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It is my proud privilege to extend a cordial welcome to you all on behalf of the Department of Geography, Institute of Indian Geographers and on my own behalf in the historic Pink City of Jaipur.

The Institute of Indian Geographers (IIG) has completed 26 years in the service of geography in India and its Life Membership has gone upto almost 700, covering all parts of the country. It is a matter of great satisfaction that the Annual Geographers Meets has selected this platform to discuss and interact on the contemporary issues of national significance. The appropriate focal theme for this year's Meet - Environment, Population and Development Disparities, provides yet another opportunity to fellow geographers to exchange views on critical links between environment, population and the development.

Man Environment Relationship

In recent years studies related to man-environmental relationships have emerged as the main area of concern for geographers. There was a great hue and cry in the western world with regard to the environment and Indian geographers too became highly conscious about this problem, (Shafi, 2004).

The interactions between environmental change and human societies have a long and complex history, spanning many millennia. They vary greatly through time and from place to place. Despite these spatial and temporal differences, in recent years, a global perspective has begun to emerge that forms the framework for a growing body of research within the environmental sciences. Crucial to the emergence of this perspective has been the growing awareness of two fundamental aspects of the nature of our planet. The first is that the Earth itself is a single system, within which the biosphere is an active, essential component. In terms of a sporting analogy, life is a player, not a spectator. Second, human activities are now so pervasive and profound in their consequences that they affect the Earth at a global scale in complex, interactive and accelerating ways; humans now have the capacity to alter the Earth systems in ways that threaten the very processes and components, both biotic and abiotic, upon which humans depend.

The United Nations convened 'The Habitat Conference in Stockholm' in 1972. The intellectuals of the Club of Rome prepared a computer model 'Limits of Growth' (Meadows) and predicted that with

the present rate of consumption, catastrophe might befall the World by the end of the 21st century. In the 1992, Rio Conference with its agenda 21 and the two conventions on 'Climate Change' and 'Bio-Diversity' drew attention to deforestation, desertification, poverty, greenhouse effect, climate change and Bio-Diversity. In 1994, the Social Conference on World population in Copenhagen (Denmark), the Beijing Conference on Environment and then the Kyoto Conference at Japan made assessment of the programmes of protection of the environment and then the Johannesburg Summit 10 years, after the Rio Conference took stock of the situation in the reduction of the level of CO₂ and finally the Delhi declaration in 2002, discussed the reduction of CO₂ level also.

The Population Environment Relationship

Earth's natural resources and systems and its human population are inherently connected. The fundamental relationships are fairly easy to grasp. People depend on food, air, and water for life. Earth provides energy and raw materials for human activities, and those activities, in turn, affect the resources and ecosystems. Pollution and damage to those environmental goods adversely affect people's health and well-being.

Assessing the interactions among population and the environment is not that simple (Anne R. Pebley, 1998). It encompasses the study of human population growth, consumption, and resource use as well as the study of the natural world, its climatology, genetics, biochemistry, and population biology. Cooperation between

natural and social scientists has been complicated by major differences in paradigms, assumptions, and definitions. At the same time, many environmentalists and scientists concerned with protection of plant and animal species, are acknowledging that protecting nature also involves improving the circumstances of people.

These challenges are evident in the study of effects of population growth on land use. First, much of the existing research focuses on case studies of specific areas or communities, and the results of such studies generally are not applicable to larger areas (Carola L. Jolly and Barbera Boyle Torrey (1993). In addition, demographic and ecological data generally are not collected in comparable geographic areas. Demographic surveys are usually conducted within a political region, such as a district or country, land use data are more often collected for a particular ecosystem or landscape, which can cut across political boundaries. Finally, much of the research conducted on population growth and environmental change has focused on documenting associations between environmental changes and demographic variables rather than identifying the specific causes of change.

It is difficult to evaluate such changes with regard to specific issues-such as land use partly because of the poor quality of available data and problems of determining what factors drive change. For example, does climate change or human activity have the greatest effect on land use? (Gorden M. Worman) Careful research examining population and environment relationships has provided a better understanding of the importance of these connections to human and ecological well-being.

Demographic Trends

Several demographic trends strongly affect the way humans change the natural world. The regional distribution of population is shifting as growth continues in some regions, especially in Africa and western and southern Asia, and declines in others, such as Europe. Within regions and countries, the population is shifting from rural to urban areas and concentrating in coastal regions. In addition, the number of households is increasing more rapidly than the population. Households are getting smaller as couples have fewer children and are less likely to share their homes with extended family members. Smaller households consume as much as or more than larger households (Nilo Keilman, 2003). Even those countries with stable or declining populations have increasing numbers of households and associated sprawl.

With the increase in population (India's population today stands at 1.07 billion (ESCAP) Population data sheet, 2002), the environment has come under great stress. By 2025, the population is estimated to reach 1.35 billion at the exponential growth rate of 1.5 per cent per annum. The increasing population would need more food, more dwelling places, more clothing, more material facilities and so on. The urban population in India today is 29 or 30 per cent and by 2025 it may go up to 40 or 45 per cent; thereby the quality of life in cities would deteriorate. Slums and squatter settlements would increase. There would be more air and water pollution, which would lead to scarcity of drinking water. If official figures of people below the poverty line are to be believed, there are 300 million people below the poverty line. So, poverty occurs

central stage. Every year with the migration of dunes, thousands of hectares of fertile lands are converted into desert. Deforestation needs to be checked. Fifty per cent of the energy needed in India is for household purposes. In spite of stringent laws, deforestation surreptitiously continues. Growing population is leading to unprecedented traffic congestion particularly in metropolitan towns.

Over the next 30 years, urban populations are expected to expand, while rural populations will hold steady or decline worldwide. The percentage of people living in urban areas is projected to increase from 47 percent to 60 percent worldwide between 2000 and 2030, according to the United Nations (U.N. Population Division, 2000). Rural populations are projected to decline in most more developed countries and some less developed countries (such as Brazil, China, and Mexico) between 2000 and 2030, although the world total is expected to rise from 2.9 billion to 3.1 billion, led by large increases in rural areas of India, Bangladesh, and Afghanistan, among other countries. Although the percentage of people living in rural areas has been declining throughout the world, the number of rural dwellers in less developed countries rose by almost 1 billion between 1960 and 2000.

Environmental Impacts

Population growth does not necessarily lead to a serious deterioration of the natural environment. Human inventiveness has resulted in technological advances that enable more food to be grown in smaller areas, waste waters cleaned, and significant areas of biodiversity protected. In India, for example, a new concept-*People's Protected*

Area (PPA) aims to conserve biodiversity by facilitating poor people's access to the resources provided by protected natural areas. The network of PPAs focuses mainly on biodiversity-rich buffer zones, fringe areas, and corridors of natural parks and wildlife sanctuaries. It aims at converting open-access natural resources into community controlled resources, thereby increasing the incomes earned by local people from front products and protecting the areas biodiversity (Jeffrey, A et.al, 2003)

Effects of Population Growth

Is population growth good or bad for the environment and human well-being? The answer to this question is neither straightforward nor simple. Consider the case of urbanization. A population shift toward urban areas means that a larger share of people will have access to health care, education, and other services; living standards are likely to improve. Greater population densities will enable more communities to capitalize on economies of scale, for example, by investing in more efficient and cost-effective water management. And concentrating population within an urban area can preserve adjacent natural habitat, assuming that urban sprawl is contained.

At the same time, dense urban populations may produce more waste than the environment can absorb, leading to significant air and water pollution and a greater incidence of infectious and parasitic diseases. Cities often develop near fragile coastal areas or rivers or adjacent to fertile agricultural land. Rapid urban growth often takes over farmland, destroys wildlife habitats, and threatens sensitive ecosystems

and inshore fisheries. Urban populations generally use more water for domestic and industrial purposes than rural population.

Limits to Population Size

The unprecedented population growth of the last century heightened anxieties about possible catastrophic collapse, brought about by exceeding the population size earth could support. In 1995, for example, the demographer Joel Cohen noted that "the possibility must be considered seriously that the number of people on the Earth has reached, or will reach within half a century, the maximum number the Earth can support in modes of life that we and our children and their children will choose to want" (Joel E. Cohen, 1995).

The real question, however, as suggested by Cohen, is not how many people the Earth can support, but how many people can Earth support with what quality of life? Answering this question involves addressing a host of value-laden questions about human society as well as the natural environment. What levels of material well-being and technology do we expect to have, and for what share of the global populations? What forms of governments and economic structures are acceptable? How much natural forest and rangeland do we expect to have? How clean do we expect the air and water to be? How many children do couples want to have? How long are we expected to live?

Conceptual Approaches

Scientists have used a number of approaches to seek answers to these questions. Cohen's line of inquiry puts people first. A natural scientist might pose the question as: How

many people. with what consumption values. can coexist with a healthy global environment? To answer this question we need to address other questions. such as: How much forest and other land area are needed to maintain reasonable stocks of biological diversity? What maximum level of global carbon dioxide emissions would maintain a reasonably stable global climate? How many fish can we harvest from the oceans and still have healthy stocks of global fish species?

Using the Earth's ecosystems rather than humans as a frame of reference might yield different, probably lower, estimates of optimum global population size. Several natural scientists writing after 1970 have suggested that we have already exceeded the population size that can be sustained over the long term. Scientists with this generally pessimistic viewpoint often focus on rapid world population growth, the growing concentration of carbon dioxide in the atmosphere, the declining health of the oceans, reduced biodiversity, persistent diseases, and degraded land.

Scientists with a more optimistic perspective often examine how we can best utilize human creative abilities, not on limits to human population growth or resources. These optimists believe that people have the creative capacity to overcome potential environmental harm brought by a growing population and intense economic activity. They point to the general improvements in human health and life expectancy, rising per capita incomes, remarkable advances in food production, and technological innovations that can reduce environmental pollution and improve the efficiency of economic activity. (Bjorn Lomborg, 2001)

Reconciling these different and sometimes contradictory conceptual approaches has been complicated by research, analytical, and statistical methodologies reflecting different disciplines and by the sometimes conflicting interests of individuals, communities, organizations, and governments.

Population- Environment Modeling

Over the past several decades, scientists have developed a number of models to study the interactions among population and the environment. These models cannot fully predict whether or when population growth and human activities will be constrained by shortages in food, water, and other natural resources, but they have helped scientists explore the role of population in environmental degradation, and have contributed to discussions of carrying capacity and sustainable development.

Limits to Growth

In 1972, Donella Meadows and her colleagues at the Massachusetts Institute of Technology published 'The Limits to Growth', which used a global systems model to describe how human populations might interact with the environment and economy (Donella H. Meadows et.al, 1974). The model used five variables: population, food, industrialization non-renewable resources, and pollution. In all the scenarios of future population and economic growth, population and industrialization surged upward and then fell sharply, a pattern the authors described as "overshoot and collapse."

The Limits to Growth model provoked a storm of criticism (Cohen, 1995). Critics

argued that human innovation and resourcefulness would improve the technology of food production/ resource recycling, fertility reduction, and pollution control enough to avoid "overshoot and collapse" and produce steady sustainable growth in population, food, and industrial output per person (H.S.D. Cole et. al, 2000).

The "overshoot and collapse" concept has been largely replaced, at least at the global level, by forecasts of a more gradual environmental deterioration over a longer period of time; the most severe degradation would be limited to specific regions.

Population Dynamics

In the last decade, the International Institute for Applied Systems Analysis (IIASA), based in Austria, has developed two series of models that take into account a range of population dynamics beyond growth. These models incorporate other variables such as educational levels and policies that affect population and environment relationships.

The first series of models focused on population development environment interactions in Botswana, Cape Verde, Mauritius, Mozambique, Namibia, and the Yucatan Peninsula. These studies examined traditional population characteristics, including age, sex, and education levels, as well as other variables appropriate to the local context: Labor force participation in Mauritius, or HIV status in Botswana, Mozambique, and Namibia are examples (Wolfgang Lutz, Warren C, Sanderson and Annabobette, 2002).

By including these ranges of variables and by producing various future scenarios, these studies helped decisionmakers to

understand that investment in human resources such as education, health, and voluntary family planning, combined with stronger political empowerment and accountability, were requirements for environmental management and sustainable development.

More recently, IIASA has collaborated with the UN Economic Commission for Africa to develop an interactive simulation model demonstrating the medium-to long-term impacts of alternative policies (including policies on HIV/AIDS) on the food security status of the population. This model, called population, environment, development, and agriculture (PEDA), focuses on the interactions between changes in population size and distribution, natural resource degradation, agricultural production, and food security.

Far-Reaching Consequences

Population and environment interactions have far-reaching consequences for human and environmental well-being. Some of the most important interactions and trends are associated with poverty and wealth; demand and supply of food, water, and energy; and emerging health risks.

Poverty

Poverty may promote environmental degradation in a variety of ways. An estimated 70 percent of the world's poor depend on land for income and subsistence, although many do not own or control these resources. In Burkina Faso, Cote d'Ivoire, and Senegal, extremely high rates of deforestation are associated with the expansion of cash crops (groundnuts, cotton,

coffee, and cocoa) by large companies for export. This expansion directly displaces forests and reduces the availability of arable land for subsistence farmers, driving them to encroach on forested land. Abject poverty can also push many of these rural residents to destroy the very resources they rely on for their livelihood.

The World Bank estimates that the number of people living in absolute poverty (less than US\$1 a day) has fallen since the mid-1980s, from 1.3 billion in 1990 to 1.2 billion in 1999. Today, however, poverty is conceptualized in much broader terms than just income. It includes access to opportunity, security, and empowerment. With this broader definition, ethnic minorities, rural residents, and women are much more likely than their counterparts to be poor. These same groups often are disproportionately affected by environmental degradation.

Land, Food, and Agriculture

From 1985 to 1995, population growth outdistanced food production in many parts of the world, particularly in Africa. In 64 of 105 developing countries studied in this period, food production lagged behind population growth. And there were 2.2 billion more people to feed in 2002 than there were in 1972.

Traditionally, the major means for increasing the food supply for a growing population has been converting more land to agricultural production. Most of the best agricultural land, however, is already in production. Each year, prime agricultural land is lost through conversion to urban uses or degraded through imprudent agricultural methods, overgrazing, or other activities.

Erosion, salinization, leaching of nutrients, and increased toxicity from use of chemical fertilizers and pesticides may all contribute to degradation.

The imbalance between food supply and demand often reflects political and social inequities. Famines generally occur because food is not available where people need it, rather than from an overall shortage in supply. These localized imbalances could become more extreme because population is growing fastest in the regions with the least-efficient food production and distribution systems.

Deforestation

During the 1990s, human activities resulted in the deforestation of 146 million hectares (563,709 square miles)- roughly the combined areas of Colombia and Ecuador. During that same time period, 52 million hectares were regained due to reforestation efforts and natural regrowth. South America and Africa experienced the greatest total deforestation; the substantial deforestation in Asia was offset by reforestation. In general, the 1990s saw forest cover expand in temperate less developed countries, decline in tropical less developed countries, and remain relatively stable in more developed countries (Roger-Mark et.al, 2003).

The direct causes of deforestation are themselves symptoms of underlying demographic, social, and economic connections. More developed countries such as Japan and the United States can drive deforestation in less developed countries by importing tropical hardwoods. Rising paper consumption has also encouraged overcutting of forests.

Many geographic areas rich in biodiversity also have a high population density. More than 1.1 billion people live within the 25 global biodiversity hotspots that ecologists describe as the most threatened species-rich regions on Earth. About 75 million live in the three major tropical wilderness areas—the Upper Amazonia and Guyana Shield, the Congo River Basin, and the New Guinea-Melanesia complex of islands—which together cover about 6 percent of Earth's surface.

Climate Change

Carbon dioxide and other gases naturally trap heat as it is radiated from the Earth's surface back to the atmosphere. This "natural" greenhouse effect keeps Earth's temperature about 33 degrees Centigrade (nearly 60 degrees Fahrenheit) warmer than it would otherwise be. Carbon dioxide, primarily from the burning of fossil fuels, adds to the natural greenhouse effect.

Since the preindustrial era, atmospheric concentrations of carbon dioxide have increased by nearly 30 percent. Other greenhouse gases such as methane and nitrous oxide have risen about 15 percent. Now estimated at 373 parts per million by volume (ppmv), scientists estimate that atmospheric concentrations of carbon dioxide are growing by about 1.5 percent annually and could reach 700 ppmv by the year 2100 (Carbon Dioxide Information Analysis Centre, 2003).

Global emissions of carbon dioxide from fossil-fuel combustion grew from 8 million to 6.518 million metric tons between 1800 and 1999. Over the same period, global per capita fossil-fuel emissions surged from less than 0.01 metric tons in 1800 to 1.13 mt

in 1999. Carbon dioxide emissions can vary greatly from year to year, in part because climate variations and weather cycles such as El Nino affect the frequency of natural and human induced fires. In recent decades, per capital consumption has stabilized, suggesting that slowing population growth would hold down the increase in the total emissions of greenhouse gases (Frederick A.B. Moyerson, 1998).

The increasing frequency of consecutive climate-related disasters have brought wide spread misery and huge economic losses to India. Is this a sheer coincidence out of the global climate change? The world scientific community has reached consensus that climate change is human induced, caused by emission of green house gases such as carbon dioxide that prevent heat from dissipating into space. The most obvious manifestation of climatic change is the rising world wide temperature (IGBP, Global Change, News Letters, 2001) The average annual temperature of the earth's surface has risen over the last century (1.25°C). The global average surface temperature is projected to go up by 1.4°C to 4.8°C by 2100. In ecological terms, this is a very rapid change. In the 20th century the annual average temperature in India has increased by about 0.57°C.

Climate change from the buildup of gases is thought to lead to more frequent extreme weather events such as droughts, violent storms, and flooding. Heat waves can be deadly. In summer 2003, several thousand people died in France because of record high temperatures. Global warming could melt polar ice caps, raising sea levels by several feet and threatening low-lying countries. If the sea level were to rise by 150 centimeters, Bangladesh could lose up to 16 percent of

its land area, displacing 34 million people.

In view of this, there are several good reasons for India to invest in studying the impacts of climate change. Climate change will trigger a series of ecological and economic fallout for India.

Water Availability

About one-third of the world's population lives in countries suffering from moderate to high water stress-where water consumption is more than 10 percent of renewable freshwater resources. Lack of access to safe water supply and sanitation also results in hundreds of millions of cases of water-related diseases and more than 5 million deaths every year (UNDP).

Water is one of the most plentiful natural resources, yet it is a finite resource that is unevenly distributed throughout the globe. Only 3 percent of all water is salt-free. Moreover, 70 percent of fresh water is locked in glaciers or icebergs. Water supplies are altered seasonally by cyclical droughts or floods, so that the amount reliably available for human use may be influenced more by periodic droughts than by average annual rainfall.

In general, the areas with the greatest water scarcity are those that are most rapidly depleting their aquifers. This is particularly true in the Middle East and North Africa, where rapid population growth has exacerbated water scarcity. Twelve of the world's 15 water scarce countries are in the Middle East and North Africa. The region's population more than doubled between 1970 and 2001, rising from 173 million people to 385 million people, thereby reducing the amount of fresh water available per capita by more than half (Farzaneh, Creel and

Roger M Desouza, 2002). By 2030, about half the world's population is projected to live in water-stressed areas.

Ecological Changes in Coastal Areas

Today, more than 3 billion people over half of the world's population live along a coastline or within 200 kilometers (125 miles) of one. By 2025, the coastal population may double to 6 billion. This concentration of people in coastal regions has many economic benefits: more transportation links, industrial and urban development, revenue from tourism, and food products. The combined effects of booming population growth and economic and technological developments, however, are threatening the ecosystems that provide these economic benefits.

Many of the world's coasts are increasingly urban. Fourteen of the world's 17 largest cities-so called megacities, with populations of at least 10 million people-are located on coasts. Eleven of these megacities (including Bangkok, Jakarta, and Shanghai) are in Asia. In addition, two-fifths of smaller cities-those with populations of 1 million to 10 million-are located near coasts (John Tibbetts, 2002).

The urbanization of coasts has increased coastal pollution. Worldwide, sewage remains the largest source of contamination, with discharges increasing dramatically in the past three decades. Eighty percent of marine pollution results from land-based sources.

Population growth and the activities associated with it can contribute to degradation of coastal and marine ecosystems. Some trends include a heavy exploitation of fisheries where coastal fish

stocks in some geographic regions are down to 30 percent or less of the supply that existed 30 years ago; growing damage to coral reefs worldwide; destruction of 50 percent of the world's mangrove forests; and growing degradation of the quality of fresh water from industrial, agricultural, urban, and environmental contamination (Sara Curran et.al. , 2002).

By 2020, marine harvests are projected to be at or below current levels, which means less seafood available per capita because the population is continuing to grow. Although experts expect some gains in harvests from better handling of the marine catch by some industries and exploitation of the few underused fishing areas, these gains will be offset by losses from poorly managed fishing areas, increased protection of areas and species from fishing, and continued degradation of marine environments.

To some up the whole issue of population environment relationship it may be stated that the field of population and environment studies has encountered a number of barriers, most notably a limited theoretical framework and incompatible methodologies. Researchers also face problems of working outside their academic disciplines and dealing with the complexities of topics that cross many disciplines. Topics like food security, environmental health, water availability, energy production and consumption, and economic opportunities are at the heart of human and environmental well-being.

- Decisionmakers need to better understand research results to guide policy decisions. But population and environmental changes are often slow, and projections of future scenarios are based on assumptions

of conditions that are difficult to predict with a high degree of certainty we need to find ways to engage decisionmakers on issues related to population and environment. Ultimately, the real issue is whether perception and policy can keep pace with a rapidly changing world.

- Sub-Saharan Africa and South Asia stand out as the regions most likely to be adversely affected by rapidly rising population, given their young age structures. However in India, the government has initiated programmes to mobilize resources or institutional capacity to build sound environmental policies, strengthen investment in education and primary health care, and quickly adopt new technological innovations that further economic growth with less environmental impact.

- Natural resources are a major part of our national wealth. The value of these resources is enormous. Management of these resources by adopting a balanced approach for environmental protection as well as giving due emphasis on promoting economic growth, is not only desirable but inescapable, if we have to improve our living standard and secure acceptable quality of life for future generations. This is possible, if we can assure that invaluable national resources are efficiently managed and waste minimized. Land must remain productive and fertile. The atmosphere must remain clear and clean, water must be unpolluted and forests should be capable of regeneration.

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