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Environmental Issues Surrounding Human Overpopulation

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Chapter 1

Human Overpopulation: Impact on Environment

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ABSTRACT

Overpopulation has recognized as a global environmental problem since few decades, as it has caused a number of adverse effects on environment. Modern medical facilities and illiteracy in some interior regions of developing countries are the major reasons for development of this inverted pyramid demographic structure. Overpopulation has resulted in a series of catastrophic consequences by causing increased pressure on existing natural resources. Deforestation, effect on welfare, climate change, decline in biocapacity, urban sprawl, food security, increase in energy demand and effect on marine ecosystem are amongst most severe impacts of overpopulation. Concrete steps need to be taken on national and international level to combat the adverse effects of overpopulation, so that sustainability of natural resources can be ensured for future generations.

INTRODUCTION

The world's population has touched a mark of 7.3 billion in 2015 and could attain growth level of 9-12 billion before the year 2050 which suggest that the impact of overpopulation can increase the pace of ecological changes and impose a burden on biodiversity (Sala et al., 2000; UN, 2015). The 49 least developed countries have shown a growth rate of 2.3% annually, which was nearly twice as compared to the developing world i.e. 1.2% per year in the year 2009 (UN, 2009). Increases in human population size have caused an increased risk of synergies among impacts with resultant accelerated environmental degradation (Harte, 2007). This increase in population size has fastened the agricultural activities and technological development up to the extent, which is catastrophic to environmental health. The negative effect of an agriculture or technological society on the abiotic and biotic components of the environment can be expressed in the simplest terms, by the relation,

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$$I = P.F$$

where P and F denotes the population and function, respectively which measures impact per capita (Ehrlich and Holdren, 1971). Thus, to reduce environmental degradation and to ensure sustainability of natural resources, better understanding of potential impacts of overpopulation on environmental and human health are required.

BACKGROUND

An exponential growth of human population over the last few centuries has caused encroachment in the wild habitats and their consequent destruction, posing a potential threat to biodiversity components (Vinod, 2012). Growth rate of world population was approximately 2% per annum from 1960-2000, which indicted potential population doubling every 35 years thus could cause ecological unsustainability (Bloom, 2011). Projected world population growth for the major regions is presented in Table 1. Improved agriculture practices, modern medical facilities and illiteracy in rural regions caused demographic transition with more natality rate and decline in mortality rate. From 1980–81 until 1999–2000, agriculture showed a growth rate of 3.2% per annum, which exceeds the population growth rate of 2.0% annually over the period, while annual growth rate of per capita income was 3.1% between 1980 and 1991 and 4.3% since there forms of 1991 (Lal, 2006). According to the Inter Academy Panel Statement on Population Growth, several environmental concerns such as, elevated level of greenhouse gases, threat to biodiversity, climate change and environmental pollution are arisen as a result of rapid population growth (Coleman, 2011; Edet et al., 2014). This chapter reviews the impacts of overpopulation on environment, indicates future perspectives and provides some recommendation to combat the adverse impact of overpopulation.

Table 1. Projected World Population Growth for Major Regions

Regions	2010 Population (millions)	2050 population Projections (millions)		
		Low fertility	Medium fertility	High fertility
Africa	1,022	1,932	2,192	2,470
Asia	4,164	4,458	5,142	5,898
Latin America and Caribbean	590	646	751	869
Europe	738	632	719	814
Northern America	345	396	447	501
Oceania	37	49	55	62
More developed regions	1,236	1,158	1,312	1,478
Less developed regions	5,660	6,955	7,994	9,136
World	6,896	8,112	9,306	10,614

Source: United Nations, Department of Economic and Social Affairs, Population Division. (2010). *World Population Prospects: The 2010 Revision*.

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IMPACTS OF OVERPOPULATION

Overpopulation has severe environmental implications. Although it has contributed in the nation's economy at global level, but has caused some adverse impacts on environment, which need to be addressed (Figure 1). Table 2 summarizes evolution of environmental concern, associated with population explosion.

Figure 1. Effect of overpopulation on Environment

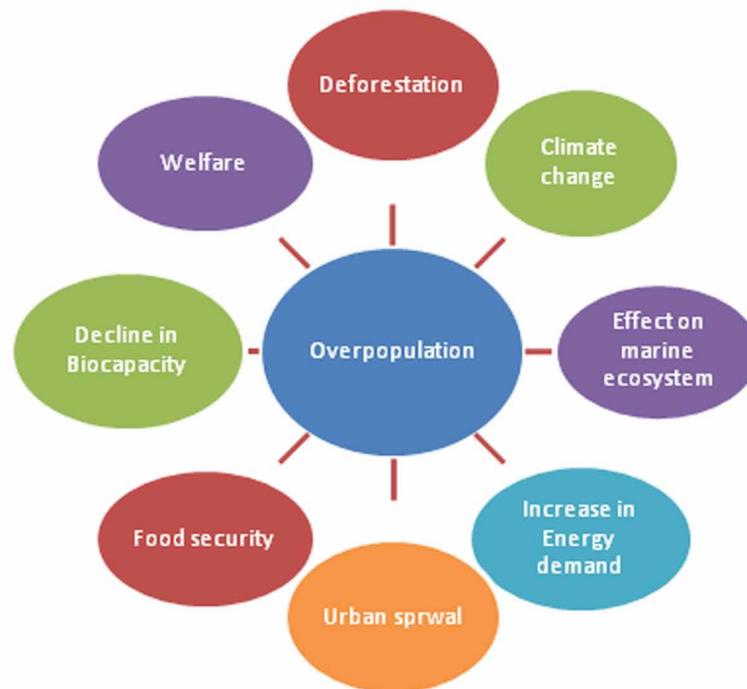


Table 2. Evolution of environmental concerns from 1940s to the present (modified)

Decade	Environmental effect	Source
1940-1950	Depletion of natural resources	United Nations report on population and resources
1960-1970	Air Pollution, Water pollution, Radioactive pollution, Disposal of waste	Declaration of the United Nations Conference on the Human Environment World Population Plan of Action of the United Nations World Population Conference
1980-1990	Climate change, Ozone depletion, Acid rain	Reports of the United States National Academy of Sciences Agenda 21 adopted by the United Nations Conference on Environment and Development Recommendations of the International Conference on Population
1990-1993	Deforestation, Water management, Control of emergence and re-emergence of diseases, Biodiversity loss	Globalization Programme of Action of the International Conference on Population and Development Resolution S-21/2 on key actions for the further implementation of the Programme of Action adopted by the General Assembly at its twenty-first special session

Source: (Ruttan, 1993)

Deforestation

Increasing urbanization has triggered deforestation at a very fast pace, in order to fulfill infrastructure demand of increasing population. Lands with high canopy covers are being subjected to deforestation and people are continuing to migrate from rural areas to urban areas. According to World Migration Report (2015), net migration from rural to urban area during 1981–1991 was 11 million which has risen during 2001-2011 to 19 million, in India. Population growth caused an exponential increase in the alternation of the land utilization patterns to supplements economic needs in the form of agricultural products, fuel wood, timber etc. However, to control conversion of forest area to agricultural, industrial and residential area, Forest (Conservation) Act was enacted in the year 1980 in India as a result of which conversion of forest area to other land use practices was reduced with the annual diversion rate of 16,000 hectare (Economic Survey of India, 1998-99; Nagdeve, 2002).

Welfare

Overpopulation has severely affected the quality of life in recent years. Quality of life (QOL) of individuals is an approach used to determine their satisfaction in:

- Life,
- Financial status,
- Education,
- Social life,
- Family life,
- Health and
- Employment.

According to Quality-of-Life Index, 2005, Ireland ranks first in the quality of life, with comparatively low population in comparison with countries such as China and India which ranks 60 and 73, respectively. Increasing population has imposed a burden on existing resources to fulfill the basic needs of such huge population, which resulted in elevated poverty percentage. According to Planning Commission, India, below poverty line population living in the rural area showed a sharp increase from 27.09% in 1999 to 41.79% in the year 2005. This increase is subsequently accelerating lack of education in a mass of poor population. It tends to increase fertility rate in illiterate and poor population, which is not much aware about degrading environmental quality due to increasing population. Table 3 represents general fertility rate of women by their education level in different states of India. Kerala showed lowest i.e. 1.3% of illiterate women, while Bihar represents highest illiteracy i.e. 51.1% of illiterate women. General fertility rate was found to be lower for literate women as compare to illiterate women in all states of India. However, states showed lower value of general fertility rate for illiterate population than the literate population which was ascribed to the fact that sample size in illiterate category was quite small as these states have significantly high literacy level (Census of India, 2011). In addition, government of developing countries like India is not able to manage medical facilities to such huge amount of population.

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Table 3. General fertility rate by level of education of women in India and bigger States, 2011

India and bigger States	General fertility rate	
	Illiterate	Total literate
India	86.7	78.7
Andhra Pradesh	43.4	71.5
Assam	103.0	76.8
Bihar	144.7	83.0
Chhattisgarh	62.9	107.8
Delhi	76.3	60.2
Gujarat	82.4	78.5
Haryana	61.7	87.9
Himachal Pradesh	18.4	62.8
Jammu & Kashmir	79.7	53.6
Jharkhand	109.7	83.7
Karnataka	41.5	75.2
Kerala	15.3	54.7
Madhya Pradesh	93.9	109.2
Maharashtra	34.0	68.8
Odisha	72.3	72.8
Punjab	52.4	62.2
Rajasthan	104.6	99.8
Tamil Nadu	11.1	62.2
Uttar Pradesh	115.4	105.4
West Bengal	46.9	61.4

Source: (Census of India, 2011)

Climate Change

Recent reports on climate change indicated more frequency and catastrophe in the weather extremes, leading to costly damage of infrastructure and loss of human life (Intergovernmental Panel on Climate Change, 2007). Increased use of fossil fuels since the mid-19th century in overpopulated regions around the globe caused release of over 1100Gt CO₂ into the atmosphere (IPCC, 2001). Furthermore, overpopulation accelerated agricultural practices, leading to enhanced emission of greenhouse gases. For example, methane is produced from rice agriculture practices and livestock. For emission of greenhouse gases, agriculture sources in 2014 accounted for 24% of 2010 global emission (IPCC, 2014). Population reduction in high-income countries might act as a possible solution. Any reduction in population growth in high-income countries, even starting from zero or negative rates, will have much more impact on reducing climate change than the same size reduction in low-income countries, because of the much higher per capita consumption and emission of greenhouse gases in the high-income countries (Rosnick, 2014). In addition, switch to alternative energy options (solar energy, tidal energy, wind energy etc) and

improved agricultural practices could help in combating the problem of climate change resulting from increased population.

Decline in Biocapacity

Increasing global population has accelerated resource consumption, which subsequently increased pressure on existing natural resources to unprecedented levels. Biocapacity is the area available as productive land and available water to produce resources or absorb carbon dioxide waste, given current management practices (Ecological Footprint Atlas, 2010). Biocapacity seems to decline sharply with increased pressure on ecological resources, as existing resources could not support consumption need of such a wide world population. Biocapacity per head decreased from 3.2 global hectares (gha) in 1961 to 1.8 gha per capita in 2008, even though total global biocapacity increased over this time (WWF Living Planet Report, 2012). The Ecological footprint denotes the land area required to meet the consumption and waste absorption needs of a population (Wackernagel & Rees, 1995). It can be used to track the availability and consumption of ecological resources and thus can aid in sustainable utilization of resources. According to Ecological Footprint accounts, demand for renewable resources has increased from 7.6 billion global hectares in 1961 to 18.1 billion global hectares in 2010. Similarly, global bioproductive area showed an increase from 9.9 billion global hectares in 1961 to 12 billion global hectares in 2010, indicating its unsustainable status (Global Footprint Network, 2015).

Urban Sprawl

Urban sprawl is one of the several consequences of rapid population growth. Sprawl is a large scale development process of real estate, producing low density, scattered, discontinuous car-dependent construction, usually on the periphery of the declining older suburbs and shrinking city centers (Hayden, 2004). Urban global population will grow to 4.9 billion by 2030, while, the global rural population is predicted to decline by approximately 28 million during 2005 to 2030 (Bhatta, 2010). In the United States, urban growth is expected to utilize about 19 million acres of farmland, environmentally sensitive and other lands during 2000–2025 (Burchell et al., 2005). Urban sprawl can be caused either by increased natality rate or by increased immigration. Better living facilities and need employment of employment are the major factors, which caused migration of population from rural area to urban area. Governmental organizations cannot deliver all basic services and quality life to huge urban population and thus, resulting massive sprawl may cause severe environmental degradation.

Food Security

Overpopulation has worsened the local and global food security by synergistic impacts of climate change. Emission from agriculture sources elevated from 4.7 billion tonnes to over 5.3 billion tonnes of carbon dioxide equivalents (CO₂ eq) during 2001-2011 (Food and Agriculture Organization, 2014). Climate change resulting from the enhanced emission of greenhouse gases has posed a severe threat on food security by affecting agricultural crop production and biodiversity. Food security is linked with food availability, accessibility and utilization. Increasing urbanization has limited the growth of agricultural sectors by encouraging industrial development in rural regions. Current food production is becoming limited along with the hasty growth in human population numbers. Technological development in the

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field of agriculture depends on availability of natural resources like water, land and energy. For instance, 1 kcal of food production requires about 10 kcal of fossil energy, which is present in limited amount and thus restrict the progress in agriculture production (Pimentel, 2011). Currently, agricultural land suitable for irrigation is 50% of the world's land. This land area is continuously being shrinking due to soil erosion, nutrient depletion, soil acidification and soil salination (Horizon, 2009).

Increase in Energy Demand

Growing global population has caused rapid inflation in energy requirement and consumption. According to Energy Information Administration (2001), use of energy, mostly for fossil fuels has boosted by nearly 85 percent globally during past 30 years, while for Asia, it is more than 300%. Sustainability for energy resources can be assured by the increased use of renewable resources, utilizing energy conserving devices for household purposes and development of advanced technologies for generating energy from biological sources.

Effect on Marine Ecosystem

Overpopulation in coastlines has mainly resulted from migration activities and caused severe environmental degradation. Mangroves, fisheries and beaches used commercially for tourism purposes are among the coastal resources, which are severely damaged by consumption practices (Naylor et al., 2002). Coral reefs are being rapidly degraded both due to direct impact of climate change and by human induced marine pollution, overfishing etc. Out of the 19,210 km² of coral reefs in South Asia, 45% of have been destroyed, while 10%, 25% and 20% are critically threatened, threatened and at low risk, respectively (Tun et al., 2004). In Mesoamerican Barrier Reef, coral cover is declining at an average rate of about 11% since 2004, with more than 50% cover loss for some reefs (Wilkinson, 2008). International agreements for conserving marine biodiversity have however caused a significant increase in several biodiversity rich marine regions but increasing population is still a hurdle for their successful implementations.

ISSUES, CONTROVERSIES, PROBLEMS

Several efforts are being taken to ensure reduction of adverse impacts of overpopulation on environment but these are associated with serious issues. For example, developing countries are being funded under clean development mechanism to increase plantation practices, but simultaneous deforestation, has checked the advantages emerging out of the strategy. Huge population in rural regions is still dependent on fossil fuels for energy needs. Although renewable energy programmes are being initiated in rural regions by various governmental organizations but the success of these programmes always remains on question. No maintainers are provided for the solar panels after their installment. As a result, most of such renewable energy devices remain in non-working condition. Several schemes are being hurred by government of India to provide employment in the rural areas so that the massive urban sprawl can be checked. Government of India inducted a scheme for self-employment in 1980-81 namely, Integrated Rural Development Programme (IRDP), which was further remodeled as the Swarnjayanti Gram Swarozgar Yojana (SGSY). In 1989, Jawahar Rozgar Yojana (JRY) was initiated by amalgamating National Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP).

The main goal of the scheme was generating more employment opportunities for people living in rural areas, advancing rural infrastructure and quality of life (Planning Commission, Government of India). However, it turns out to be a very time consuming process for procuring actual financial gain by rural people due to red tapism involved in governmental procedures especially in developing nations. In addition, to ensure food security, use of enormous quantity of chemical fertilizers further worsened the environmental health by reducing soil fertility.

POSITIVE EFFECTS OF OVERPOPULATION

As a major problem many scientists agreed that human population may reach the point at which the earth will no more able to sustain life. However, many believe that ever increasing population have some advantages such as:

- Economic benefits,
- Increased human resources,
- Higher demand in industries,
- Innovative, cheaper and
- More readily available products etc.

A nation with high population and/or increasing number of youth can add more people to developmental activities. An increasing population can boost the economic growth of a country only if the demand for better services grows. Therefore, to yield positive effects from growing population a nation must have sound policies. Keeping the pace with population growth, countries that utilize their human resources efficiently in developing better health care and medicine, food production,

SOLUTIONS AND RECOMMENDATIONS

The impact of overpopulation on food security can be reduced by raising food production, improving food distribution and by increasing economic access to food (Gregory et al., 2005). Similarly, deforestation can be reduced by proper management of forest. For the management of forest, an effective strategy should be developed to harmonize conservation priorities and development goals i.e. by including native people in decision making procedures regarding utilization and conservation of forest resources (Chakravarty et al., 2008). Similarly, for the efficient utilization of renewable energy, regular employment of maintainers and operators for each installed renewable energy plant should be ensured. In addition, Transparency in funding mechanisms of governmental procedures must be ensured, so that urban sprawl can be reduced. Population explosion awareness programs in developing nations need to be conducted, so that problem can be solved at grass root level. Some countries like China, had taken strong steps to combat problems of overpopulation but the scheme (One child policy) has failed due to several reasons. The scheme has encouraged people for increasing incidents of feticides, tending to gender inequality. A large mass of population is now entered in an old age and only a small proportion of young generation is there to support economic growth of country. Thus any scheme must be viewed with its possible pros and cons, before implementation.

FUTURE RESEARCH DIRECTIONS

Demographic structure of different countries needs to be evaluated and the reasons behind the inverted demographic pyramid should be assessed for each country. In addition, research needs to be conducted on the effective ways to maintain impartial sharing of resources, so that carrying capacity of ecosystem could be increased. Effective ways for awareness of people about programs related to family planning must be determined and implemented.

CONCLUSION

Overpopulation has posed severe threat to environment with regard to deforestation, ecosystem degradation, climate change and adverse impact of human welfare. Several measures were adopted by developed and developing nations in order to reduce the damage caused by overpopulation. These measures proved inefficient to curb population growth, as were associated with some serious drawbacks. Therefore, effective awareness programs about population control, education in rural regions and impartial sharing of resources must be ensured, so that population explosion could be controlled.

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KEY TERMS AND DEFINITIONS

Mortality rate: It denotes the death of individuals per unit time.

Natality rate: It represents the birth of individuals per female per unit time.

Red tapism: It denotes the requirement of excessive paperwork for any work, that usually prevent or delay decision making process in bureaucracy.