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ENVIRONMENTAL VULNERABILITY AND SOCIAL WELL-BEING[1]

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Environmental vulnerability arises from poorly managed ecosystem posing deleterious or negative anthropogenic pressures on ecosystem functions. While well - managed ecosystems reduce risks and vulnerability, poorly managed systems can exacerbate them by increasing risks of floods, drought, crop failure or disease. Susceptibility of ecosystem services to a sustained level of stress over a period in time disrupts and impairs the "level and composition of the stream of environmental services that people receive." [i]This maketh the potential of an environmental disaster. Therefore, environment vulnerability is a function of quality of ecosystem services available over a period in time. The Millennium Ecosystem Assessment identifies a "direct driver"- which is any natural or human induced factor that unequivocally influences ecosystem processes; and an "indirect driver"- which is any natural or human induced factor, which operates more diffusely, by altering one or more drivers. The MA categories of indirect drivers of change are demographic, economic, sociopolitical, scientific and technological, and cultural and religious. Important direct drivers include climate change, plant nutrient use, land conversion leading to habitat change, and invasive species and diseases.[ii]Human well being is affected not just by gaps between ecosystem service supply and demand but also by the increased vulnerability of individuals, communities and nations. Human vulnerability is therefore tied to changes in the quality of ecosystem services.

Ligia Noronha (2001) puts together the work of A. Sen (1981 and 1987), Anil Gupta and Robert Chambers, interpreting determinants of vulnerability[iii] as follows:

1. "Entitlements: (Both assets and access) individual/communal/familial/intra-family;
2. Personal Heterogeneity: age, gender, physical disabilities;
3. Variations in Social Obligations: weddings, dowry, funerals;
4. Environmental Location: marginal lands, climatic differences;
5. Livelihood diversification strategies;

[1] The paper draws on the Ph.D. work of Ms. Sanchita Talukdar, former Research Scholar in the department, under the guidance of the author and is suitably modified.

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6. Support networks: traditional/extended (non governmental organizations or the state);
7. Access to knowledge, information and technology network;

Human vulnerability due to environmental location is a typical feature of third world urbanization as pointed out by Main and Williams (1999-E.E Reference collection). A spate of natural and man-made environmental calamities has befallen cities of the third world, since the 1970s, "principally on account of the residential occupation of marginal urban environments[iv] by those who are unable to secure residence in less vulnerable sites."[v](see table 1)

The Global Environment Outlook – 3, report, reiterates that the 'vulnerability gap' widening within societies, between countries and across regions is putting the disadvantaged more at risk to environmental change and disasters. Vulnerable places are unevenly distributed which intensifies the uneven distribution of human exposure to environmental threats; for eg, "some locations, such as high latitudes, floodplains, river banks, small islands and coastal areas , pose more risk than others." [vi] Further, the report identifies that 'the environmental divide' ("characterized by a stable or improved environment in some regions, for eg. Europe and North America, and a degraded environment in most of the developing countries")[vii] has led to highly unequal distribution of environmental quality with reduced quality of life experienced almost everywhere.

A critical feature of vulnerability studies to global environmental change is the problem of identification of agents and levels. This is primarily due to the fact that the impacts (of an environmental event) are both spatially and socially differentiated. An ecosystem approach to vulnerabilities involves the assessment of "the health of ecosystems and their ability to cope with external threats and the links of this to human well-being."[viii] The notion of environmental vulnerability is embedded in a social-ecological system wherein negative externalities are identified in order to understand the interaction between events, trends, and policies at higher levels and its impacts at local, regional, national or global scale. Vulnerability assessments can be used to translate early warning information into preventive action and is a necessary element in early warning and emergency preparedness. A concern for susceptible individuals and groups in terms of the choices they have, the opportunities they have to make choices, and their internal capability to cope with development stress/resilience is scientifically studied which facilitates to initiate a schema for environmental sustainability analysis. According to the Human Development Report 2003, poor people are the most vulnerable to environmental shocks and stresses, including floods, prolonged drought and the emerging effects of climate change. In normal times, India's bio-diversity –related products (such as wild fruits or honey) account for about 20 per cent of the incomes of poor rural people. But during drought they account for more than 40 per cent because cultivated crops fail. Taking such situations into consideration, the

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HDR report stresses on the fact that, "ignoring environmental sustainability, even if doing so leads to short-run economic gains, can hurt poor people and undermine long-run poverty reduction."[ix] To quote another issue, in India, "the urban dimension of environmental health problems is typically manifested in the slum areas. These areas suffer due to unequal access to land, public utilities, and the urban infrastructure. Drainage, drinking water, and other water systems are in close contact, thus making them highly vulnerable to pollution. Slums are usually located in the proximity of major industries and road intersections, which have a negative impact on the ambient air quality"… : "with respect to air pollution alone, the Indian urban population is exposed to some of the highest pollutant levels in the world.."[x]

"The national ambient air quality standard prescribed by the CPCB for RSPM is 100µg/m3. Results from Mumbai, during the period between March 11 and April 5, 2004 show RSPM levels ranging between 1,606 µg/m3 and 1,81,061 µg/m3. [xi]

In New Zealand, sustainability is used in the 1991 Resource Management Act where sustainable management is defined as: "managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while:

1. Sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations; and
2. Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
3. Avoiding, remedying, or mitigating any adverse effects of activities on the environment."[xii]

"Building on Herman Daly's views on sustainability at a EPA (Environment Protection Agency)-sponsored forum, several panelists proposed that sustainability should incorporate non-declining levels of ecosystem services and community welfare, as well as distributional equity." The 2005 Environmental Sustainability Index (ESI) identify the following five core components of environmental sustainability:- (Table 2)

1. The State of the environmental systems , such as air, soil, ecosystems and water;
2. The stresses on those systems, in the form of pollution and exploitation levels;
3. The Human vulnerability to environmental change in the form of loss of food resources or exposure to environmental diseases;
4. The social and institutional capacity to cope with environmental challenges; and finally;
5. The ability to respond to the demands of global stewardship by cooperating in collective efforts to conserve international environmental resources such as the atmosphere.

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Table 1: Negative externalities and threats of disaster as determinants of marginal urban residential environments.

Ongoing Problem			***Threat of disaster***	
Negative externality	*Problem*	*Site specificity within city*	*Disaster*	*Site specificity within city*
Tectonic zone	Construction	***Low***	Earthquake/volcano	low
Steep slope	***Construction***	Very high	Landslide	Very high
	Access	Very high		
Swampy land	• Construction	Very high	Flooding	High
	• Access	Very high		
	• Insects/disease	High	Epidemic	High
Floodable Land	Insects/disease	Very high	Epidemic	Very high
	Construction	Very high	Flooding	Very high
	Access	Very high		
Industrial production zone	• Airborne pollution	High/low ***High***	Gas leak/explosion	Very high
	• Waterborne pollution	Very high	Epidemic	High
	• Noise	High		
	• Crowds of workers			
Rubbish dump	Airborne pollution	High/low High	Methane explosion Epidemic	Very high High
	Waterborne pollution	High		
	Insects/disease			
Burial ground	Waterborne pollution	High High	Epidemic	High
	Superstitious fears			
Borrow pit	Insects/disease	High	Epidemic	High
	Construction	Very high		
Airport flight path	Noise	High	Crash	High

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High tension electricity cables	Noise/illness	Very high	Electrocution	Very high
Railway line, Main road	Airborne pollution Noise	Very high Very high	Crash	Very high
Sewer	Waterborne pollution Insects/disease	High High	Gas leak/explosion Epidemic	High High

(Source: Ibid, 1999, page 571.)

Table 2: Components of Environmental Sustainability

Components	Logic
Environmental Systems	A country is environmentally sustainable to the extent that its vital environmental systems are maintained at healthy levels, and to the extent to which levels are improving rather than deteriorating.
Reducing Environmental Stresses	A country is environmentally sustainable if the levels of anthropogenic stress are low enough to engender no demonstrable harm to its environmental systems.
Reducing Human Vulnerability	A country is environmentally sustainable to the extent that people and social systems are not vulnerable (in the way of basic needs such as health and nutrition) to environmental disturbances; becoming less vulnerable is a sign that a society is on a track to greater sustainability.
Social and Institutional Capacity	A country is environmentally sustainable to the extent that it has in place institutions and underlying social patterns of skills, attitudes and networks that foster effective responses to environmental challenges.
Global Stewardship	A country is environmentally sustainable if it cooperates with other countries to mange common environmental problems, and if it reduces negative extraterritorial environmental impacts on other countries to levels that cause no serious harm.

(Source : 2005 Environmental Sustainability Index Report, Benchmarking National Environmental Stewardship, Copyright: 2005, Yale Center for Environmental Law and Policy, Online : www.yale.edu/esi)

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Environmental sustainability is intrinsically linked to the notion of the quality of life[xiii] of communities. "Quality in societies relates to the quality of life of individuals within society whereas quality of societies refers to the societies themselves as holistic entities."[xiv] The World Health Organization Quality of Life (WHOQOL) Group defines quality of life as follows:

"[*Quality of life] is an individual's perception of their position in life in the context of culture and value systems in which they live and in relation to their goals, expectations, values and concerns.. incorporating…physical health, psychological state, level of independence, social relations, personal beliefs and their relationship to salient features of the environment… quality of life refers to a subjective evaluation which is embedded in a cultural, social and environmental context."*[xv]

Ecosystems and Human Well-Being

"*Eco-Systems are dynamic entities composed of the biological community and the abiotic environment. An ecosystem's abiotic and biotic composition and structure is determined by the state of a number of interrelated environmental factors (for e.g. Nutrient availability, temperature, light intensity, grazing intensity and species population density) will result in dynamic changes to the nature of these systems.*

The Millennium Ecosystem Assessment Conceptual Framework

MA defines an ecosystem as a "dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit."

Humans are an integral part of ecosystems. Ecosystems provide a variety of benefits to people, including provisioning, regulating, cultural and supporting services. Changes in these services affect human well being in many ways. (see Figure 1)

1. Provisioning Services are the products people obtain from ecosystems, such as food, fuel, fiber, freshwater, and genetic resources.
2. Regulating Services are the benefits people obtain from the regulation of ecosystem processes, including air quality maintenance, climate regulation, erosion control, regulation of human diseases, and water purification.
3. Cultural services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.
4. Supporting services are those that are necessary for the production of all other ecosystem services, such as primary production, production of oxygen, and soil formation.

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Ecosystem changes affect human well-being in the following ways:

- Security is affected both by changes in provisioning services, which affect supplies of food and other goods and the likelihood of conflict over declining resources, and by changes in regulating services, which could influence the frequency and magnitude of floods, droughts, landslides, or other catastrophes. It can also be affected by changes in cultural services as, for example, when the loss of important ceremonial or spiritual attributes of ecosystems contributes to the weakening of social relations in a community. These changes in turn affect material well being, health, freedom and choice, security and good social relation.
- Access to basic material for a good life is strongly linked to both provisioning services such as food and fiber production and regulating services, including water purification services.
- Health is strongly linked to both provisioning services such as food production and regulating services, including those that influence the distribution of disease-transmitting insects and of irritants and pathogens in water and air. Health can also be linked to cultural services through recreational and spiritual benefits.
- Social relations are affected by changes to cultural services, which affect the quality of human experience.
- Freedom of choice and action is largely predicated on the existence of the other components of well being and are thus influenced by changes in provisioning, regulating or cultural services from ecosystems.

Drivers of Ecosystem Changes

The Millennium assessment report , defines a “driver” as any factor that changes an aspect of an ecosystem. The indirect drivers of ecosystem change are primarily:

- Demographic (such as population size, age and gender structure, and spatial distribution);
- Economic (such as national and per capita income, macroeconomic policies, international trade, and capital flows);
- Sociopolitical (such as democratization, the roles of women, of civil society, and of the private sector, and international dispute mechanisms);
- Scientific and Technological (such as rates of investments in research and development and the rates of adoption of new technologies, including biotechnologies and information technologies);

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- Cultural and religious (such as choices individuals make about what and how much to consume and what they value).

The interaction of several of these drivers, in turn, affects levels of resource consumption and differences in consumption both within and between countries. Clearly these drivers are changing-population and the world economy are growing, for instance, there are major advances in information technology and biotechnology, and the world is becoming more interconnected. Changes in these drivers are projected to increase the demand for and consumption of food, fiber, clean water, and energy, which will in turn affect the Direct Drivers.
The Direct drivers of ecosystem change are primarily physical, chemical and biological-such as land cover change, climate change , air and water pollution, irrigation , use of fertilizers, harvesting and introduction of alien species. Change is apparent here too: the climate is changing, species ranges are shifting, alien species are spreading, and land degradation continues.

Human well-being can be enhanced through sustainable human interactions with ecosystems supported by necessary instruments, institutions, organizations, and technology. Creation of these through participation and transparency may contribute to freedoms and choice as well as to increased economic, social and ecological security. Ecological security implies the minimum level of ecological stock needed to ensure a sustainable flow of ecosystem services. Yet the benefits conferred by institutions and technology are neither automatic nor equally shared. In particular, such opportunities are more readily grasped by richer than poorer countries and people; some institutions and technologies mask or exacerbate environmental problems; responsible governance, while essential, is not easily achieved; participation in decision-making, an essential element of responsible governance, is expensive in time and resources to maintain. Unequal access to ecosystem services has often elevated the well being of small segments of the population at the expense of others.

McGranahan et.al, 2001 interprets the above diagram as follows – as local environmental health burdens decline with increasing urban affluence, global burdens increase, and city-regional burdens first increase and then decline.

Figure 1: Linkages between Ecosystem Services and Human Well-being

Figure 1 depicts the strength of linkages between categories of ecosystem services and components of human well-being that are commonly encountered, and includes indications of the extent to which it is possible for socioeconomic factors to mediate the linkage. (For example, if it is possible to purchase a substitute for a degraded ecosystem service, then there is a high potential for mediation.) The strength of the linkages and the potential for mediation differ in different ecosystems and regions. In addition to the influence of ecosystem services on human

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Well-being depicted here, other factors—including other environmental factors as well as economic, social, technological, and cultural factors—influence human well being, and ecosystems are in turn affected by changes in human Well-being.

Source: Adapted from The Millennium Ecosystem Assessment, 2005, Ecosystems and Human Well-Being: Synthesis, Island Press, Washington D.C., Copyright World Resources Institute, 2005.

Figure 1

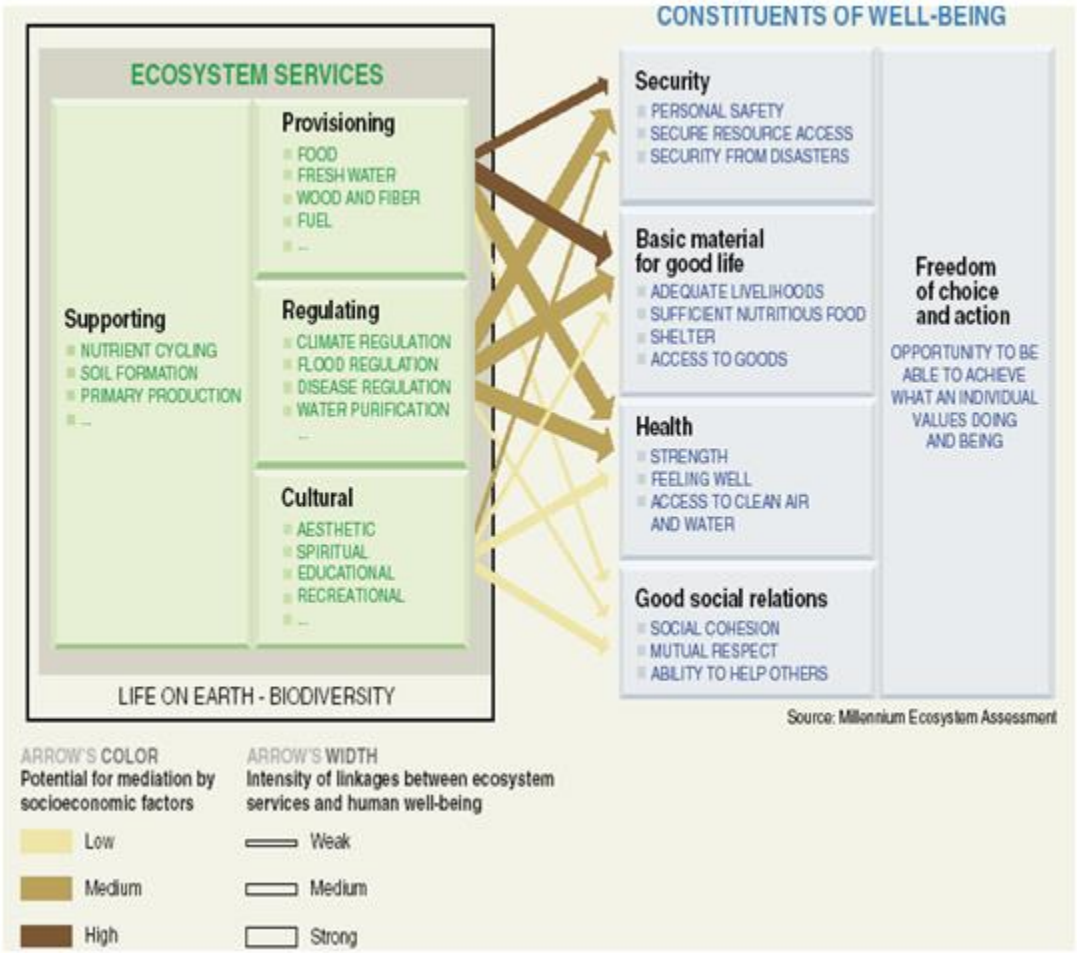

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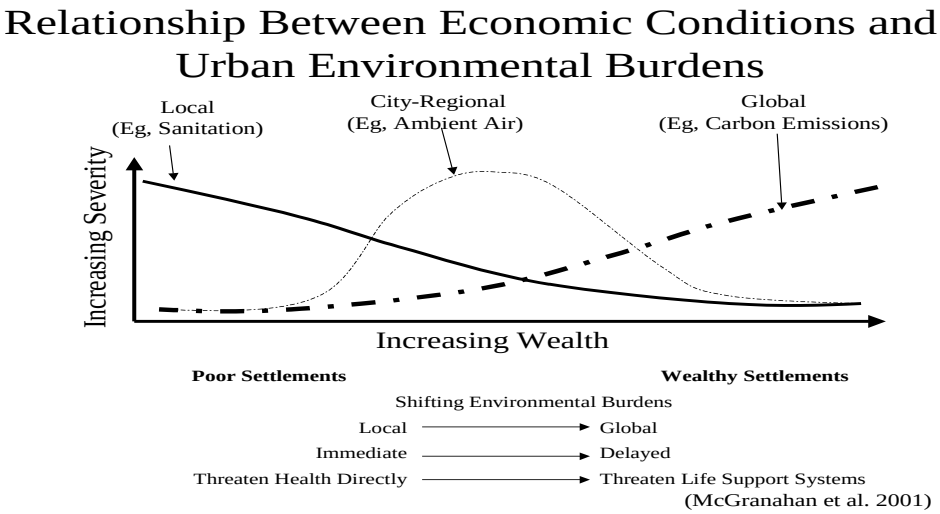
Figure 2



Environmental destruction today affects every single group:

1. Rural women through scarcity of Bio Mass Products.
2. Farmers through soil erosion, water logging and declining soil productivity.
3. Tribals through deforestation.
4. Nomads through deterioration of grazing lands.
5. Riverine fishermen through water pollution;
6. Marine fishermen through over fishing.
7. Artisans through the scarcity of bio-mass based raw materials.
8. Urban people through air and water pollution.

Over the years, evidences of these environmentally vulnerable groups have been found all over Asia, varying in levels of severity.

Cities as urban systems are mostly “sites of consumption”. Even if urban systems are not major producers of eco system services, urban activities can alter the supply of ecosystem services at every scale, from within to far beyond the bounds of the urban area itself. The primary issue within urban areas, from the perspective of human well-being is whether the urban settlements provide a healthy and satisfying living environment for residents. Urban development can easily threaten the quality of the air, the quality and availability of water, the waste processing and recycling systems, and many other qualities of the ambient environment that contribute to human well-being.

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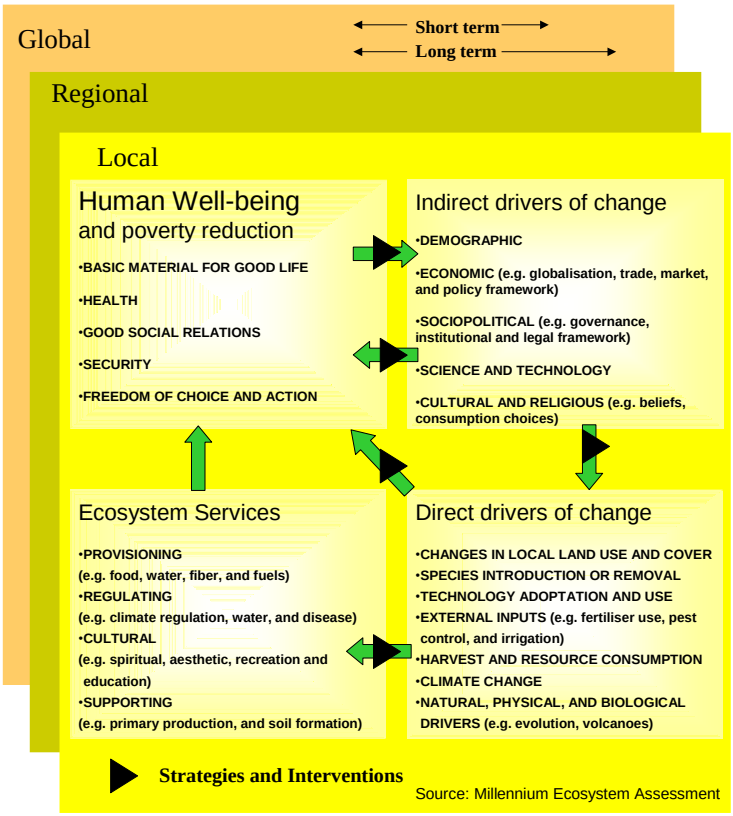
Figure 3



Environmental Vulnerability and Social Well being

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According to the Human Development Report 2003, poor people are the most vulnerable to environmental shocks and stresses, including floods, prolonged drought and the emerging effects of climate change. In normal times, India's bio-diversity–related products (such as wild fruits or honey) account for about 20 per cent of the incomes of poor rural people. But during drought they account for more than 40 per cent because cultivated crops fail. Taking such situations into consideration, the HDR report stresses on the fact that, "ignoring environmental sustainability, even if doing so leads to short-run economic gains, can hurt poor people and undermine long-run poverty reduction." To quote another issue, in India, "the urban dimension of environmental health problems is typically manifested in the slum areas. These areas suffer due to unequal access to land, public utilities, and the urban infrastructure. Drainage, drinking water, and other water systems are in close contact, thus making them highly vulnerable to pollution. Slums are usually located in the proximity of major industries and road intersections, which have a negative impact on the ambient air quality"…

Figure 4: An ecological perspective of the health-related quality of life of communities

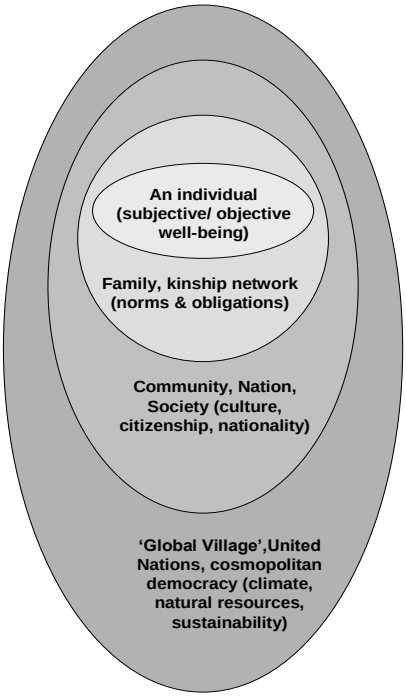

Figure 4 depicts an ecological perspective of the health –related quality of life of communities. This diagram shows the potential impact of meso and macro environments upon individual's quality of life.

"The innermost of these circles concerns individuals; their subjective well-being, both hedonic and eudemonic, and their objective well-being, including their health and material circumstances. It is worth noting that there is a strong permeability, between the first two ovals, between the individual and their family, kinship and associational networks (along with associated norms and obligations). This is particularly true in relation to material circumstances and the important facet of our subjective well-being that is influenced by family and other close relationships. These two ovals, taken together, represent the micro system within which people negotiate their day to day quality of life."

"The third oval, comprises the meso system. This includes the neighbourhood and community." Primarily, it is these three areas that are the most central, determining quality of life for most people and it is within this ambit of micro and meso system that the more individualistic, health

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promotion-oriented approach to public health is focused. However, "the fourth oval, representing ecological perspectives on public health is getting increasingly recognized as a potential impact on an individual's quality of life; It denotes the macro system, including national identity, culture, wealth, politics, citizenship and, crucially, central government health policy. Its content can be expanded to include the exosystem including international aspects of sustainability, global governance, global environmental conditions among others."

The focus on money income as a measure of social well being is no longer accepted. "Thinking only in terms of income can hide other aspects of deprivation such as poor quality housing or people's capacity to challenge detrimental changes in their local environments". Blomquist (2004) counters that money income is imperfect because neither does it measure the satisfaction individuals and households derive from traditional market goods nor does it directly measure the value of the social and natural environment in which the consumption of traditional market goods takes place.

Thus environmental sustainability integrates concern for the natural environment into the system of social quality of life. Since sustainable development (SD) is not only concerned with the natural environment but also with human quality of life, SD indicators must include the degree of participation of communities in decision-making. If decisions to preserve the environment have a significant detrimental effect on other dimensions, sustainable development is not attained, so these indicators should be considered in decision-making processes alongside the more obvious indicators of environmental quality.

A snapshot of Environmental Degradation in India

Table 3: Environmental Degradation in India

Components of environmental quality	**Air quality**
Nature of the problem	1. Outdoor air pollution: SPM, CO,NOX, RSPM, hydrocarbons, Ozone, peroxy-acetyl nitrate, metals and other gases and vapours. 2. Indoor air pollution: CO, benzo(a)pyrene, tiny,respirable particulates.
Sources or Causes of environmental pressures	1. Growing industrialization, increasing vehicular pollution, Industrial emissions, automobile exhausts and the burning of fossil fuels. 2. Biomass fuels such as crop residues and dung cakes , wood and wood chips along with open stoves "chulhas" and inadequate ventilation affect the vulnerable groups-children and women.
State of environmental quality	1. Carbon dioxide emissions increased from 677.9 Million metric tons to 1,218.9 million metric tons in 2002.[xvi] 2. Out of 61 cities, 59 have violated the annual average residential standard for RSPM

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	in the year , out of which 24 even violated the industrial standard too (CPCB 2005b)[xvii]. 3. Sixty nine percent of the total air quality monitoring stations in India were reported to be violating the 24-hourly spm standardsgreater than 2 percent times in 2003 (CPCB 2005b)[xviii]. 4. A National level toxic gas sampling conducted by the community environmental Monitors agency, in 12 locations around the country revel the presence of 45 toxic chemicals in air samples of which 13 were human/animal carcinogens[xix] 5. Monitoring kitchen smoke in the early 1980s, Kirk smith had revealed that women were exposed to total suspended particulates of about 7,000 microgrammes per cubic meter in each cooking period. In 1990s, "it became clearer that for a 24hour concentration measured inside homes-women are exposed to more than 2,000 microgrammes per cubic meter of toxic, tiny particulates, in a cooking cycle.
Impacts on human well being	1. The prevalence of cancer is about 4.1% Amongst all the diseases, visibly indicating the effects of air pollution in urban places (CPCB 2000b)[xx] 2. In a study covering 2031 children and adults in 5 mega cities, of the 1852 children tested, 51.4% had blood lead levels above 10 ug/dl (microgram per deciliter). The percentage of children having 10 ug/dl or higher blood lead levels ranged from 39.9% in Bangalore to 61.8% in Mumbai. Among the adults, 40.2 % had blood lead levels of about 10 ug/dl.[xxi] According to 1995 estimates in a study commissioned by the MoEF , total annual economic losses due to air pollution could exceed INR 9000 crores or 1.1 % of GDP.[xxii] 3. A comprehensive national survey of ambient air by Community Environmental Monitors, found that the chemicals in the air samples collected across 12 locations around industrial locations in India, "target virtually every system in the human body-eyes, central nervous system, skin and respiratory system, the liver, kidneys, blood, the cardiovascular system, reproductive system; heart; the peripheral nevous system, lungs and gastrointestinal tract; the bone marrow and lymphatic nodes.[xxiii] 4. The World Health Organisation estimates that there are over 1.6 million premature deaths each year from cookstove pollution. Some 4,00,000 to 5,50,000 women and under five children die prematurely each year in India because of this deadly smoke…[xxiv]
Components of environmental quality	**Water Quality**
Nature of the problem	1. Contamination of rivers, groundwater, wells and ponds in rural areas and cities. 2. Destruction of wetlands, water-stress/scarcity
Sources or Causes of environmental pressures	Causes of water pollution can be attributed to: 1. Rapid urbanization; 2. Industrialization; 3. Disposal of untreated domestic and municipal sewage 4. River banks or lakes used for defecation and littering; 5. Agricultural run-off and improper agricultural practices;

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	6. Religious and social practices
State of environmental quality	"The MoEF estimates that industrial pollution contributes more than one-third of the total pollution in rivers and other water bodies. Distillers, synthetic fibre, pulp and paper, soap and detergents, dye intermediates, and tanneries are the major contributors to water pollution. Agricultural practices, such as increased use of nitrogeneous fertilizers, affects groundwater through nitrate-leaching and is a potential threat to the quality of potable water. Fertilizer and pesticide run-offs in the rural areas cause considerable pollution, as only 60% of the chemical fertilizer is utilized and the balance is leached into the soil, polluting the groundwater. Excess phosphate run off leads to eutrophication in water bodies.[xxv] "According to the scientists at the National Environmental Engineering and Research Institute, a staggering 70% of the available water in India is polluted. Only five states, Maharashtra, Gujrat, Delhi, Uttar Pradesh and West Bengal, generate more than 63% of the total waste water in India as they lack treatment facilities (Down to Earth, July 15, p.19). Sewage generated from 25 heavy polluting cities and towns account for about 75 percent of the pollution load in the river. The Yamuna with 200 million litres of untreated muck being dumped in it everyday by Delhi's Sewerage System has become one of the most polluted rivers in the world (Down to Earth, June 30, 2000, p.55)."[xxvi]
Impacts on human well being	The increasing river water pollution is the biggest threat to public health. The diseases commonly caused due to polluted water are cholera, diarrhoea, hepatitis, typhoid amoebic and bacillary, dysentery, guineaworm, whereas scabies, leprosy, trachoma and conjucvitis are some of the diseases associated with water scarcity. All these could be attributed to the rapidly increasing population and lack of water resources. Inadequate access to safe drinking water and sanitation facilities leads to higher infant mortality and intestinal diseases. More than one million children died due to diarrhoea ar other gastrointestinal disorders in 1990s. In addition, around 90 lakh cases of acute diarrhoeal diseases have been reported in India, Uttar Pradesh reporting the highest num of cases (Central Bureau of Health Investigation, 1996). It is estimated that 73 million workdays are lost every year due to water related diseases. The cost of treating them and loss in production amount to Rs. 600 crores a year (Citizen's Report, 1982).[xxvii] Agriculture using industrial effluent canal water has contributed to low agricultural yields and heavy metals in agricultural produce (see thesis –M. S.University of Baroda)

Components of environmental quality	**Land/Soil**[xxviii]
Nature of the problem	Soil erosion, land salinization, loss of nutrients, alkalization, water logging in irrigated areas
Sources or Causes of environmental	Shifting cultivation is a major cause of land degradation. Intensive agriculture and irrigation contribute to land salinization, alkalization and

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pressures	water logging. Extensive use of pesticides and fertilizers not only contaminate the water bodies but has also shown to reduce land fertility and rise in population of immune-pests. While soil erosion by rain and river in hill areas causes landslides and floods, deforestation, overgrazing, traditional agricultural practices, mining and incorrect siting of development projects in forest areas have resulted in opening up of these areas to heavy soil erosion.
State of environmental quality	According to the Economic Survey of India, 1998-99, Out of the total geographical area of 328.7 million hectares, 175 million hectares are considered to be land-degraded area. Water and wind erosion is the major contributor of 141.3 million hectares to soil erosion, with other factors like water logging 8.5 million hectares, alkali soil 3.6 million hectares, acid soil 4.5 million hectares, saline soil including coastal sandy areas 5.5 million hectares adding to the situ degradation. According to the National Remote Sensing Agency and Forest Survey of India, 80 million hectares of the 142 million hectares under cultivation are substantially degraded and about 40 million hectares of the 75 million hectares controlled by the forest department have canopy cover of less than 40 per cent Nearly 12 million hectares of pasturelands are also substantially degraded. Thus, a total of 132 million hectares representing 40 per cent of the country's total landmass have productivity well below their potential. Forests also play an important role in enhancing the quality of environment by influencing the ecological balance and life support system (checking soil erosion, maintaining soil fertility, conserving water, regulating water cycles and floods, balancing carbon dioxide and oxygen content in atmosphere etc. India has a forest cover of 76.52 million square km of recorded forest area, while only 63.34 million square km can be classified as actual forest cover. This accounts for 23.28 percent of total geographic area against 33 percent recommended by National Forest Policy of 1988. The total forest area diverted for non-forestry purposes between 1950 and 1980 was 4.5 million hectares i.e. at an annual rate of 0.15 million hectare.
Impacts on human well being	Land degradation primarily affects the rural population who depend on agriculture as their livelihood. Soil erosion due to increasing deforestation has led to increase in deserts. For achieving and maintaining food security, sustainable forestry, agricultural and rural developments controlling of land/soil erosion is very much necessary.

Components of environmental quality	**Waste**
Nature of the problem	Solid wastes [xxix]generated by domestic, commercial and industrial activities are often discriminately disposed. Municipal services and industrial waste disposal facilities have

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	not been able to keep pace with the growing population and rapid industrialization; India faces the serious challenge of environmental-friendly disposal of municipal solid waste, hazardous waste, biomedical waste and radioactive waste.
Sources or Causes of environmental pressures	Domestic, Commercial and Industrial activities.
State of environmental quality	The amount of municipal solid waste (MSW) generated in most Indian cities is rapidly increasing. The per capita quantity increases with the size of the city and is 0.27-0.66 kg per capita per day. In metropolitan cities, values up to 0.61 kgs per capita per day have been recorded. Per capita waste generation is increasing at the rate of 1.33% (CPCB 1999). It is roughly estimated that Indian cities and towns generate about 4,000 tonnes of municipal waste per day and almost all waste finds way to landfill sites, which are seldom managed in an environmental friendly manner. The average waste collection in Indian cities is 72% and only 70% of the cities have adequate waste transport facilities. Estimates show that every year 54,404 tonnes of medical waste is generated in the country (based on a generation figure of 250g/capita/day). About 85% of the hospital wastes are actually non-hazardous, 10% are infectious, and 5% are non-infectious but hazardous (CPCB 1998b). According to a study, Delhi shows an average waste generation rate of 1.5 kg/bed/day and about 45.5% of the total waste is infectious in nature (CPCB 1998b). In another study carried out in Mumbai, the average waste generated is 1.13kg/bed/day, out of which the average infectious waste component is 0.52 kg/bed/day (CPCB 1998b). It is estimated that currently hazardous waste generation from industrial sector is 4.4 million tones (MT) annually, of which approximately 1.6 MT is recyclable, 0.18 MT is incinerable and 2.5 MT is destined for disposal in landfills (MoEF, 2000). Industries that generate huge quantities of waste are thermal power stations, and iron and steel plants, non-ferrous metal industries, sugar and fertilizer industries. Disposal of these wastes is largely uncontrolled – dumping on public land or in MSW sites is quite common. One estimate that there exists 1580 major accident hazard units in 234 districts of 19 states/union territories of the country.
Impacts on human well being	The levels of urban solid wastes being generated in different cities poses a serious threat to environmental quality and human health. Many cities generate more solid wastes than they can collect or dispose of. Open dumping and uncontrolled land filling are in most cases the main disposal methods. The organic material (garbage) is a fertile breeding ground for bacteria and viruses that cause disease. Due to inadequate collection, improper disposal and lack of proper storage facilities, solid waste get into open drains and obstruct free flow of water. The municipal solid waste sites often receive industrial and hazardous waste including those from hospitals and laboratories adding to the problem of disposal and serious

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consequences for environment and health of individuals. The system for disposing non biodegradable urban solid waste is practically non-existent. There is tremendous scope for improving technological input and institutionalization of responsible social practices such as, the practice/requirement of segregating household solid waste into distinct categories for facilitating an efficient and environmentally safe disposal.
A major problem in urban solid waste management relates to sewage disposal. With inadequate and often inappropriate and malfunctioning systems of sewage disposal, the threat to the availability of safe drinking water is quite serious in most urban areas in the country. There is an urgent need for revamping and maintaining the sewage system in almost all cities and more importantly increasing its coverage to slums and the shanties that are entrenched in most metro cities.

[i] *A. M. Freeman (2003)*

[ii] *See Appendix1 , Fig B for a diagrammatic exposition of the subject.*

[iii] *Ligia Noronha, 2001 attempts to decipher the meaning and underlying dynamics of the term vulnerability:-*

"The essence of vulnerability is that which refers to the potential for a negative outcome or outcomes in socio-economic and health status as a result of external events: be they natural, economic, political, or social."(Glewwe and Hall 1998, Moser 1998 as quoted by Noronha 2001)." These negative outcomes has three aspects:

- *The **external event** that either stresses or threatens – this is the driver or pressure;*
- *The **vulnerability** of the exposed unit, individual or group, as defined by the predisposition to be stressed by events, or the sensitivity leading to illness, harm, or some other negative outcome-this predisposition can be genetic, psychosocial, or biological. But it is essentially an inability to anticipate negative outcomes and manage risks.*
- *The **resiliency** of individuals or a group, which is the capacity to cope or respond to stress in different ways, resulting in different categories of vulnerability [namely, "1. Physical and material 2. Social and Organizational 3. Motivational and attitudinal"- Anderson and Woodrow (1989) as quoted in Noronha (2001)]. Thus resiliency is related to coping with crises after they occur."*

[iv] *"Marginal urban environments are sited in and/ or around negative externalities. These negative externalities are natural or man-made features of urban environments that make nearby residence unattractive because they entail actual or potential ongoing problems for local residents and/or threats of disaster. The most widespread features of the natural environment are probably steep slopes, which make access and construction difficult and may threaten landslides; flood plains, swamps and other water margins, which may cause problems for access and construction and health, and may threaten floods; and zones threatened by tectonic activity. Industrial production sites are probably the most problematic man-made feature of urban environments, with their threat of environmental pollution or even major disaster, but rubbish dumps, burial grounds, borrow pits, airport flight-paths and high-tension electric cables also figure prominently in creating undesirable residential locations in Third World cities."-(Main and Williams, 1999, page 153).*

[v] *Hamish Main and Stephen Wyn Williams (1999), page 151.*

[vi] *Global environmental Outlook-3, See www.unep.org/geo/geo3/pdfs/synthesis.pdf, page 12*

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[vii] *Ibid, page 11*

[viii] *"An ecosystem is considered to be healthy and functioning well if it is active; maintains its organization, connectivity and autonomy over time; and is resilient to stress ." Constanza 1995. (as quoted in Noronha, 2001)*

[ix] *The Human Development Report 2003 overall focus is on the commitments in the Millennium Development Goals. Among 18 targets of the MDGS , (Targets 2,5,8,9and 10) are directly linked to sustainability and sustainable development issues.(see http://www.developmentgoals.org/)*

[x] *TEDDY (TERI Energy Data Directory and Yearbook). 2004/05, page 430.*

[xi] *The Indian Express ,May 3, 2004 , "Mumbai's air quality the worst in India, says CPCB."*

[xii] *The concept of sustainability comes from "Our Common Future", the report that arose from the World Commission on Environment and Development, 1987, in which sustainable development has been defined as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, Brundtland Report, Oxford University Press, Oxford). This definition has been widely adopted especially since the 1992 United Nations Conference on Environment and Development."- www.sustain.canterbury.ac.nz/sustainability/whatis-sustain.shtml*

[xiii] *The terms quality of life and well being are used interchangeable in the document because they almost mean the same thing. "The well being achievement of a person can be seen as an evaluation of the 'wellness' of the person's state of being (rather than say, the goodness of her contribution to the country, or her success in achieving her goals). The exercise, then is that of assessing the constituent elements of the person's being seen from the perspective of her own personal welfare."(Sen, A. K. , 19990, page 36). These constitutent elements 'of the person's being' finds mention in the definition of quality of life of the individual and is central in explaining societal quality of life.*

[xiv] *Chapter 6 , Societal quality of life, from the book Quality of Life( ) , page 160*

[xv] *Self-defined quality of life, page 33, in Quality of Life and the individual.*

[xvi] *Percapita carbon dioxide emissions increased from 0.8 metric tons in 1990 to 1.2 metric tons in 2002. India, along with Japan, is among five largest producers of carbon dioxide after United States, China and Russian Federation. –2006 World Development Indicators.(pp161)*

[xvii] *TEDDY (Teri Energy Data Directory and YearBook)2004/05, page409.*

[xviii] *Ibid, page 409.*

[xix] *It should be noted that this is the first comprehensive study on toxic Volatile compounds in ambient air in locations situated within industrial settings. VOCs (Volatile Organic Compounds) include many carcinogens that can exert long term , even fatal effects at very low concentrations. (for the report see SmokeScreen : Ambient Air quality in India, available on www.sipcotcuddalore,com)*

[xx] *TEDDY (Teri Energy Data Directory and Yearbook) 2004/05, page 429. For impacts of industrialization on human well being, see 'Industry at any Cost', available at http://www.rainwaterharvesting.org/Crisis/Industrial-pollution.htm*

[xxi] *Ibid , page 429. TERI quotes a study by the George Foundation (1999), Bangalore on lead poisoning in India.*

[xxii] *Chapter 1, State of Environment Report, India 1999, Ministry of Environment and Forests; http://www.envfor.nic.in/soer/1999/chap1.html*

[xxiii] *Smokescreen , page . 2006*

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[xxiv] *Further, "Kirk Smith, estimates that lost health life years (calculated as disability-adjusted life years of dalys) could range from 12 million to 17 million each year. Sick days could cross over 2 billion each year. The burden of disease from cookstoves comes right after dirty water and lack of sanitation (which contribute over 10 per cent of the disease burden and malnutrition, over 22 per cent of the disease burden in India)."- Sunita Narain, (Business Standard, 08.07.2003. The High end killer).*

[xxv] *TEDDY (Teri Energy Data Directory and Yearbook) 2004/05, page 422.*

[xxvi] *Nagdeve, 2002, Environment and Health in India, Paper will be psented at the IUSSP Regional Population Conference on 'Southeast Asia's Population in a Changing Asian Context at Bangkok, Thailand, 10-13 June 2002.page 11.*

[xxvii] *Ibid, page 12.*

[xxviii] *This section on land degradation has been compiled from Nagdeve, 2002.*

[xxix] *Solidwaste: nature of problem. Causes/sources and state of solid waste in India compiled from TEDDY ONLINE 2004/05; while the impacts of solid waste on human well being is compiled from national human development report 2001.*
