fodder. Moreover, as other sources of livelihood have eroded, for many years now selling firewood has been one way by which tribal women in eastern and central India have been eking out a living (Bhaduri and Surin, 1980). With thinning forests, this is becoming less and less possible, even as the activity itself exacerbates the problem of deforestation.

Third, as the area and productivity of VCs and forests fall, so does the contribution of gathered food in the diets of poor households. In addition, nutrition suffers when fuelwood shortages are acute, as poor households economize on fuel by shifting to less nutritious foods which need less fuel to cook or can be eaten raw, or eat partially-cooked food which could prove toxic, or eat leftovers which could rot in a tropical climate, or miss meals altogether.[13] A tradeoff

Table 2. *Time taken and distance traveled for firewood collection in different regions*

State/Region	Year of Data	Firewood collection*		Data source
		Time taken	Distance travelled	
Bihar (plains)	c. 1972	NA†	1–2 km/day	Bhaduri & Surin (1980)
	1980	NA	8–10 km/day	
Gujarat (plains)				
(a) Forested	1980	once every 4 days	NA	Nagbrahman and Sambrani (1983)
(b) Depleted		once every 2 days	4–5 km	
(c) Severely depleted		4–5 hr/day	NA	
Karnataka (plains)	NA	1 hr/day	5.4 km/trip	Batliwala (1983)
Madhya Pradesh (plains)	1980	1–2 times/week	5 km	Chand and Bezboruah (1980)
Rajasthan				
Alwar plains	1986	5 hr/day (winter)	4 km	Author's observation in 1988
Ajmer plains	1970s	1.9 hr/journey	1.9 km	Survey by author in 1993
(average: all seasons)	1990s	2.1 hr/journey	2.1 km	
Uttar Pradesh				
Chamoli (hills)				
(a) Dwing	1982	5 hr/day‡	over 5 km	Swaminathan (1984)
(b) Pakhi		4 hr/day		
Garhwal (hills)	NA	5 hr/day	10 km	Agarwal (1983)
Kumaon (hills)	1982	3 days/week	5–7 km	Folger and Dewan (1983)
Kumaon (hills)	1970s	1.6 hrs/journey	1.6 km	Survey by author in 1993
(average: all seasons)	1990s	3–4 hrs/journey	4.5 km	

*Firewood collected mainly by women and children.
†NA: Information not available.
‡Average computed from information given in the study.

between the time spent in fuel gathering vs. cooking can also adversely affect the meal's nutritional quality. Although these nutritional consequences impinge in some degree on all household members, women and female children bear the greater burden because of the noted gender biases in intrafamily allocations for food and health care.

Fourth, apart from the health consequences of inadequate nutrition, poor rural women are also more directly exposed than are men to water-borne diseases, and to the pollution of rivers and ponds with fertilizer and pesticide run-offs, because of the nature of domestic and agricultural tasks they perform: fetching water for home use and animal care; washing clothes near ponds, canals and streams; transplanting rice (usually a woman's task in much of Asia), which is associated with a range of diseases, including gynaecological infections (Mencher and Saradamoni, 1982; UNDP, 1980), the risk of which is compounded by chemically polluted irrigation water; cotton picking, also done mainly by women, which exposes them to pesticides that are widely used for cotton cultivation;[14] and so on.[15] In India, high exposure to pesticides is known to cause limb and visual disabilities (Mohan, 1987). Moreover, the burden of family ill-health associated with water pollution falls largely on women who take care of the sick.

Fifth, population displacements arising from the submersion of villages in the building of large irrigation and hydroelectric works, or from large-scale deforestation, disrupts social support networks. Such support can include reciprocal labor-sharing arrangements during peak agricultural seasons, or loans in cash or kind (small amounts of food, fuel, etc.). Women in poor households typically depend a great deal on such informal networks, which they also help to build through daily social interaction, marriage alliances that they are frequently instrumental in arranging, and complex gift-exchanges (Sharma, 1980; Vatuk, 1981). Spread across nearby villages, these networks, once disrupted, cannot be reconstituted easily, an aspect usually ignored by rehabilitation planners.

Sixth, the gathering of food and medicinal items, done mainly by women and children in many regions, helps them acquire a considerable knowledge of the nutritional and medicinal properties of plants, roots, and trees, critical for surviving prolonged shortages during climatic disasters such as droughts (Agarwal, 1990). The degradation of forests and VCs and their

appropriation by a minority is eroding the material base on which such knowledge about nature is founded and kept alive.[16] This, in turn, will further undermine the ability of poor households to cope with subsistence crises.

3. REGIONAL VARIATION IN GENDER VULNERABILITY, ENVIRONMENTAL DISADVANTAGE, AND POVERTY INCIDENCE

The noted and likely class-gender effects of environmental degradation and natural resource appropriation, however, are not experienced uniformly. The effects vary regionally across India, since there are distinct regional differences in the extent of environmental disadvantage, incidence of poverty, and women's status.

(a) *Regional variations in gender vulnerability*

Although women in relation to men are disadvantaged in some degree in all parts of India, their vulnerability is greater in northern India, especially the northwest, than elsewhere in the country.[17] This regional variation is reflected, for instance, in measures such as sex ratios (females per 1,000 males), rural female labor force participation rates, rural female literacy rates, women's access to property, and rural fertility rates. Regional variations in social practices such as dowry, close-kin marriages, and *purdah* (female seclusion) also impinge on the above factors.

(i) *Sex ratios (see Table 3 and Figure 1)*

Sex ratios (females per 1,000 males) are female-adverse in all parts of India, except Kerala.[18] They are the most adverse, however, in northwest India (with the exception of Himachal Pradesh) and the least adverse in south India. It is notable that among the lowest values are found in Punjab and Haryana, two of India's most agriculturally prosperous states.

Female-adverse sex ratios embody the effects on female survival of an anti-female bias in intrahousehold distribution of food and especially of health care. In the absence of a bias we would expect there to be more females than males in the population, that is for the ratios to be over 1000, as they are in most parts of the developed and developing world (Dreze and Sen, 1989, p. 52).

This anti-female bias in the distribution of basic necessities within the household, in large parts of India but especially in the northwest, is also revealed by other indicators such as gender differences in anthropometric measures, morbidity and mortality rates, the quality of medical treatment received during illness, hospital admissions, and so on (Agarwal, 1986b; A. K. Sen, 1985). On intrahousehold distribution of food, the evidence is more mixed: surveys reveal a notable bias in northern India but no clearcut bias in southern India (Harriss, 1990).

The economic reasons for this regional variation in intrahousehold gender bias lie in the girl child being seen as an economic burden much more in northern India (especially the northwest) than in the south, due to at least three factors: the much lower female labor force participation rates in the northwest than elsewhere in the country; the higher female/male marriage costs because of the greater incidence and amounts of dowry in the north, relative to the south;[19] and the taboo on Hindu parents in northern India (especially among the upper castes) seeking any kind of material support from married daughters (Agarwal, 1994), while parents in south India socially can and do seek such support during drought or other crises (Caldwell, Reddy and Caldwell, 1988). Also conducive to such support-seeking is the prevalence of close-kin marriages in south India (Agarwal, 1994).

(ii) *Rural female labor force participation rates (RFLFPR) (see Table 3 and Figure 2)*

This variable (computed for populations of 15 years of age and above) serves as a proxy for several factors such as: one, the degree of physical and economic visibility of women's work which affects social perceptions about women's productive contributions to the household and to the economy (what Sen, 1990a, terms the "perceived contribution response") — the greater the visibility, the greater the likelihood of women's (and female children's) needs being better taken into account by the family; two, the extent of a woman's familiarity with her physical environment; and three, the extent of a woman's physical mobility, which impinges on her ability to undertake a better job search and assert her legal rights, including in family property. Higher labor force participation could also enhance women's ability to bargain for a larger share in household resources and increase her say in decision-making. These positive aspects of women's labor force participation exist notwithstanding the fact that in poor households women typically enter the labor force out of economic compulsion.

We note from Table 3 and Figure 2 that regionally, northwestern and eastern India (which constitute a large part of northern India) are areas of low female labor force participation in work outside the home confines,[20] while south and northeast India are areas of relatively higher participation rates. Within northwest India, the rates for Punjab, Haryana, and Uttar Pradesh are much lower than those for Himachal Pradesh and Rajasthan, but even taking that into account the overall rates for the northwest are lower than for the south and northeast.

These differences reflect regional differences in a mix of factors, especially: one, the emphasis on

Table 3. *Indicators of gender, environment, and poverty vulnerability*

States	Sex Ratio F/M 1991	Rural Female Labor Force Parti. Rates (RFLFPR) 1981	Rural Female Literacy Rates (RFLR) 1991	Rural Total Fertility Rates 1988	Normal Rainfall Levels: Annual (mm) 1989	Percentage Forest Area 1987–89	Percentage Rural Nonpoor 1987–88	Male-female Differences in: Rural Labor Force Parti. Rates 1981	Male-female Differences in: Rural Literacy Rates 1991
INDIA	929	24.4	25.37*	4.3		19.49	55.12	60.2	22.0
NORTHERN INDIA									
Northwest									
Haryana	874	7.6	27.09	4.5	722.9	1.27	76.83	74.2	24.7
Himachal P.	996	29.2	41.94	3.7	1664.2	24.00	75.25	51.6	19.0
J&K	923	9.2	NA	4.9	1179.1	9.20	66.89	75.0	NA
Punjab	888	2.6	36.86	3.5	768.5	2.32	78.98	79.4	13.7
Rajasthan	913	16.1	9.24	4.8	529.2	3.80	58.11	69.2	28.8
Uttar P.	881	9.4	16.00	5.6	1217.6	11.49	52.30	76.1	25.8
West and Central									
Gujarat	936	20.2	32.78	3.6	834.2	5.90	58.43	65.4	23.4
Madhya P.	932	39.7	15.66	5.1	1195.0	30.03	50.17	49.5	24.9
Maharashtra	935	47.3	33.83	3.9	1190.3	14.32	45.83	38.2	23.9
Eastern									
Bihar	912	15.3	14.63	5.5	1254.3	15.50	33.74	68.5	24.1
Orissa	972	16.7	25.78	3.9	1456.3	30.26	34.36	69.6	23.8
West Bengal	917	10.0	31.39	4.0	2123.8	9.46	42.81	69.1	19.0
SOUTH INDIA									
Andhra P.	973	46.6	20.77	3.4	897.3	17.40	68.44	43.7	19.3
Karnataka	961	33.4	29.05	3.7	1783.6	16.80	57.71	54.1	20.9
Kerala	1040	20.2	74.16	2.0	2718.6	26.11	55.98	44.2	5.8
Tamil Nadu	972	39.8	36.75	2.7	1000.6	13.62	48.70	47.2	21.5
NORTHEAST INDIA									
Arunachal P.	861	67.1	19.68	NA	4334.0	81.80	NA	22.0	18.3
Assam	925	55.4	31.88	3.9	2365.7	33.10	46.92	NA	15.7
Manipur	961	61.2	35.39	NA	2026.3	80.10	79.76	15.2	18.3
Meghalaya	947	60.8	30.14	NA	2365.7	70.98	NA	28.1	4.8
Mizoram	924	60.6	54.01	NA	2026.3	89.47	NA	23.0	8.4
Nagaland	890	72.6	41.87	NA	2026.3	86.12	NA	5.3	11.0
Tripura	946	14.3	36.18	NA	2026.3	50.78	75.78	65.8	18.8

Sources: For Sex Ratio and Rural Literacy Rates 1991: Computed from GOI (1991b).
For Rural Labour Force Participation Rates 1981: Computed from GOI (1987b).
For Rural Total Fertility Rates (RTFR): GOI (1991c), p. 26.
For Normal Rainfall: GOI (1992), p. 41; For Forest Area: GOI (1991a), pp.2 3, 28.
*Does not include J&K where the figures for 1991 were not collected.

purdah, which is high in northern (and especially northwestern) India, but is not practiced among Hindus in south or northeast India, and is also less strict among Muslims in these parts; two, the incidence of low-caste and tribal populations (northeast India, for instance, has a significant tribal population) — women in these communities are less constrained in working outside the home than upper-caste women, due especially to the absence of *purdah* among tribal groups and the lesser emphasis on it among low-caste Hindus; three, the prevailing cropping patterns — women's labor input is typically much greater in rice and coarse grain cultivation (the former dominates south and east India) than in wheat cultivation which dominates the northwest;[21] and four the incidence of poverty and land inequality which compels poorer women to seek wage work.[22] Northwest India is characterized by high *purdah*, a dominance of wheat cultivation, low levels of tribal population, and relatively high agricultural prosperity, all of which make for lower levels of women's visible participation in the labor force.

It is notable that male-female *differentials* in rural labor force participation rates (RLFPRs) follow a regional pattern very close to that of female labor

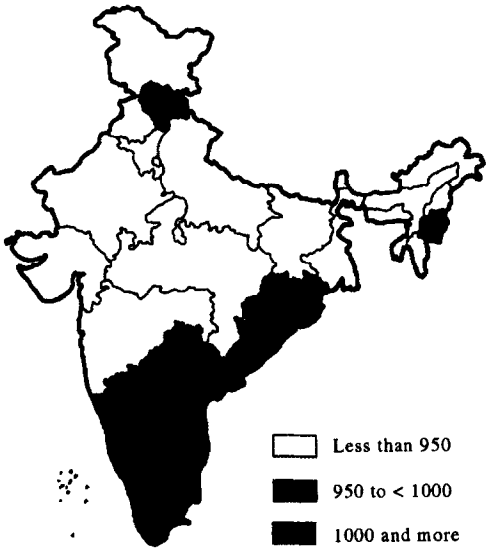

Figure 1. *Sex ratios (1991).*

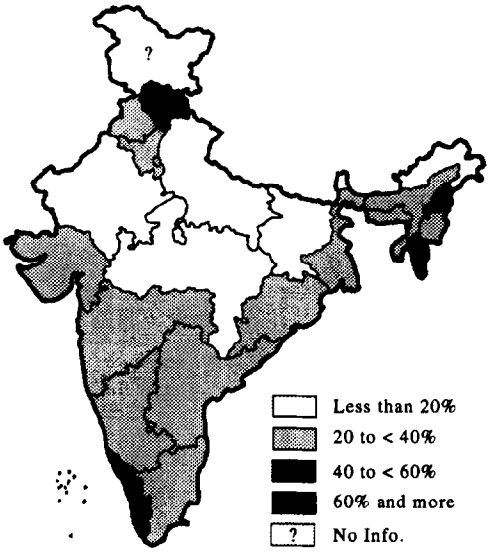

Figure 3. *Rural female literacy rates (1991).*

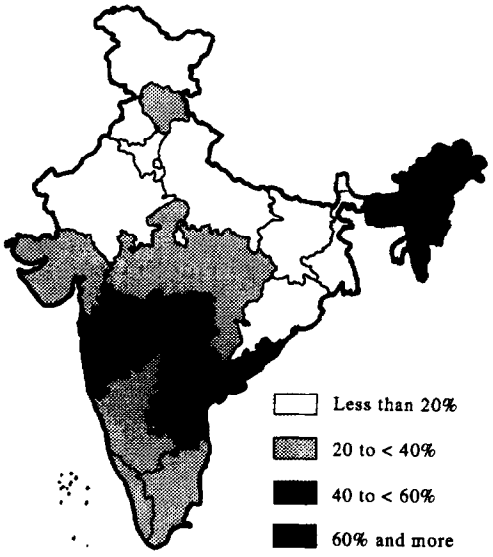

Figure 2. *Rural female labor force participation rates (1981).*

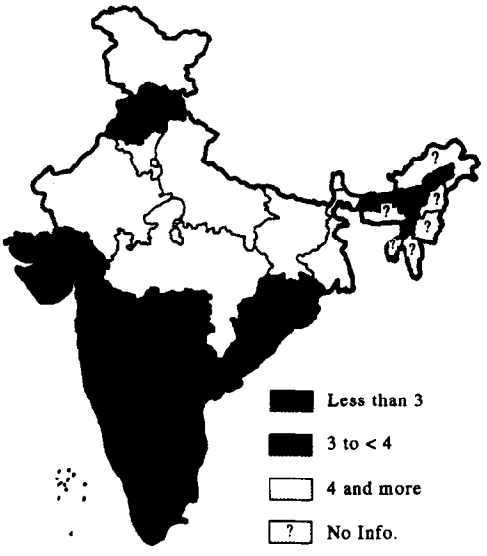

Figure 4. *Rural total fertility rates (1988).*

force participation rates (Table 3). Indeed the correlation coefficient between the two variables is –0.96. The states that fall in the lowest ranges of RFLFPR (below 10%) also have the highest gender differentials in participation rates, and vice versa. This is as one might expect given that rural male labor participation rates show little variation across states (the coefficient of variation is 0.07), since men are not subject to the same social constraints on working outside the home as women in northern India, nor are male participation rates subject to the same biases in survey reporting.[23]

(iii) *Rural female literacy rates (RFLR) (see Table 3 and Figure 3)*

Female literacy is taken here as an indicator of women's overall capability to achieve as well as to function autonomously, and as reducing women's vulnerability to being duped and exploited. Female

literacy rates in rural India show dramatic variations across the country (Table 3 and Figure 3). They are highest in Kerala, on the higher side in northeast India, but extremely low in several northern states, most notably Rajasthan (with a rate of 9.2), Uttar Pradesh, Bihar, and Madhya Pradesh — the states which constitute the "Hindi heartland" of India.

The high female literacy rate in Kerala is striking, and is due to several favorable factors, including the substantial presence of communities traditionally practicing matrilineal inheritance (and among whom girl children were especially valued); the importance given to women's education historically both by local rulers and by matrilineal groups such as the Nayars;[24] missionary educational activity; and, in more recent years, the state-funded expansion of basic education. Himachal Pradesh also stands out, particularly in the context of northwest India, in having relatively high female literacy (second highest after Kerala), just as it does relatively well on the RFLFPR and the sex ratio (again coming second to Kerala on the latter count).

Gender *differentials* in rural literacy rates (RLRs) follow a regional pattern broadly similar to that of rural female literacy rates, in that the regions of low gender differentials in literacy, like the regions of high female literacy, lie mainly in the south and northeast: the correlation coefficient between the two variables is –0.73. At the same time, regional variations are less for gender differentials than for female literacy rates *per se*.

(iv) *Women's access to property, especially arable land*[25]

Traditionally, both in law and in practice, property inheritance, and especially the inheritance of arable land (the most important form of rural property in India), was overwhelmingly patrilineal (that is, inheritance was through the male line). The exceptions were a few pockets of matriliny (inheritance through the female line) or of bilaterality (inheritance to and through both sons and daughters) among some tribal and Hindu communities located in the northeast (principally Meghalaya) and the southwest (principally Kerala). Historical evidence also suggests that women of affluent households in patrilineal Hindu communities of the south and west occasionally inherited (or received in dowry) landed property in practice, unlike women in the north who virtually never did. Among patrilineal Muslim communities scattered across India, although women were legally entitled to half their brothers' shares under the Shariat, traditional practices were often very similar to those of local Hindus, and women were typically disinherited from landed property; although again there were rare cases of affluent families endowing women with land.

Today women have legal rights to inherit parental land in most communities and regions of India. Although these largely remain rights on paper, there are notable regional differences which follow the observed historical patterns. In the traditionally matrilineal communities of southwest and northeast India, women of propertied households often inherit some land. But they seldom do so among the traditionally patrilineal groups, again the likelihood being greater in southern than in northern India. For instance, a recent sample survey by Marty Chen, of rural households with widows in seven states, found that in the northern states only 8% of women whose fathers owned land inherited some as daughters, while in the southern states 18% did so. The percentage for all the surveyed states taken together was 13.[26]

The regional difference is due to a complex set of factors among which differences in marriage practices are particularly important. For instance, in-village and close-kin marriages, which are permitted among Hindu families in south India, allow any land a daughter inherits to remain within the overall purview of the extended family; this makes for less opposition to her claims. In northern India most Hindu communities forbid such marriages, and marriage between unrelated individuals and outside the village is the norm. Distant marriages also make it more difficult for women to assert their property claims, or to manage any land they may inherit, and most forfeit their shares in favor of brothers. The ideology and practice of female seclusion in northern India further compound the difficulties women face in establishing their property claims and in managing land. This is less of a constraint in the southern states.

Despite women's relative advantage in the southern states, however, the difference while notable is not enormous, and everywhere women's low command over landed property adversely affects theirs and the children's immediate welfare and vulnerability (especially but not only in households which are *de facto* female headed). The vast gender gap in effective land rights also reduces women's bargaining power both within and outside the household and so aggravates their disadvantage in the distribution of other private and public goods as well (for elaboration see Agarwal, 1994).

(v) *Rural total fertility rates (RTFR) (see Table 3 and Figure 4)*

These rates again show a distinct regional pattern which reinforces that noted for most of the variables discussed above. The rates are on top of the scale in the "Hindi heartland" of Bihar, Uttar Pradesh, Madhya Pradesh, and Rajasthan, and at the bottom of the scale in the southern states of Kerala and Tamil Nadu. The four northern states mentioned, account for some 40% of the country's population.

The greater the number of children rural women bear during their reproductive years (that is, the higher the RTFR) and hence the more time they spend in bearing and rearing children, the less time and energy

they will have for income-generating work. High rates would also circumscribe the geographic radius of their lives. Although, when older, children could assist in farming, high fertility restricts women precisely in the ages when they could be most physically energetic and mobile. Moreover, to the extent that a decline in the rates is a result of a woman's own decision to have fewer children, or of her being the main party to the decision, this may be seen as an indicator of women's relative autonomy in decision-making within the household.

(vi) *Overview*

In overview then, by most of the noted indicators (relating to 1991 or the late 1980s), women are much more vulnerable economically and socially in northern India than they are in the south or northeast. In addition, within the northern belt they are especially vulnerable in most of the northwestern states, as well as in the eastern and central states of Bihar and Madhya Pradesh. In terms of change, although a more detailed comparison with the 1970s is made later, it needs mention here that while female literacy has grown and total fertility rates have declined in virtually all parts of rural India since the 1970s, the regional pattern of greater female disadvantage in northern India relative to the rest of the country continues (see Table 5). Moreover, sex ratios have been declining, and while the decline over 1971–91 has occurred even in some of the southern and northeastern states, Agnihotri's (1995) calculations show that a disproportionate amount of the overall decline is accounted for by the northern states, especially Bihar and Uttar Pradesh.

In terms of our analysis this means that if all other things were constant, on account of the gender factor alone women in northern India are likely to be affected more adversely by deteriorating environmental conditions, than women elsewhere.

(b) *Regional variations in environmental disadvantage*

A number of indicators would be important in assessing environmental disadvantage, such as rainfall levels, the percentage of geographic area under forests and VCs, soil quality, groundwater levels, and so on. Unfortunately there is an absence of reliable and comprehensive state-wise data on variables such as the latter three. Hence the first two (rainfall and forest area) are used here.[27]

(i) *Normal rainfall levels (see Table 3 and Figure 5)*

Rainfall levels serve as an indicator of environmental vulnerability associated with climatic conditions prevailing in different regions. Arid and semi-arid regions, for instance, are more prone to drought than regions of high rainfall. Although irrigation technology may mitigate the effects of such vulnerability to some extent, especially in relation to crop production, the availability of water for irrigation is not independent of rainfall. Indeed it is dependent on rainfall in many ways: e.g., for recharging the groundwater table for wells and tubewells, and for replenishing streams, rivers and canals in surface irrigation works. Moreover, the excessive sinking of tubewells in many semi-arid regions (and even elsewhere), as noted earlier, has lowered the water table permanently, and dried up many ordinary wells. Hence while mitigating climatic disadvantage in the short term, tubewells in several regions have increased environmental vulnerability in the long term, especially for those who cannot afford to invest in ever deeper ones. In addition, rainfall levels affect the availability of biomass in a region, especially biomass in the VCs and forests, which is of particular importance for the livelihoods of poor households with little or no irrigated land of their own.

In terms of "normal" rainfall (the average rainfall over a 30-year period), we note that the northeastern states are the most advantaged and large parts of northwestern, western and central India the least advantaged, with south and east India falling in between. "Normal" rainfall has been taken rather than the actual rainfall in a given year, since our interest here is in the overall climatic disadvantage of the region as a general feature, rather than that specific to a particular year.

(ii) *Percentage area under forest (see Table 3 and Figure 6)*

The percentage of geographic area under forest again gives an indication of environmental vulnerability. As noted, forests provide poor households in

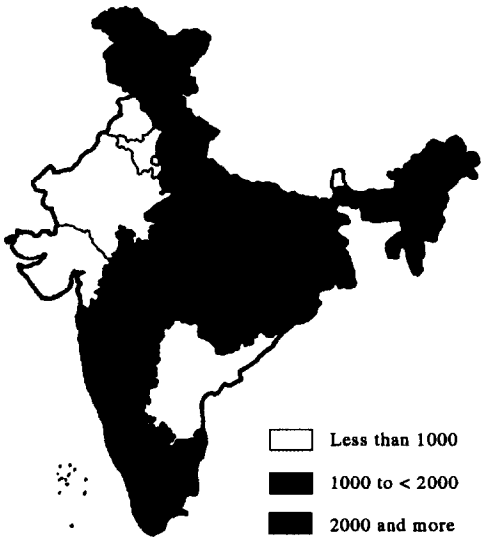

Figure 5. *Normal rainfall levels (1989).*

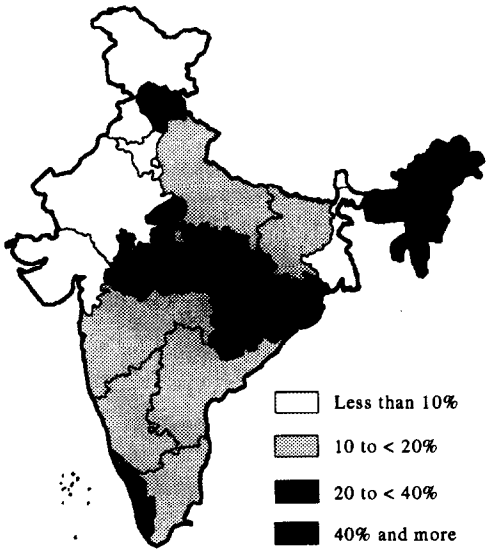

Figure 6. *Percentage geographic area under forests (1987–89).*

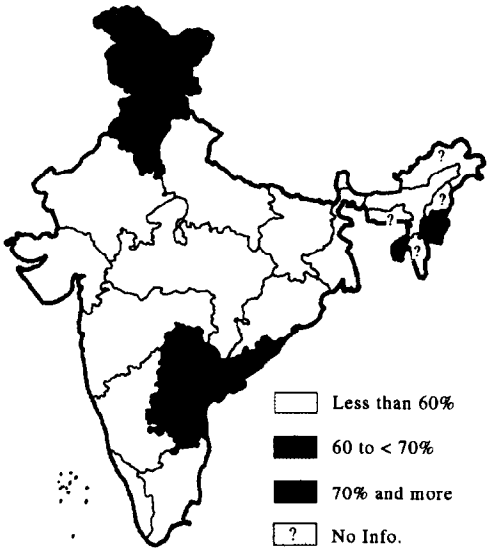

Figure 7. *Percentage rural nonpoor (1987–88).*

general, and women in particular, with a variety of basic items for daily use, and deforestation would therefore increase the vulnerability of rural livelihood systems. The northeastern states in general have high to very high levels of forest cover, and northwestern and western India have very low levels, Himachal Pradesh being an exception in the northwest. The lowest levels are found in Haryana, Punjab, and Rajasthan — a geographic belt which is quite denuded. The remaining states come in between, with Orissa and Madhya Pradesh (in eastern and central India respectively) on the higher side, with about 30% of their area under forest, and most other eastern states and the southern states on the lower side.

(c) *Regional variations in poverty incidence*

Regional variations are again striking in poverty incidence, measured in terms of the proportion of people in a state who are below the poverty line (taking the head-count ratio), or conversely, as used here, the proportion of nonpoor in a state (see Table 3 and Figure 7). The northwestern states have the highest proportion of nonpoor (or the lowest incidence of poverty), while the eastern states have the lowest proportion of nonpoor (or highest incidence of poverty). Southern, central and western India come in between. Poverty estimates are not available for several northeastern states, but where they are (as for Assam, Manipur and Tripura) the incidence is on the lower side, being closer to the northwestern pattern.

The geographic patterns of gender, environment, and poverty disadvantage across states indicates that the three "maps" do not necessarily overlap. Indeed some of the areas with the lowest poverty incidence are among the most gender biased, as in northwest India. Women are affected by all three factors, namely the environmental vulnerability of the state in which they are located, the incidence of poverty in it, as well as its extent of gender bias. They would be best-off if located in regions where all three aspects of vulnerability are low, and worst off where all are high. States such as Kerala and Himachal Pradesh do relatively well on all three counts, with low gender bias, medium environmental disadvantage, and medium-to-low poverty incidence. States such as Bihar, however, do badly on all three counts. In broad terms we could thus surmise that although poor rural women everywhere would be affected negatively by environmental degradation, those in Bihar would be among the most adversely affected and those in Kerala and Himachal Pradesh among the less adversely affected.

In most states, however, the three elements of vulnerability move in different directions. It is not possible to say, merely by looking at the absolute figures for each element individually, what the final effects would be of the three elements coming together. For this we now need to examine the GEP(V) indices discussed below, which aggregate the individual elements.

4. GEP(V) INDICES: MEASURING GENDER-ENVIRONMENT-POVERTY VULNERABILITY CROSSREGIONALLY AND INTERTEMPORALLY

The aggregations attempted here can only capture very broad differences between states, and not the

more subtle variations stemming from the qualitative factors discussed above. In addition, intrastate differences (say, between hills and plains), which can be important both environmentally and culturally, are not captured. The results presented here therefore need to be read against the backdrop of the more complex mosaic of gender, environment, and poverty vulnerabilities highlighted earlier.

(a) *Indicators selected and index specification*

The gender vulnerability indices have been computed by using three of the indicators discussed in the previous section: sex ratio, rural female literacy rate, and rural total fertility rate. The lower the sex ratio and rural female literacy rate, and the higher the rural total fertility rate in a given region, the greater the gender vulnerability in that region. On literacy I have used the female literacy rates rather than the gender gap in literacy, since what is important in assessing women's vulnerability is less women's literacy level relative to men's than the level of female literacy *per se* as a critical indicator of the development of (or shortfalls in) women's capabilities and ability of achieve.[28] Moreover, the overall level of female literacy prevailing in a region both reflects and affects social attitudes and gender biases on other counts. Hence women living in a region with a high female literacy rate, even if it has a high gender gap in literacy, will tend to be less vulnerable than those living in a region in which the female literacy rate is low, even though the gender gap in literacy is also low. In any case, as noted earlier, female literacy rates and the gender gap in literacy rates are highly negatively correlated.

Environmental vulnerability has been measured here by the level of normal rainfall and the percentage area under forests. The lower the normal rainfall levels in a state and the lower its forest cover, the more would be its environmental vulnerability.

It needs mention that the indices for environmental vulnerability are somewhat more difficult to interpret than those for gender or for poverty. For instance, an increase in female literacy rates and a reduction in poverty incidence can both be seen as achievable and appropriate goals for public policy. But rainfall levels are exogenously determined and not open to policy intervention. The percentage area under forest in a region is partly exogenously determined, depending on the climatic zone in which the region falls, and partly open to policy intervention. But one may not want to aim at maximum achievable levels of forest area, given other competing needs for land, e.g., for agriculture or industrial/urban expansion. At any rate, there is no information available that could enable us to determine what the maximum climatically achievable or maximum socioeconomically (or environmentally) desirable forested area might be by state. Some government policy documents mention that at least one-third of India's geo-area should desirably be under forest, but there is no specification of how this all-India average might be distributed across different regions of India.

Apart from paucity of information that precludes the construction of a more complex measure, there is also a positive reason for constructing the environmental index as done here, namely that it still remains a reasonable measure of environmental vulnerability. It would be appropriate to assume that a state with a high level of normal rainfall and high forest cover would be less environmentally vulnerable than one with low levels of rainfall and forest cover, even if the ability of public policy to act on these variables might be limited.

For measuring poverty vulnerability I have taken the proportion of nonpoor in a state. The lower this proportion (*viz.*, the higher the proportion of poor), the greater the poverty vulnerability.

As noted earlier, a formula similar to that used by UNDP to compute the Human Development Index has been used to arrive at the vulnerability indices, GEP(V), first separately for 1971 and 1991, and then for changes over time. The appendix gives details of the methodology used to compute the indices.

To rank states relative to each other for a specified year, the following GEP(V) indices are presented here: GEP(V)1, 1971; and GEP(V)2, 1991. These aggregate the effects of sex ratios, rural female literacy rates, rural total fertility rates, percentage geo-area under forests, normal rainfall, and percentage rural non-poor in 1971 and 1991 respectively.[29]

To combine a measure of progress over time with interstate comparisons at one point in time, the computation procedure is modified as described in the appendix note. The modified GEP(V) indices so obtained are: GEP(VT)1 for 1971; and GEP(VT)2 for 1991. States are then ranked by the size of the difference between the 1971 values and the 1991 values of the GEP(VT) indices, to assess shifts over time.

In the above measurements, each of the indicators (three for gender vulnerability, two for environmental vulnerability, and one for poverty vulnerability) is assumed to have equal weight in the aggregation. Another exercise is also attempted, however, by first consolidating the three gender indices into a single index, and the two environment indices also into one index, leaving us with one index each to represent the three aspects of concern: Gender (G), Environment (E), and Poverty (P). The average of these gives us what I term the consolidated GEP(VC) indices for 1971 and 1991 as follows: GEP(VC)1 for 1971, and GEP(VC)2 for 1991. In addition, G(T), E(T), P(T), and GEP(VCT) are the consolidated indices measuring temporal shifts in ranking between states over 1971–91, computed by a method similar to that followed for GEP(VT).

Effectively, these indices measure what could be termed the "GEP-gap" between states at a point in time, and over time.

(b) *Results*

(i) *The unconsolidated indices*

From Tables 4 and 5 we note that the indicators chosen take a wide range of values. For instance, in 1991 (Table 4), the sex ratio ranged from 861 in Arunachal Pradesh to 1,040 in Kerala; the rural female literacy rates ranged between 9.2 in Rajasthan and 74.2 in Kerala: the total rural fertility rates were as high as 5.6 in Uttar Pradesh compared with 2.0 in Kerala; normal rainfall ranged from a low of 529 in Rajasthan to 4,334 in Arunachal Pradesh; the percentage geo-area under forests ranged from 1.3 in Haryana to 89.5 in Mizoram; and the percentage of rural nonpoor ranged from 79.8 in Manipur and 79.0 in Punjab (which, even in 1971, had one of the lowest levels of poverty in the country) to 33.7 in Bihar.

The situation in 1971 was not markedly different (Table 5) in terms of either the high regional variation in the values taken by the indicators, or the states falling at the two ends of the ranges. For instance, in 1971, as in 1991, Kerala had the highest sex ratio and rural female literacy rate, and was among the lowest in rural fertility rates. Similarly, Arunachal Pradesh had the lowest sex ratio, Rajasthan one of the lowest rural

Table 4. *Indicators and GEP(V) index, 1991*

States	Sex Ratio F/M 1991	Rural Female Literacy Rates 1991	Rural Total Fertility Rates 1988	Normal Rainfall Levels: Annual (mm) 1989	Percentage Forest Area 1987–89	Percentage Rural Nonpoor 1987–88	GEP(V)2† Index
INDIA	929	25.37*	4.30		19.49	55.12	0.67
Andhra P.	973	20.77	3.40	897.3	17.40	68.44	0.59
Arunachal P.	861	19.68	NA	4334.0	81.80	NA	0.48
Assam	925	31.88	3.90	2365.7	33.10	46.92	0.62
Bihar	912	14.63	5.50	1254.3	15.50	33.74	0.88
Gujarat	936	32.78	3.60	834.2	5.90	58.43	0.67
Haryana	874	27.09	4.50	722.9	1.27	76.83	0.73
Himachal P.	996	41.94	3.70	1664.2	24.00	75.25	0.46
J&K	923	NA	4.90	1179.1	9.20	66.89	0.70
Karnataka	961	29.05	3.70	1783.6	16.80	57.71	0.60
Kerala	1040	74.16	2.00	2718.6	26.11	55.98	0.28
Madhya P.	932	15.66	5.10	1195.0	30.03	50.17	0.75
Maharashtra	935	33.83	3.90	1190.3	14.32	45.83	0.69
Manipur	961	35.39	NA	2026.3	80.10	79.76	0.35
Meghalaya	947	30.14	NA	2365.7	70.98	NA	0.48
Mizoram	924	54.01	NA	2026.3	89.47	NA	0.39
Nagaland	890	41.87	NA	2026.3	86.12	NA	0.49
Orissa	972	25.78	3.90	1456.3	30.26	34.36	0.68
Punjab	888	36.86	3.50	768.5	2.32	78.98	0.63
Rajasthan	913	9.24	4.80	529.2	3.80	58.41	0.82
Tamil Nadu	972	36.75	2.70	1000.6	13.62	48.70	0.59
Tripura	946	36.18	NA	2026.3	50.78	75.78	0.45
Uttar P.	881	16.00	5.60	1217.6	11.49	52.30	0.85
West Bengal	917	31.39	4.00	2123.8	9.46	42.81	0.70
Mean							0.603
SD							0.156

Sources:
For Sex Ratio and Rural Female Literacy Rates (RFLR) 1991: Computed from GOI (1991b).
For Rural Total Fertility Rates (RTFR): GOI (1991c), p. 26.
For Normal Rainfall: GOI (1992), p. 41.
For Forest Area: GOI (1991a), pp. 23, 28.
For Rural Poor 1987–88, Head Count Ratio: Minhas, Jain and Tendulkar (1991), p. 1676.
*Does not include J&K where the figures for 1991 were not collected.
†GEP(V)2: Average of 1991 indices, relating to Sex Ratio, RFLR, RTFR, normal rainfall, percentage forest area, and percentage rural nonpoor.

Table 5. *Indicators and GEP(V) index, 1971*

States	Sex Ratio F/M 1971	Rural Female Literacy Rates 1971	Rural Total Fertility Rates 1972	Normal Rainfall Levels: Annual (mm) 1973	Percentage Forest Area 1972–75	Percentage Rural Nonpoor 1970–71	GEP(V)1† Index
INDIA	930	13.17	5.80		16.89	42.67	0.64
Andhra P.	977	10.92	4.77	863.2	17.70	48.43	0.57
Arunachal P.	861	3.00	7.00	4323.0	61.50	NA	0.59
Assam	896	16.51	5.68	2417.8	26.87	49.64	0.59
Bihar	954	6.39	5.07	1308.2	13.05	31.21	0.67
Gujarat	934	17.19	6.42	893.4	4.85	42.24	0.73
Haryana	867	9.24	7.39	816.2	1.81	59.98	0.83
Himachal P.	958	18.15	5.32	1708.2	27.12	71.27	0.45
J&K	878	4.98	5.06	1098.7	10.03	72.33	0.64
Karnataka	957	14.54	4.64	1636.6	15.38	47.18	0.55
Kerala	1016	53.10	4.58	2674.7	22.12	30.97	0.34
Madhya P.	941	6.10	7.16	1233.4	24.52	37.60	0.75
Maharashtra	930	17.84	5.06	1189.8	13.22	44.25	0.62
Manipur	980	16.35	4.47	1950.8	67.53	27.13	0.32
Meghalaya	942	18.94	4.74	2417.8	64.03	NA	0.37
Mizoram	946	NA	NA	1950.8	65.91	NA	0.37
Nagaland	871	16.39	NA	1950.8	49.61	NA	0.64
Orissa	988	12.06	4.88	1543.9	31.07	25.39	0.57
Punjab	865	19.88	5.92	640.2	2.18	71.35	0.69
Rajasthan	911	4.03	6.98	531.0	3.30	45.26	0.84
Tamil Nadu	978	18.98	4.76	952.7	12.84	33.55	0.60
Tripura	943	17.27	4.29	1950.8	60.11	45.46	0.41
Uttar P.	879	6.99	7.45	1312.7	8.80	48.64	0.83
West Bengal	891	15.02	NA	2151.4	9.45	23.33	0.80
Mean							0.599
SD							0.158

Sources:
For Sex Ratio: GOI (1981), p. 30.
For Rural Female Literacy Rates (RFLR): GOI (1974), pp. xxiv.
For Rural Total Fertility Rate (RTFR): GOI (1981), p. 68.
For Normal Rainfall: GOI (1976), p. 38.
For Forest Area: National Remote Sensing Agency Data, Table reproduced in CSE (1986), p. 80.
For Rural Poor 1970–71, Head Count Ratio: Minhas, Jain and Tendulkar (1991), p. 1676.
*For RTFR, the sample size is very small for Meghalaya, Manipur, Tripura.
†GEP(V)1: Average of 1971 indices, relating to sex ratio, RFLR, RTFR, normal rainfall, percentage forest area, and percentage rural nonpoor.

female literacy rates, and Uttar Pradesh the highest rural fertility rate. A substantial reduction in poverty in Manipur is, however, noteworthy: in 1971 it ranked among the lowest in the percentage rural nonpoor in the population, while in 1991 the state ranked slightly higher than even Punjab on this count.

From Table 6, Figure 8, and Table A1, which give the results of the first set of GEP(V) indices, we note that in both 1971 and 1991, the highest vulnerability end of the range contained only the northern states of the country (covering northwest, west, east and central India), and the lowest vulnerability end contained Kerala, Himachal Pradesh, and most of the northeastern states. In both years, the states that fell in the highest vulnerability end (those with the highest GEP-gap) included the following four: Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh, and Bihar joined them in 1991; and the least vulnerable states included the following six: Himachal Pradesh, Kerala, Manipur, Meghalaya, Mizoram and Tripura. Figure 8 also clearly brings this out.

The high rank correlation of 0.876 (Table A1) for 1971 and 1991 indicates that the ranking between states did not change substantially over the two decades. In other words, the least vulnerable states and the most vulnerable ones were broadly the same in 1971 and 1991.

In terms of temporal shifts, Table 7 and Table A1

Table 6. *Unconsolidated indices: States falling in different ranges of GEP(V) indices, 1971 and 1991*

	GEP(V)1: 1971	GEP(V)2: 1991
≤ 0.50	Himachal P., Kerala, Manipur, Meghalaya, Mizoram, Tripura	Arunachal P., Himachal P., Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Tripura
> 0.50–≤ 0.60	Andhra Pradesh, Arunachal P., Assam, Karnataka, Orissa, Tamil Nadu	Andhra Pradesh, Karnataka, Tamil Nadu
> 0.60–≤ 0.70	Bihar, J&K, Maharashtra, Nagaland, Punjab	Assam, Gujarat, J&K, Maharashtra, Orissa, Punjab, West Bengal
> 0.70	Gujarat, Haryana, Madhya Pradesh, Rajasthan, Uttar Pradesh, West Bengal	Bihar, Haryana, Madhya Pradesh, Rajasthan, Uttar Pradesh

Source: Tables 4 and 5.

Table 7. *Temporal shifts over 1971–91: States falling in different ranges of GEP(VT) indices*

Range of difference (1971–91)	GEP(VT)1 – GEP(VT)2
≤ 0.05	Bihar, Meghalaya
> 0.05–≤ 0.10	J&K, Karnataka, Maharashtra, Mizoram, Orissa, Uttar P.
> 0.10–≤ 0.15	Andhra P., Assam, Himachal P., Madhya P., Rajasthan, Tamil Nadu, Tripura
> 0.15–≤ 0.20	Arunachal P., Gujarat, Haryana, Punjab, West Bengal
> 0.20	Kerala, Manipur, Nagaland

Source: Table A1.

indicate the extent to which the GEP-gap narrowed over 1971–91 and which states made most progress on this count. Two types of changes are captured here: an improvement or worsening of a state's degree of GEP vulnerability in 1991 relative to 1971, and a shift in its rank in relation to other states. The intertemporal difference was greatest for Kerala, Manipur and Nagaland, all three of which show notable reductions

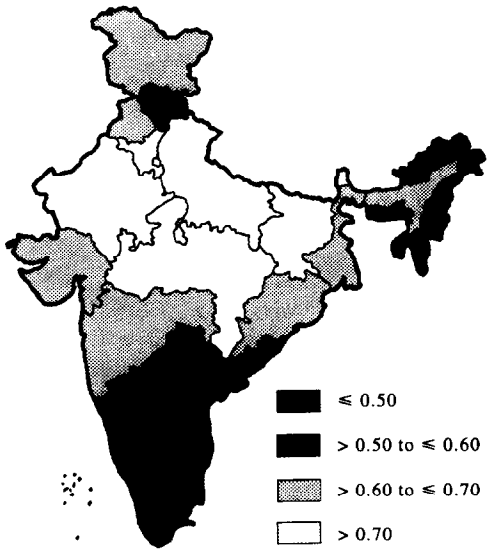

Figure 8. *GEP(V)2 Index (1991).*

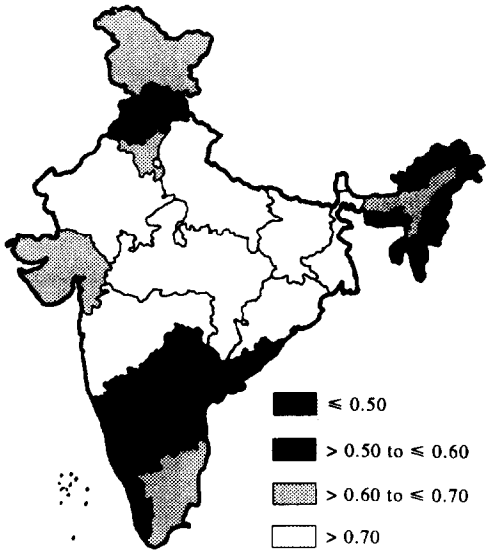

Figure 9. *GEP(VC)2 Index (1991).*

in their GEP-gap. In contrast, Bihar retrogressed slightly, and a number of other states, including Meghalaya, Orissa and Maharashtra, made very little progress. In between come states such as Gujarat, Haryana, Punjab, West Bengal and Arunachal Pradesh, which made a fair degree of progress, and the remaining states which made marginal progress.

(ii) *The consolidated indices*

The results of the consolidated indices reinforce

the above observations. The states falling in the most vulnerable part of the range in both 1971 and 1991 were the northern ones, and those falling in the least vulnerable part of the range were Kerala, Himachal Pradesh and the northeastern states (see Table 8, Table A2, and Figure 9).

Moreover, from Table 9 (which enables a comparison between G, E and P indices for 1991) it is interesting to note that there are several states which did especially poorly on gender but were economically prosperous (that is, they fell in the high vulnerability part of the spectrum on the gender index, but in the

Table 8. *Consolidated indices: states falling in different ranges of GEP(VC), 1971 and 1991*

	GEP(VC)1: 1971	GEP(VC)2: 1991
≤ 0.50	Arunachal P., Himachal P., Kerala Meghalaya, Mizoram, Tripura	Arunachal P., Himachal P., Kerala, Manipur Meghalaya, Mizoram, Nagaland, Tripura
> 0.50 – < 0.60	Andhra P., Assam, J&K, Karnataka, Manipur, Punjab	Andhra P., Karnataka, Punjab
> 0.60 – ≤ 0.70	Maharashtra, Nagaland, Orissa, Tamil Nadu	Assam, Gujarat, Haryana, J&K, Tamil Nadu
> 0.70	Bihar, Gujarat, Haryana, Madhya P., Rajasthan, Uttar P., West Bengal	Bihar, Madhya P., Maharashtra, Orissa, Rajasthan, Uttar P., West Bengal

Source: Table A2.

Table 9. *States falling in different ranges of G, E, P, GEP(VC) consolidated indices, 1991*

	G: 1991 Index	E: 1991 Index	P: 1991 Index	GEP(VC)2: 1991 Index
≤ 0.50	Himachal P., Kerala, Mizoram, Tamil Nadu	Arunachal P., Manipur, Meghalaya, Mizoram, Nagaland	Andhra P., Gujarat, Haryana, Himachal P., J&K, Karnataka, Manipur, Punjab, Rajasthan, Tripura	Arunachal P., Himachal P., Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Tripura
> 0.50– ≤ 0.60	Andhra P., Gujarat, Karnataka, Maharashtra, Manipur, Meghalaya, Orissa, Tripura	Assam, Kerala, Tripura	Kerala, Uttar P.	Andhra P. Karnataka, Punjab
> 0.60– ≤ 0.70	Arunachal P., Assam, Nagaland, Punjab, West Bengal		Madhya P., Tamil Nadu	Assam, Gujarat, Haryana, J&K, Tamil Nadu
> 0.70	Bihar, Haryana, J&K, Madhya P., Rajasthan, Uttar P.	Andhra P., Bihar, Gujarat, Haryana, Himachal P., J&K, Karnataka, Madhya P., Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar P., West Bengal	Assam, Bihar, Maharashtra, Orissa, West Bengal	Bihar, Madhya P., Maharashtra, Orissa, Rajasthan, Uttar P., West Bengal

Source: Table A2.

low vulnerability part on the poverty index): this includes Haryana and Punjab. In terms of the environment index, all the states, other than Kerala and the northeastern ones, fell in the high vulnerability part of the range. Bihar, however, again performed persistently poorly on all three counts.

For changes over time, Table 10 and Table A3 give an idea, based on the consolidated indices, of how different states progressed in terms of reducing their GEP-gap during 1971–91, taking G(T), E(T), P(T) separately, as well as GEP(VCT). We find that although a number of states reduced their gender and poverty vulnerability, few reduced their environmental vulnerability; indeed, in some states this increased. Moreover, some states, such as Kerala, had a low gender vulnerability even in 1971 and reduced it substantially further by 1991. Some other states, such as Arunachal Pradesh, Haryana, Punjab and West Bengal, were highly gender vulnerable in 1971 and became less so in 1991, but despite the improvement they continued to be in the relatively high vulnerability range on this count.

Finally, as measured by the GEP(VCT) index, the states that made most progress in reducing overall

Table 10. *Temporal shifts in consolidated indices over 1971–91; States falling in different ranges of G(T), E(T), P(T), and GEP(VCT)*

Range of difference (1971–91)	G(T) Index	E(T) Index	P(T) Index	GEP(VCT) Index
≤ 0.05	Bihar, Manipur, Meghalaya	Andhra P., Assam, Bihar, Gujarat, Haryana, Himachal P., J&K, Karnataka, Kerala, Madhya P., Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar P., W. Bengal	Assam, Bihar, Maharashtra, J&K	Bihar, J&K, Meghalaya
> 0.05– ≤ 0.10	Mizoram, Orissa, Tripura	Manipur	Himachal P., Uttar P.	Assam, Maharashtra, Orissa, Uttar P.
> 0.10– ≤ 0.15	Andhra P., Karnataka	Arunachal P., Mizoram	Punjab	Himachal P., Karnataka, Madhya P., Mizoram, Punjab, Rajasthan
>0.15– ≤ 0.20	Madhya P., Maharashtra Rajasthan, Tamil Nadu, Uttar P.		Karnataka Orissa	Andhra P., Gujarat, Haryana, Tamil Nadu, Tripura
> 0.20– ≤ 0.25	Assam, Gujarat, J&K, Nagaland	Nagaland	Madhya P., Rajasthan	Nagaland W. Bengal
> 0.25	Arunachal P., Haryana, Himachal P., Kerala, Punjab, W. Bengal		Andhra P., Gujarat, Haryana, Kerala, Manipur, Tamil Nadu, Tripura, W. Bengal	Arunachal P., Kerala, Manipur

Source Table A3.

GEP vulnerability over time were Manipur, Kerala, and Arunachal Pradesh; and those that made least progress were Bihar, Jammu and Kashmir (J&K), and Meghalaya. Given Meghalaya's low initial GEP-gap, however, the lack of progress is less a cause for concern than it is for Bihar and J&K which started out with high GEP-gaps in 1971.

(iii) *In overview*

Overall the results indicate that gender, environment and poverty vulnerabilities overlap in some regions and not in others. In Bihar, for instance, the three elements overlap: the state has high gender vulnerability, high environmental disadvantage, and a high incidence of poverty. Madhya Pradesh and West Bengal follow close behind. By contrast, the southern states (especially Kerala) and much of northeast India are relatively favorable for women in terms of lower gender bias, lesser depletion of the natural resource base, favorable rainfall levels, and poverty levels which are medium (that is, they are less high than in the eastern states, albeit much higher than in the northwestern ones).

In between are states which perform poorly on one or two counts but not on all three. The most notable are Punjab and Haryana, which are among the most advanced in terms of agricultural prosperity and have relatively low poverty incidence, but perform poorly on gender equality and vulnerability. Clearly low poverty and overall prosperity can go hand in hand with a high degree of anti-female bias. Although the position of women has improved over time in both states by some indicators, such as a rise in female literacy and a drop in fertility rates, in overall terms northwest India continues to be a region of high gender vulnerability, relative to most other parts of the country. This is also a region of environmental vulnerability, in that, in most northwestern states there is virtually no area left under forest and little under VCs.

In terms of all three elements (gender, environment, and poverty) taken together, the states with the biggest GEP-gaps today are all located in northern India, while those with the smallest GEP-gaps are all located in south and northeast India.

5. RESPONSES

The noted negative effects of gender bias, poverty, and environmental degradation, however, have not gone unchallenged by those affected. The last two decades have seen the emergence of numerous women's groups, poor peasant and tribal movements, and environmental groups, the former two protesting the gender and class bias in existing patterns of development, the latter their high environmental costs. In some cases, challenges relating to gender, poverty and the environment have overlapped. Certainly poor women have been significant actors in some major environmental movements. Similarly, over the years there have been a multiplicity of government schemes and programs to tackle all three forms of vulnerability, variously targetting women, the poor, and the environmentally degraded regions. Here, it is not possible to detail these multiple forms of grassroots or State responses to a complexity of interlinked disadvantages, or to analyze the effectiveness of these responses. I will therefore focus only (and briefly) on one element, namely environmental action (nongovernmental and governmental) and its implications for poor rural women.

The environmental movements that have emerged in India in recent decades embody an increasing resistance to ecological destruction, whether caused by the direct logging of trees, or by the submersion of forest and village land with large irrigation and hydroelectric works. Nonviolent movements such as Chipko in the Himalayas and Appiko in Karnataka are among examples of forest-related environmental resistance. Movements resisting large dams include those associated with the Narmada valley project in central India, the Koel-Karo in Bihar, the Silent Valley Project in Kerala (which was shelved due to local protests and central government intervention in 1983), the Inchampalli and Bhopalpatnam dams in Andhra Pradesh (against which 5,000 tribals, with women in the vanguard, protested in 1984), and the controversial Tehri dam in Garhwal.

Women's participation in such movements has typically been high, with some notable features. Women have protested not only jointly with the men of their community, but on occasion even in opposition to the village men, due to different priorities in resource use, as on several instances in the Chipko movement (Agarwal, 1991). In tree-planting schemes, Chipko women (as also women in other contexts) have typically favored trees which provide fuel and fodder, rather than the commercially profitable varieties often favored by men.[30]

These movements apart, in recent years numerous micro-level forest protection groups have been formed, some self-initiated by village communities; others catalyzed by nongovernmental organizations (NGOs); and yet others state-initiated, as under the recently launched Joint Forest Management (JFM) program in which village communities and the government share the responsibilities and benefits of protecting and regenerating degraded forest land.

The government's recognition that environmental degradation may be acquiring crisis proportions in some regions dates back to only about a decade and a half ago. Moreover, the approach to finding solutions has mostly been piecemeal rather than comprehensive. For instance, the problems of deforestation and fuelwood shortage were initially addressed mainly through tree-planting schemes, some launched under

direct government management, others promoted by encouraging village communities and individual farmers to plant. Many of the government's direct planting ventures, however, had poor tree survival rates and typically did little to alleviate the local fuel-fodder problem.[31] There was, for instance, a preoccupation with monocultural plantations of tree species for commercial use, which at times even replaced mixed forests, and which (such as eucalyptus) provided no fodder and poor fuel. In addition, the takeover of village land used by the local population for various other purposes, the top-down implementation, and the failure to elicit the approval and support of the villagers when the schemes were initiated, led to widespread local hostility and resistance. Far from benefiting the poor these schemes often took away even their existing rights in local resources. Moreover, typically women either did not feature in such schemes, or at best were made caretakers in tree nurseries, with little say in the choice of species or other aspects of the project (Agarwal, 1986a). Community forestry schemes again had high failure rates in the 1980s, in the absence of effective institutional mechanisms to ensure village participation in decision-making and the equitable distribution of costs and benefits.

The real "success" stories of the 1980s, with plantings far exceeding targets, came from farm forestry, with the better-off farmers, in many regions, reaping quick profits by allotting fertile crop land to commercial tree species, eucalyptus again being a great favorite. As a result, in some regions, employment, crop output, and crop residues (that could be used for fuel) declined, sometimes dramatically (Chandrashekar, 1987; Agarwal, 1986a).

Over the years, however, environmental movements, and reporting on the state of the country's environment by journalists, grassroots activists, and academics, have had some impact on developmental thinking in India, and improved environmental awareness in policy formulation. Moreover, resistance to the destruction of nature and nature-dependent livelihoods, the demand for environmentally sustainable policies and more egalitarian access to natural resources, and the lack of success with top-down schemes, have led to a shift toward a more participative approach in scheme implementation. In concrete terms, this can be seen in some recent government programs and initiatives, in particular, the earlier-mentioned JFM program launched in 16 states which seeks to involve local communities in natural resource protection and regeneration. How well this program works in different regions remains to be seen, but from my recent visits to some JFM sites in Gujarat and West Bengal during 1993–95, the results are encouraging, and hold more promise of some substantial benefits reaching the villagers than did most previous government programs (see Agarwal, forthcoming (a), for details). Similar micro-initiatives undertaken independently by village communities or catalyzed by NGOs also hold such promise.

However, the gender implications of JFM and other recent village-level initiatives are, so far, disquieting. For instance, in many cases a ban on firewood collection in the local protected forests and VCs, imposed by the all-male village forest management committees without consulting the women, has made it necessary for women to walk several additional miles for this basic household need (Agarwal, forthcoming (a)). Unlike environmental movements such as Chipko and the Narmada Bachao Andolan which have had substantial women's participation, most of the village-level micro-initiatives are dominated by men. Women's formal participation, in particular, is limited, although in some regions women have formed informal groups which are doing the effective work of forest and VC management. The contrast with movements may in fact lie precisely in this, *viz.* the situation-specific and episodic mobilization needed in protest agitations, compared with the more formalized formation of groups needing regular interaction in many micro-initiatives. Elsewhere I have examined the implications of and factors underlying women's low participation in the formal forums of these initiatives, as well as what restricts or facilitates women's exercise of agency in such environmental action (Agarwal, forthcoming (a)). Here it suffices to summarize the factors.

The restricting factors include the traditional exclusion of women from village assemblies and councils which is replicated in the new initiatives; gender ideology (e.g., notions about acceptable female behavior, about women's capabilities and appropriate roles in society, and about women's presence in "male spaces"); lack of a critical mass of women to lend weight to women's voices; the inconvenient timings of meetings; women's age and marital status; and male bias among villagers, government officials, and sometimes also NGO personnel). The factors facilitating women's participation include, in particular, the presence of gender-progressive NGOs, especially women's groups, and the fact that many of the initiatives have arisen among hill or tribal communities where women face fewer restrictions on their physical visibility and mobility. This last point needs elaboration in that the considerable regional and community-wise variation in women's status discussed in this paper is likely to impinge on women's ability to undertake collective action around environmental issues.

In particular, as noted earlier, there are significant differences across regions and between communities (tribal/nontribal, Hindus/Muslims, upper-caste/ lower-caste Hindus, hill dwellers/plains dwellers), in the emphasis on female seclusion and gender segregation, and hence in the constraints on women's mobility, freedom to participate in public meetings, and ability

to speak out in mixed gatherings of men and women. We would therefore expect regional and community-wise differences in women's ability to organize collectively (just as we had noted the effect of these aspects on female labor force participation rates). Female seclusion practices among Hindus, as noted, are strongest in northern India and virtually non-existent in south and northeast India; and within northern India they are strongest among the upper- caste groups located in the plains, and little practiced among the upper castes in the hills or among lower- caste and tribal communities anywhere. Seclusion practices among Muslims, although not identical to those for Hindus, show a similar regional and community-wise variation. Manifest less in the practice of veiling (which is not widespread) and more in the gender segregation of public space (e.g., women being discouraged from spending time in spaces where men congregate, as in the market place), such practices severely restrict women's free interaction in public forums.[32]

Of course, the social construction of appropriate female behavior (the emphasis on soft speech, deference to male elders, etc.) operates in some degree everywhere, even in the absence of overt strictures, including in the hill and tribal communities where most of the environmental protection movements and micro-initiatives have thus far emerged. But since women in such communities are not explicitly restricted, and play a visible and substantial role in the economy in all parts of the country, this tends to reduce the importance of the regional dimension. The effect of this dimension on women's ability to undertake collective action is likely to be more significant among upper-caste Hindus and for Muslims. For instance, we would expect it to be much more difficult for upper-caste Hindu women in the northwestern plains of India to participate than those from south India, for the reasons noted. Moreover, it would be important to map these regional and community differences for understanding women's responses to the environmental crisis and the possibilities of their acting collectively in their own interest, as an increasing number of non-tribal or non-hill communities get involved in forest and VC management.

6. SUMMARY COMMENTS AND POLICY POINTERS

The experience of the past two decades offers several insights and lessons on the links between gender, poverty, and the environment in rural India.

The processes of environmental degradation and appropriation of natural resources by the State, and by small numbers of individuals, have specific class-gender implications, manifest in the erosion of both livelihood systems and knowledge systems, but it is women and female children of poor rural households who are affected most adversely. The effects, however, are not experienced uniformly across all regions of India, since there are geographic differences in gender bias, in environmental risk, and in poverty incidence. Rural women are likely to be worst-off in regions where all three forms of disadvantage are strong and reinforce each other, and best-off where all three are weak.

If we were to concentrate on areas where poor rural women are likely to be affected most adversely by further environmental degradation, then the state needing the highest priority is Bihar, followed by several others in northern India, namely Uttar Pradesh, Rajasthan, West Bengal, Orissa, and Madhya Pradesh. These warrant special attention in terms of wasteland development and forest regeneration schemes focused on poor rural women which could give the latter greater control over common property resources. These states also need to be the special focus of programs for increasing female literacy; of health and other support services which would help women make informed decisions concerning their fertility; and of general support structures (possibly provided by NGOs) for improving women's effective property rights in the region. (On this last count, as noted earlier, the adverse effects on women of the statization and privatization of communal resources are closely linked not only to the gender division of labor, but also to private property differentials between women and men.)

Insofar as the major success stories of forest regeneration today relate to communities taking charge of their local natural resource base, a viable solution will need decentralized planning and control. In addition, it will require institutional arrangements that ensure the involvement of the rural poor, and especially women, in decisions about what species of trees and other vegetation are planted or encouraged to grow, who holds control over the land on which regeneration takes place, and how the associated benefits are shared.

Poor rural women's active participation in forest protection and wasteland development schemes is imperative for several reasons. First, resources in women's hands are more likely to be used for the family's well-being than resources in men's hands, given the noted evidence that in poor rural households where both spouses are employed, women tend to spend almost all their earnings on the family's basic needs, and men often a significant part on their personal needs.

Second, without women's cooperation, either rules instituted for protecting communal lands and forests tend not to work, given women's primary responsibility for fuel and fodder collection; or women tend to be left worse-off than before, as noted earlier in relation to JFM and other village-level initiatives. Involving women in the decision-making process can ensure a

more equitable solution. In the long term, of course, the challenge lies in ensuring that rural men also share equally in these and other household tasks.

Third, in schemes involving tree-planting, women and men, as noted, often have different priorities in species selection. Women typically prefer a diversity of species which fulfill everyday household needs, such as for fuel, fodder, and food items, over species which fulfill only sporadic needs, such as of small timber, or which mainly bring occasional cash returns. Involving women in species selection is therefore critical. In particular, trees which provide fuel and fodder (in regions where these are scarce) can not only decrease women's work burden, but the advantage of greater availability can be reaped by all household members. Moreover, there would be less incentive to keep girl children out of school for collection purposes.

Fourth, improving women's access to communal land resources would help redress, in some small degree, existing severe gender inequalities in access to private land resources. Moreover, as noted, the privatization of communal resources over the past several decades has affected poor rural women the most adversely, given the widespread class and male bias in the privatization process. Initiatives which protect the communal character of village commons, or which create new collective forms of resource control in women's hands, therefore appear vital. Fifth, involving women could enhanced the use and development of more diverse knowledge about plants and species.

In all this, focusing especially on states with high GEP-gaps would be a useful starting point. Moreover, the past two decades of India's experience with development projects that seek to reach the disadvantaged, and especially women, indicates that schemes which follow a group approach are more effective than those which follow an individual-oriented approach. Recent success stories of forest and VC regeneration, including of women's NGOs and informal groups operating under a diversity of institutional arrangements, bear this out (Agarwal, forthcoming (a)).[33]

Indeed, the concerns of environment, poverty, and gender taken together highlight both the need for reexamining, and the possibility of finding new resolutions for, many long-standing issues relating to development, redistribution, and institutional change.

NOTES

1. In India, the term "state" relates to administrative divisions within the country and is not to be confused with "State," used throughout the paper in the political economy sense of the word. Elsewhere in South Asia these administrative divisions are termed provinces.

2. This section draws substantially from Agarwal (1991, 1992), and also brings to bear on the discussion new material, including from a primary survey I undertook during 1993–94.

3. I am using the term "class" here in a broad sense, without intending to underplay the caste/tribal forms of disadvantage, but recognizing the considerable overlap of these categories with class (and more generally with poverty).

4. On traditional systems of community water management, see Sengupta (1985); and Seklar (1981). On communal management of forests and village commons, see Guha (1983), Gadgil (1985), and Moench (1988). On firewood-gathering practices, see Agarwal (1986a): firewood for domestic use in rural households was customarily collected in the form of twigs and fallen branches, which did not destroy the trees. Even up to some 15 years ago, 75% of firewood used as domestic fuel in northern India (and 100% in some areas) was in this form (Agarwal, 1987).

5. I use the term "control rights" here, since what appears critical in this context is less who owns the resources, than who has control over them. For instance, the control of State-owned resources could effectively rest with the village community.

6. See, e.g., Baland and Platteau (1994); Bromley and Cernea (1989); and Dasgupta and Maler (1990), for useful discussions on the relationship between different property rights regimes and environmental protection and regeneration.

7. For details, see Agarwal (1986a).

8. Personal observation in Rajasthan, Punjab and Haryana.

9. For a discussion on the causes of this regional variation see section 3 of this paper. See also Agarwal (1986b), Miller (1981), and Agnihotri (1995).

10. See discussions in Agarwal (1986b, 1984) and Bardhan (1977).

11. For a detailed regional mapping of some of these variables in the context of women's land rights in South Asia, see Agarwal (1994).

12. A study in Nepal is indicative (Kumar and Hotchkiss, 1988): it found that the substantial increase in firewood collection time due to deforestation significantly reduced women's crop production time, leading to an associated drop in the production of maize, wheat and mustard, the cultivation of which is primarily dependent on female labor in the region surveyed. These are all crops grown in the dry season when there is increased competition from fuel and other collection activities. The same is likely to be happening in the hills of India.

13. A study in Bangladesh found, for instance, that with fuel shortage the total number of meals, as well as the number of cooked meals eaten daily in poor households, declined (Howes and Jabbar, 1986).

14. In China, in cotton-growing areas, several times the acceptable levels of DDT and BHC residues have been found in the milk of nursing mothers among agricultural workers (Wagner, 1987).

15. See also Agarwal (1981).

16. Indeed it is not unusual for village women to deny possessing any such knowledge about traditional remedies to outsiders, and to emphasize they only use modern medicines. In my earlier-mentioned field survey, women, both in Kumaon and in Rajasthan, initially denied knowing anything about local medicinal herbs, roots, etc., before finally admitting they often used several traditional remedies based on local plants. Existing development strategies have made little attempt to tap or enhance indigenous knowledge and understanding.

17. In the discussion below, the terms "northern India" and "north India" are used only when a very broad comparison of the northern and southern (*viz.* the peninsular) parts of the country is intended, and would roughly include the north-western, central, and eastern states, but exclude the north-eastern (mainly tribal) states. Typically, however, the more detailed geographic division is used in the discussion.

18. Migration patterns do not affect the state-level sex ratios much since interstate migration appears to be quite low. According to estimates based on the 1971 census, interstate migration typically involved 3–4% of the total population (Agnihotri, 1995). This would have increased somewhat since then but there are no strong reasons to expect any dramatic changes in patterns.

19. See e.g. Miller (1981) and Agarwal (1986b). It appears though that this regional difference has narrowed in recent years (as discussed in Agarwal, 1986b).

20. The 1981 figures are used here since the age-wise breakup for workers (to calculate the participation rate for the 15 and above age group), is not yet available for 1991. The 1981 census divides workers into "main" and "marginal", depending on whether they have worked for the major part (over 183 days) of the previous year. The figures for main workers have been used (rather than for main plus marginal), since my concern here is with capturing the physical and economic visibility of women's work and women's physical mobility: these are better indicated by taking only the "main" workers category. The "marginal" workers would also include many women who are involved in work within the home compound, such as looking after family cattle and poultry. Although undeniably this is important to capture if our purpose were to measure women's economic contribution, but the main worker category better captures *social perceptions* about their contributions, and it is the latter, as noted, which has particular implications for gender bias within the home.

21. See also Bardhan (1974) and G. Sen (1985) on this. The effect of cropping pattern differences may, however, be offset by the other factors mentioned: for instance, in West Bengal although rice cultivation dominates, female labour force participation in field-related work is low.

22. G. Sen (1985), for instance, in her district-level analysis of 1971 census data, found that a high incidence of women agricultural wage labourers in the female population in a district was significantly correlated with low agricultural growth rates, a high proportion of gross cropped area under coarse grains, and high inequality in land ownership.

23. For definitional and enumeration biases which lead to the underreporting of women workers in India's census and National Sample Survey data, see Agarwal (1985).

24. In 1891, almost half the female literates in Kerala were Nayars (Nayar, 1989, p. 211). Notably also, in 1817, the young queen of Travancore, Rani Gouri Parvati Bai, placed clear responsibility for promoting education on the State: "The state should defray the entire cost of education of its people in order that there might be no backwardness in the spread of enlightenment among them, that by diffusion of education they might be better subjects and public servants and that the reputation of the state might be advanced thereby" (cited in Sen, 1990b, p. 66).

25. For a detailed discussion on the issue of women's rights in property, especially agricultural land in South Asia, see Agarwal (1994).

26. Marty Chen, personal communication of her survey results, reported in more detail in Agarwal (forthcoming (b)).

27. Although, as discussed earlier, VCs play a very important role in the livelihoods of poor households, and especially of women, the data on them are not reliable or comprehensive enough for our statistical analysis. Jodha's (1986) study, quoted earlier, is based on a survey and only covers some states. The main method of computing area under VCs for all states of India would be from the Government of India's "land use statistics." These give information under various heads such as net sown area, current and permanent fallows, culturable wasteland, uncultivable wasteland, and so on. Some of these categories can be clubbed together to obtain state-wise assessments of area under VCs (as attempted in Agarwal, 1994). These estimates however, would be rough, and in some cases misleading. For instance, Rajasthan appears to have 40% of its geo-area under VCs (the largest percentage in the country), but this is in large extent accounted for by barren land, a significant part of which consists of desert dunes.

28. On the issue of human capabilities, including female literacy, see especially Sen (1989); and see Dreze and Sen (1995) on the relationship between female literacy and other variables, such as female under-five mortality. The most recent *Human Development Report 1996* also uses female illiteracy rates (rather than the gender gap in literacy) as one of three indicators to compute the "capability poverty measure" — an index of poverty focused on human capabilities.

29. I also computed these indices, and the consolidated indices discussed later, without including the rural total

fertility rates, but the results were not markedly different. For these results, see my earlier mentioned 1995 UNRISD discussion paper, of which the present paper is a shorter version.

30. A gender divergence in choice of trees in tree-planting schemes was noted not only in the Chipko movement, but also in Rajasthan by Brara (1989), and in Gujarat by Sarin and Khanna (1993); in Gujarat, women also favored more diverse species than men.

31. For a discussion on these schemes and their shortcomings, see Agarwal (1986a).

32. For a detailed discussion of regional variations in seclusion practices, and more generally on women's participation in public activities, see Agarwal (1994).

33. The Bankura wasteland development project in West Bengal is a good example. Initiated in 1980 by an NGO, it had by 1988 spread to 36 villages involving about 1,500 (mostly poor tribal) women as members of groups which collectively planted trees for sericulture, on wasteland donated by the villagers (Singh, 1988). Many of these plantations are today yielding a fair profit (personal visit in 1993). Moreover, many members of these groups are among the most active women participants in the JFM program in the state. Also see Singh and Burra (1993) for other success stories relating to women's wasteland management.

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APPENDIX: GEP(V) INDICES: COMPUTATION METHOD AND DATA SOURCES

(a) *Computation method (see also UNDP, 1992, pp. 91–96)*

The individual indices of vulnerability (one for each indicator), by states, were computed as follows for all indicators, other than the rural total fertility rate (RTFR), which is discussed further below:

$$Z_{ij} = \frac{[\max_j X_{ij} - X_{ij}]}{[\max_j X_{ij} - \min_j X_{ij}]}$$

where X_{ij} denotes the actual value of an indicator ($i = 1, \ldots n$); max X_{ij} denotes the maximum value of the indicator attained by any state ($j = 1, \ldots k$) in the sample, and min X_{ij} denotes the minimum value attained.

For RTFR (the rural total fertility rate) the individual index was computed as: $1 - Z_{ij}$, since for this variable the higher the value the greater the vulnerability, while for the other variables the higher the value the lower the vulnerability.

The average of the individual indices gives us the GEP(V) indices, expressed algebraically as follows:

$$\text{GEP(V)} = 1/n \sum Z_{ij}$$

where n is the number of indicators used.

These indices rank states relative to each other for a specified year, and the maximum and minimum values are specific to that year. Over time, the actual values of the indicators change, as do their maximum and minimum values across all the states.

To combine a measure of progress over time with interstate comparisons at one point in time, the calculation procedure was modified as follows. The maximum and minimum values were defined here not for each point of time but over a period of time.

Thus to measure reduction in vulnerability during 1971–91, the minimum would be the minimum of all values of a given indicator (say sex ratio) for all states over the 20 years; similarly for the maximum. This helps us to make comparisons over time as well as across regions. The GEP(VT) values were obtained by taking the average of the individual indices for each indicator as before. The difference between the GEP(VT) values for 1971 and 1991 obtained in this way give the extent to which that state has moved over time in relation to itself and in relation to other states.

For the consolidated indices, I first computed the arithmetical means of the three individual indices for gender bias (to obtain the consolidated "G" index in Table A2; and computed the arithmetical mean of the two individual indices for environmental vulnerability (to obtain the consolidated "E" index in Table A2), and then proceeded as with the unconsolidated indices.

(b) *Data sources*

Information on the above indicators was obtained for years that fall as close as possible to 1971 and 1991. Sex ratios and rural female literacy rates were computed from the censuses in the respective years. Rural total fertility rates were again obtained from the census. Estimates of poverty incidence were taken from Minhas, Jain and Tendulkar (1991) who derived them from national sample survey data on consumption. Estimates for poverty are often controversial and vary widely depending on the underlying assumptions and the deflators used. My choice of source was dictated especially by two considerations: (i) the availability of figures for both 1970–71 and a year close to 1991, namely 1987–88; and (ii) the availability of estimates for a larger number of states (including some in the northeast), than provided by other sources. Figures used for normal rainfall were those published by the Meteorological Survey of India.

The information on forests, however, warrants some comment. It is now well established that estimates of forest area provided in the government's "land use statistics" are grossly inaccurate since they reflect forest area in administrative terms, rather than actual forest cover. It is the latter that is of interest to us in measuring environmental vulnerability. The figures used here for 1972–75 are those obtained through the national remote sensing agency (NRSA). The figures for 1987–89 are those assessed by the Forest Survey of India (FSI) on the basis of NRSA information. The FSI has argued that NRSA figures may somewhat underestimate actual forest cover, especially for the northeastern states (due to, among other things, cloud cover when the survey was done). From 1980 onward, therefore, the FSI have provided assessments that seek to compensate for this underestimation. For 1972–75, however, I understand such a modification exercise was not undertaken by the FSI. This means that the rise in forest cover between 1972–75 and 1987–89, which is especially noticeable in the northeastern states, may in some part represent actual increases (due to, say, a decline in area under shifting cultivation and an associated increase in land with open forests in the northeast); and in part represent an improvement in the accuracy of the estimates. In the absence of other estimates, however, I have used the NRSA 1972–75 estimates. This does not present a problem for ranking states in terms of environmental vulnerability in 1972–75. But a problem could arise in comparisons over time between 1972–75 and 1987–89, in that, some of the noted increases in forest area may be spurious. I therefore also tried computing the GEP(V) indices by omitting the area under forest, but this did not substantially affect the overall results in terms of shifts in the relative rankings of states over time.

Table A1. *States ranked by GEP(V) indices and GEP(VT) indices, 1971–91*

States ranked by GEP(V) indices in 1971 and 1991				Temporal shifts in GEP(VT) indices over 1971–91			
GEP(V)1 1971		GEP(V)2 1991		States	GEP(VT)1 1971	GEP(VT)2 1991	GEP(VT)1 minus GEP(VT)2
Manipur	1	Kerala	1	Andhra P.	0.67	0.55	0.12
Kerala	2	Manipur	2	Arunachal P.	0.65	0.46	0.19
Mizoram	3	Mizoram	3	Assam	0.67	0.55	0.12
Meghalaya	4	Tripura	4	Bihar	0.75	0.78	–0.03
Tripura	5	Himachal P.	5	Gujarat	0.79	0.62	0.17
Himachal P.	6	Meghalaya	6	Haryana	0.86	0.67	0.19
Karnataka	7	Arunachal P.	7	Himachal P.	0.57	0.42	0.15
Andhra P.	8	Nagaland	8	J&K	0.72	0.63	0.09
Orissa	9	Andhra P.	9	Karnataka	0.65	0.55	0.10
Assam	10	Tamil Nadu	10	Kerala	0.49	0.26	0.23
Arunachal P.	11	Karnataka	11	Madhya P.	0.79	0.67	0.12
Tamil Nadu	12	Assam	12	Maharashtra	0.71	0.63	0.08
Maharashtra	13	Punjab	13	Manipur	0.57	0.34	0.23
J&K	14	Gujarat	14	Meghalaya	0.52	0.47	0.05
Nagaland	15	Orissa	15	Mizoram	0.47	0.38	0.09
Bihar	16	Maharashtra	16	Nagaland	0.71	0.48	0.23
Punjab	17	J&K	17	Orissa	0.68	0.61	0.07
Gujarat	18	West Bengal	18	Punjab	0.76	0.60	0.16
Madhya P.	19	Haryana	19	Rajasthan	0.87	0.75	0.12
West Bengal	20	Madhya P.	20	Tamil Nadu	0.70	0.55	0.15
Uttar P.	21	Rajasthan	21	Tripura	0.55	0.43	0.12
Haryana	22	Uttar P.	22	Uttar P.	0.85	0.76	0.09
Rajasthan	23	Bihar	23	West Bengal	0.83	0.63	0.20
				INDIA	0.73	0.59	0.14
Rank correlation, GEP(V)1 & GEP(V)2 = 0.876				Mean	0.689	0.558	0.132
				SD	0.114	0.131	0.062

Table A2. *GEP(VC) consolidated indices, 1971 and 1991*

	Consolidated Indices 1971				Consolidated Indices 1991			
States	G*	E†	P‡	GEP(VC)1§	G	E	P	GEP(VC)2
INDIA	0.61	0.77	0.61	0.66	0.67	0.40	0.54	0.53
Andhra Pradesh	0.42	0.84	0.49	0.58	0.53	0.86	0.25	0.54
Arunachal P.	0.95	0.05	NA	0.50	0.61	0.04	NA	0.33
Assam	0.65	0.56	0.46	0.56	0.61	0.58	0.71	0.63
Bihar	0.53	0.81	0.84	0.73	0.87	0.82	1.00	0.90
Gujarat	0.64	0.93	0.61	0.73	0.55	0.93	0.46	0.65
Haryana	0.94	0.96	0.25	0.72	0.78	0.97	0.06	0.61
Himachal Pradesh	0.47	0.65	0.02	0.38	0.40	0.72	0.10	0.41
J&K	0.70	0.86	0.00	0.52	0.73	0.87	0.28	0.63
Karnataka	0.42	0.75	0.51	0.56	0.54	0.75	0.48	0.59
Kerala	0.03	0.56	0.84	0.48	0.00	0.57	0.52	0.36
Madhya Pradesh	0.78	0.73	0.71	0.74	0.79	0.75	0.64	0.73
Maharashtra	0.50	0.83	0.57	0.63	0.58	0.84	0.74	0.72
Manipur	0.34	0.31	0.92	0.53	0.52	0.36	0.00	0.29
Meghalaya	0.43	0.28	NA	0.36	0.60	0.36	NA	0.48
Mizoram	0.45	0.33	NA	0.39	0.48	0.30	NA	0.39
Nagaland	0.83	0.45	NA	0.64	0.67	0.32	NA	0.49
Orissa	0.40	0.64	0.96	0.67	0.55	0.71	0.99	0.75
Punjab	0.72	0.98	0.02	0.57	0.61	0.96	0.02	0.53
Rajasthan	0.84	0.99	0.55	0.79	0.83	0.99	0.47	0.76
Tamil Nadu	0.36	0.86	0.79	0.67	0.38	0.87	0.67	0.64
Tripura	0.40	0.37	0.55	0.44	0.56	0.52	0.09	0.39
Uttar Pradesh	0.93	0.84	0.48	0.75	0.93	0.85	0.60	0.79
West Bengal	0.78	0.73	1.00	0.84	0.63	0.74	0.80	0.73
Mean	0.587	0.666	0.461	0.598	0.598	0.683	0.386	0.580
SD	0.232	0.255	0.346	0.134	0.187	0.251	0.334	0.162

*G (consolidated) = Average of individual indices for sex ratio, rural female literacy rate, RTFR.
†E (consolidated) = Average of individual indices for % area under forest, normal rainfall.
‡P (consolidated) = Individual index for % rural nonpoor.
§GEP(VC) = sum of individual (consolidated) indices/no. of individual (consolidated) indices.

(Table A3 — *overleaf*)

Table A3. *Temporal shifts over 1971–91 in G(T), E(T), P(T) and GEP(VCT) consolidated indices*

States	G(T)	E(T)	P(T)	GEP(VCT)
INDIA	0.14	0.42	0.22	0.26
Andhra Pradesh	0.12	0.00	0.36	0.16
Arunachal Pradesh	0.38	0.12	NA	0.25
Assam	0.23	0.03	–0.05	0.07
Bihar	–0.06	0.01	0.04	0.00
Gujarat	0.24	0.00	0.28	0.18
Haryana	0.28	–0.01	0.30	0.19
Himachal Pradesh	0.28	–0.02	0.07	0.11
J&K	0.22	0.01	–0.10	0.05
Karnataka	0.14	0.02	0.19	0.12
Kerala	0.30	0.03	0.44	0.26
Madhya Pradesh	0.16	0.03	0.23	0.13
Maharashtra	0.16	0.01	0.03	0.06
Manipur	0.04	0.08	0.93	0.35
Meghalaya	0.04	0.04	NA	0.03
Mizoram	0.06	0.15	NA	0.11
Nagaland	0.23	0.22	NA	0.23
Orissa	0.09	–0.01	0.16	0.08
Punjab	0.27	0.02	0.14	0.14
Rajasthan	0.16	0.00	0.23	0.13
Tamil Nadu	0.20	0.01	0.27	0.16
Tripura	0.06	–0.04	0.54	0.19
Uttar Pradesh	0.16	0.00	0.06	0.07
West Bengal	0.28	0.00	0.35	0.21
Mean	0.176	0.030	0.194	0.143
SD	0.103	0.058	0.227	0.082