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Sustainable Development and Relevance of Ancient Wisdom

Gauri Shankar Gupta September, 2019 Győr Dissertation submitted to the Doctoral Program in Management (SzEEDS^M), Doctoral School of Regional Sciences and Business Administration, Széchenyi István University, Győr in part fulfillment of the Degree of Doctor of Philosophy

Sustainable Development and Relevance of Ancient Wisdom

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Author's Declaration

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree or qualification of this or other university or other institute of learning.

Furthermore, this dissertation contains no materials previously written and/or published by another person, except where appropriate acknowledgement is made in the form of bibliographical references, etc.

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Abstract

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Existence of life is closely inter-twined, with nature. Nature provides the support system for survival of different species of life that exist on the planet Earth. As evident from historical records, for thousands of years, humanity lived in harmonious relationship with nature. The Industrial Revolution marked a major turning point in Earth's ecology and humans' relationship with their environment. However, the full impact on the world's psyche would not begin to register until the early 1960s, some 200 years after its beginnings when machines began to replace human beings in work places and mass production from large-scale industries at lower prices started flooding the market, making small and cottage industries unsustainable. New sources of energy and transport services provided mobility never seen before. Simultaneously automation and mechanization of agriculture and large-scale agricultural production considerably reduced employment opportunities in rural areas. All these factors led to massive migration to urban areas. Increasing global population has further added to this pressure.

Overtime Industrial Revolution profoundly impacted every aspect of human life from food to clothing, from sports to music, from education to medicine, from habitation to work places, from transportation to communication, from entertainment to travel, from relationships to sex and from production to distribution to consumption completely transforming the life-style adding considerably to human comforts. With increasing production and services, Gross World Product (GWP) has recorded unprecedented growth since 1950 giving birth to what we call 'consumer society'. It now takes less than two weeks for the world to produce the same output as the whole of the year 1900. Despite massive economic growth large-scale incidence of hunger and poverty, extreme inequality of income and wealth, and large and growing slums continue to characterize human society. Over one billion people live with less than US\$ 1.25 per day. In addition, almost

one billion people live in urban slums in sub-human condition. Ironically, despite high incidence of poverty and deprivation, the number of global billionaires is rising very rapidly.

Moreover, this massive economic growth has come at a great environmental cost. Human induced activities are leading to massive degradation of environment. Extraction of minerals is taking place at an unprecedented rate of 60 to 65 billion tons each year with gross extraction of over 100 billion tons. With increasing use of chemicals and pesticides, intensive agriculture, and continuing deforestation over 35 percent of world's top soil has been degraded. Fresh water consumption has gone up 9 times during the last century due to increasing industrial, agricultural and municipal use. Per capita availability of fresh water on a global basis fell from 17,000m³ in 1950 to 7,300m³ in 1995 and is presently estimated to be less than 5,000m³. Water bodies are shrinking and are getting contaminated with increasing amount of industrial and municipal effluent. In addition to the huge quantity of industrial effluent, globally 330KM³ of municipal sewage and over 1.7 billion tons of solid municipal waste is generated every year. According to UNEP 6.4 million tons of litter consisting of 8 million items is dumped directly into the oceans and seas every year. There are 13,000 pieces of plastic every KM² of ocean surface. Due to growing air contamination, quality of air has deteriorated in all the major cities around the world. In many cities air quality is rated as 'unhealthy to hazardous'. Presently 92 percent of urban population is breathing air quality far below WHO norms. Over 11 million people die every year directly due to air and water pollution alone.

Anthropogenic greenhouse gas emissions are rapidly increasing giving rise to global warming. According to the Intergovernmental Panel on Climate Change between 1880 to 2012 global mean temperatures have risen by about 1.1 degree centigrade. Since 1979, the Greenland and Antarctic ice sheets have been losing mass and at a much larger rate since 2002. The annual mean Arctic sea-ice extent decreased over the period 1979 to 2012, at a rate of 3.5 to 4.1% per decade. Each succeeding decade has been warmer compared to the previous one, with the last 16 years of this century being the warmest ever. Over the period 1901 to 2010, global mean sea level rose by 0.19 [0.17 to 0.21] m. Weather patterns are becoming increasingly erratic resulting in manifold natural disasters all over the world. Glaciers and ice sheets are melting and sea levels are rising. Oceans are absorbing increasing amount of CO₂ resulting in acidification of oceans. Additionally, they are getting contaminated with massive amount of plastic accumulating in the

ocean beds. As a result, marine life and coral reefs have been seriously affected. Marine biodiversity has declined and many species are getting extinct. Due to massive deforestation to meet the increasing need of land for agriculture and human habitation, forest cover has declined substantially. Thus, Earth's ecosystem as a whole, has taken a heavy toll and production and consumption patterns have become unsustainable. The basic problems we face today could be summarised as follows:

- a. Unsustainably large and growing human population that exceeds the carrying capacity of the Earth.
- b. Growing urbanization, which requires large infrastructure of roads, water supply, drainage, waste disposal, energy supply and so on.
- c. Increasing desires of a small but highly prosperous section of the society for more and more consumption combined with growing economic disparity.
- d. Highly entropy-increasing technologies that deplete the earth of its resources and whose unassimilated wastes (including non-biodegradable, toxic and nuclear) poison the air, water and land.
- e. Land conversion that destroys habitat, increases soil erosion, and accelerates loss of species diversity.
- f. Increasing amount of liquid and solid waste from urban areas and industrial units is contaminating soil, water bodies and oceans.
- g. Increasing CO₂ emissions leading to global warming, climate change, extinction of species and ecosystem imbalances.

Negotiations on sustainability have been on the international agenda since the Stockholm Conference on Human Environment, 1972. Since then several impressive reports, protocols and declarations have been produced by World Commission on Environment and Development 1987, the Earth Summit in Rio in 1992, UN Millennium Summit 2000, the World Summit on Sustainable Development in Johannesburg in 2002, the Rio+20 Summit in Rio in 2012, the United Nations Sustainable Development Summit in New York in 2015, and a host of conferences held under the United Nations Framework Convention on Climate Change. As part of 2030 Agenda for sustainable development, a set of 17 sustainable development goals and 169 targets were adopted by the United Nations in 2015. Paris Agreement has been ratified by 186 countries and has come into force.

While the complex international negotiations in various forums in many exotic places around the world have produced thousands of documents and declarations, the situation on the ground continues to deteriorate with increasing CO_2 emissions, ever-increasing solid and liquid waste, degradation of soil, contamination of water bodies, shrinking of fresh water supplies and deteriorating air quality. The pace of environmental degradation during the 15 years from 2000-2015, has been the worst with 50% increase in emission of greenhouse gases, growing desertification, increasing contamination of oceans and unmitigated deforestation.

Despite ongoing environmental degradation, there are many positive signs. Public awareness of environmental degradation has increased considerably. According to Pew Research, 56% of global population is aware of the global warming and its consequences. In many countries climate change is considered as the single biggest challenge to humanity. A large number of NGOs and civil society groups are working on a variety of mitigation measures. Paris Agreement has been ratified by 186 countries. Governments in collaboration with civil society groups taking concrete steps towards reducing emissions, enhancing the share of renewable energy, reprocessing of waste, gradual elimination of single-use plastic, water conservation, planting of trees, promoting green architecture and cities, containing deforestation, mitigating soil degradation and so on. Nationally determined mitigation targets have been announced and innovation funds have been set up by many countries. As the rate of natural disasters is increasing, governments are becoming more and more pro-active.

This thesis investigates consequences of fast-growing production, consumption and contamination particularly since the Second World War and the failure of international negotiations in containing environmental degradation. In order to test the four research questions in proper social context, I have undertaken empirical research in two different townships that have been founded on sustainable living practices based on the time-tested concept of moderation in consumption so that the humanity is not on a constant war with nature, which nurtures and supports our very existence. These are; Auroville in South India inhabited by people from 53 different nationalities was founded in February 1968 as International township, based on the vision of human unity and sustainable living and Krishna Valley in Hungary founded in 1993 as ecological

township based on consciousness based sustainable living. Separate studies have been undertaken on the sustainable living practices followed in these townships. A survey on the experience of the residents was undertaken in each of the two townships. Initial surveys were conducted with the help of a questionnaire, followed by group discussion and brainstorming sessions with small group of residents in these townships.

After studying and analysing, the practices followed in these townships, I have come to the conclusion that the task ahead is not easy given the evolution of new comfortable life-style, based on consumerism since the onset of Industrial Revolution. Temptation of consumerism is now deeply rooted in human psyche. Higher Gross Domestic Product and Per Capita Income has become a global mantra. Mass production systems, increasing population and vast urbanization are further complicating the problem of sustainability. Therefore, the sustainable practices put in place during the last few decades, particularly since the early 1990s to support evolution of green economy, need to be further promoted. Innovations and technology could supplement efforts towards sustainable development of agriculture, housing, transport, water and energy practices and recycling of waste. Large production units have led to concentration of wealth and reduced humans to robotic life suppressing their ingenuity. Revival of rural economy and reducing dependence on large-scale production units are very important aspect of sustainability, particularly in the developing countries. In the recent decades technology has successfully dismantled monopolies of large production units in many sectors of economy such as; solar and wind energy, cellular phones, radio and electronic media and so on. Similarly, 3D printing has the potential to replace large-scale production units into thousands of smaller units scattered all over the world. Governments and scientific communities could promote such innovative technologies to return back to diversified small and cottage industrial systems to restore human ingenuity, creativity and dignity and to make people self-sufficient and reduce their vulnerability to large anonymous systems. Such technologies will also help in reducing excessive concentration of wealth and income and reduction in extreme inequality.

More importantly, ancient wisdom dictates that austerity and moderation in consumption and respect for nature are one-stop and lasting solutions to contain environmental degradation. This is the way that governed the life of our ancestors who lived for thousands of years in harmony with nature. Nature nurtures each one of us every single day. The air we breathe, the water we drink, the food we eat, the habitation we live in, the clothes we wear and whatever else we consume comes directly from the Mother Nature. The day this stops, human existence will come to an end. This is ancient wisdom and a plain and simple truth. No complex statistics, graphs or tables are needed to understand this simple fact. Under these circumstances how can we treat nature as an object of exploitation and a dumping ground for human induced waste? If we continue to do so, we are waging a war against our own existence. These is also the lesson we can learn from the living practices in Auroville and Krishna Valley. Similar living practices can also be found amongst the nomadic people of Mongolia, Kovcheg village in Russia, Lammas Eco Village in Wales, EcoVillage at Ithaca, New York and Findhorn Ecovillage, Scotland.

Thus, education based on consciousness is key to sustainable development. Enlightened are those who can manage with less. Needs are limited while the desires are infinite and they grow in geometric progression. Chasing these desires is the primary cause of human distress and environmental degradation. Therefore, mad race for higher GDP and more and more consumption must come to a halt. Environmental issues, harmonious co-existence with nature and the insatiable nature of human desires must form part of education system in all the countries to raise the level of human consciousness. Respect for nature must be cultivated in the same way as we teach respect for other humans, traffic rules and social behaviour. In each nation, social, political and economic leaders should be persuaded to present examples of moderation and austerity in consumption to the younger generations.

Keywords: Industrial Revolution; paradox of sustainable development; poverty, hunger and inequality; anthropogenic greenhouse gas emissions; global warming; solid and liquid waste; contamination of soil, water and air; Earth Summit; sustainable living; consumerism; harmony with nature; and ancient wisdom.

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Abbreviations

ADB	Asian Development Bank
AI	Artificial Intelligence
BRIICS	Brazil, Russia, India, Indonesia, China and South Africa
CFCs	Chlorofluorocarbons
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GLASOD	Global Assessment of Human-induced Soil Degradation
GWP	Gross World Product
EEP	European Environment Agency
EPA	United States Environmental Protection Agency
FAO	Food and Agriculture Organization of United Nations
IEA	International Energy Agency
IPCC	Inter-governmental Panel on Climate Change
ISRIC	International Soil Reference and Information Centre
IUCN	International Union for Conservation of Nature
LADA	Land Degradation Assessment in Dryland
MGDs	Millennium Development Goals
NASA	National Aeronautics and Space Administration of US
NGOs	Non-governmental Organizations
PCSD	Presidents' Council on Social Development, United States of America
POP	Persistent Organic Pollutants
PPP	Purchasing Power Parity
UN (UNO)	United Nations Organization
UNCED	United Nations Conference on Environment and Development, 1992
UNCSD	United Nations Conference on Sustainable Development, 2012 (Rio+20)
UNEP	United Nations Environment Programme

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNICEF	United Nations International Children's Emergency Fund
UNMS	United Nations Millennium Summit, 2000
UNSDS	United Nations Sustainable Development Summit, 2015
WB	World Bank
WCED	World Commission on Environment and Development
WHO	World Health Organization
WSSD	World Summit on Sustainable Development, 2002

Research Questions and Research Methodology

Background:

Since the inception of the industrial revolution in the 18th Century, human life has been transformed beyond recognition. It wasn't that the industrial revolution became a stalwart juggernaut overnight. Slowly overtime, machines began to replace manual labor. Fossil fuel replaced wind, water and wood; used primarily for the manufacture of textiles and the development of iron making processes. Gradually over a period of 200 years, scientific and technological developments have had a profound impact on the humanity as a whole. Developments in transport, communication and production systems; medicine, biological and genetic sciences; new materials; nuclear technology; space research and digital technology have fundamentally altered the way of living.

Modes of transport have catapulted human life from simple horse drawn carriages to spacecraft cruising at unprecedented speeds into outer space. Simple wooden boats have been transformed into large luxurious sea cruisers, which are no less than floating cities on the ocean surface. Simple two-way oral communication has travelled a long way to high speed wireless internet and cellular and satellite phones with instant connectivity all around the globe and beyond. Traditional small and cottage industries have been replaced by large scale production units with unprecedented automation, churning out billions of products every day to satisfy ever growing human desires. Genetic and medical sciences have precisely mapped the human genome and body organs; and have invented highly complex systems of diagnosis, medication and surgical intervention (Gupta, 2012, p.19).

These technological innovations have intruded into every sphere of our life from cooking to washing to shopping to entertainment to production to transportation and communication. Similar transformations could be seen in many other fields of human life. Internet, cellular and digital connectivity have reduced the world to a global village. Most of these amazing transformations have occurred in our own lifetime. Moreover, the pace of transformation continues unabated and at an ever-increasing speed. We are in for many more future shocks with growing appetite for innovations, more and more consumption and ever-increasing competition (Gupta, 2018 p.11).

Perspective:

Although these unprecedented transformations have made human life more comfortable than it has ever been, they have also put tremendous pressure on natural resources and the environment surrounding us. Rather than respecting nature for sustaining life on Earth, we are exploiting nature in every possible way as if nature is our enemy. There is global competition for control over minerals, land, water resources and energy. Simultaneously, mass production and ever-increasing consumption are contaminating air, soil, rivers, lakes and oceans in a manner never seen before. Increasing CO₂ emissions are leading to global warming and climate change. Global temperatures are on the rise with erratic weather patterns, fast melting glaciers and ice-sheets, rising sea levels and dying rivers and lakes (Gupta, 2018 p.67). During the last six decades with gradual destruction of small and rural industries, massive migration to cities has led to large-scale slums around mega-cities with sub-human living conditions. Disparity in income and wealth is increasing at an unprecedented pace. We are witnessing massive hunger, poverty and deprivation in the midst of unprecedented economic growth and economic prosperity. In view of the above, serious questions have been raised whether this new life-style based on increasing consumption and comforts with growing environmental degradation and massive economic disparities is sustainable or will it render the Earth inhabitable endangering the very existence of life. A host of international conferences, negotiations and declarations have taken place on this subject particularly since 1972, but without any tangible impact on the ground realities so far.

Research Questions:

Thus, environmental degradation and extreme poverty and hunger are the most serious challenges to humanity in modern era and need our urgent attention. This research project begins with this practical problem characterizing the world today (Trochim et al. 2016 p.10). Therefore, in my research, I propose to examine the sustainability of this path based on the following four fundamental questions pertaing to this issue:

- 1. What is sustainable development? Is there a paradox between sustainability and economic development? Could they co-exist?
- 2. What is the connection between rapid economic and technological transformations and environmental degradation?
- **3.** What is the current status of international negotiations on issues of sustainability?
- 4. Since our ancestors lived in harmony with nature for thousands of years, could their wisdom be relevant to contain further environmental degradation?

In order to examine these issues, we need to study both the positive and negative impacts of these far-reaching changes during the last decades of our journey as human race. Although, human life has become far more comfortable compared to the hardships our ancestors faced; we need to ponder as to why; despite these great strides in economic and technological fields; we face unprecedented challenges of hunger & poverty and environmental degradation, that are threatening social cohesion and even the very existence of life on Earth. Therefore, in order to understand the sustainability of the path we are traversing, we need to examine these challenges facing humanity, both based on comprehensive literature review (Trochim et al. 2016 p.11) and qualitative empirical research (Saldana, 2009).

Research Methodology:

a) Keeping the above in view, a comprehensive study has been undertaken in order to analyse each of these questions in depth. The methodology has been divided into three parts. The first part deals with the literature review based on available scientific studies, data, documentations and international declarations and agreements on issues of sustainability. Data and documents for this purpose have been obtained from a variety of authentic sources such as the United Nations and its agencies like FAO, UNEP, WHO, World Bank, IMF and so on; Intergovernmental Panel on Climate Change (IPCC), National Aeronautics and Space Administration of US (NASA), International Union for Conservation of Nature (IUCN), European Environment Agency, UNESCO and other scientific studies by individuals and national institutions. The second part deals with the wisdom of our ancestors in dealing with environmental issues over thousands of years. Practices followed by ancient civilizations in different parts of the world have been studied and examined for

this purpose. This section is based on time-tested historical record. The third part is based on two separate pieces of empirical researches undertaken in two townships specifically set up for sustainable living and harmonious relationship with nature.

- b) The first empirical research has been undertaken in Auroville in South India, also known as the City of Dawn. Auroville was set up in 1968 under the aegis of UNESCO based on the vision of human unity and sustainable living by Sri Aurobindo and his spiritual collaborator Mirra Alfassa, known as the Mother. Auroville belongs to humanity as a whole transcending national boundaries, religious beliefs and ethnicity. As of April 2017, Auroville residents represented 53 different nationalities. This township has been selected based on its international character and sustainable living practices. The second empirical research has been undertaken in Krishna Valley, Hungary which was set up as eco-friendly township in 1993. This is the largest ecological township in Eastern Europe based on consciousness and sustainable living. This is primarily a Hungarian township with one family each from Russia and UK. Thus, the first township provides an international perspective in the setting of a developed country, Hungary.
- c) Both these studies have been conducted in accordance with the approved and time-tested qualitative and quantative research methods (Creswell, 2006 and Seidman, 2005) in three phases. Views of the residents were ascertained based on a well-crafted questionnaire based on the pertinent literature. The questionnaire covers issues concerning sustainability, economic growth, consumerism, environmental degradation, tecnnology and innovation, disparity of income and distributive justice, urbanization, and so on. A copy of the questionnaire is at Appendix II. The sample of the respondents were selected in consultation with the managing committees of the townships keeping in view the holistic representation of the residents based on age, gender, years of stay and experience. Resposes were received from 26 residents each both in Auroville and Krishna Valley. Precise details of the responses are given at Appendix III. This was followed by observation on the ground of the variety of sustainable systems in place in these townships such as; solar energy, water treatment, waste recycling, commercial activities, forestry & green

areas, education and living habits. Thirdly, intense discussions were held with the citizens in small brain-storming session on the sustainle living patterns and global environmental challenges. Finally, in-depth interviews were conducted with some distinguished inhabitants on different aspects of sustainability to validate the research outcome. These townships provided a social laboratory for validation of theoretical research undertaken based on secondary data and literature review.

- d) In terms of chronology, the first chapter addresses the concept of sustainability and the paradox of sustainable development. The second chapter deals with economic growth and prosperity, human comforts and growing consumerism particularly since 1950. The third chapter deals with vast economic inequality and large incidence of poverty and hunger in the midst of plenty and prosperity. The next three chapters deal with accelerating environmental cost of rapid economic development and consumerism. These chapters cover increasing degradation of soil; growing water stress and water contamination; air pollution and declining air quality; and global warming and climate change. Chapter seven deals with the international conferences, declarations and agreements and their outcome. Chapter eight highlights the ancient wisdom and the sustainable living practices followed by our ancestors and the relevance of these practices in modern era.
- e) The next two chapters, chapters nine and ten bring out the results of the two empirical studies in sustainability undertaken in Auroville, India and Krishna Valley, Hungary. Format of the questionnaire used for undertaking the research is given in Appendix II. Appendix III, provides precise outcome of the research conducted in Auroville and Krishna Valley. Chapter 11, summarises the research outcome with reference the four research questions and future research areas.

Chapter 1

Sustainable Development – An Introduction

1.1 Overview:

Existence of life is closely inter-twined with nature. Nature provides the support system for survival of different species of life that exist on the planet Earth. Thus, our survival as human race is completely dependent on nature. The air we breathe, the water we drink, the food we eat, the clothing we wear, the habitation we live in, the energy we use and all other products we consume come directly or indirectly from the nature surrounding us. Precisely because of this, many ancient civilizations have termed nature as our mother. As evident from historical records quoted in the next section of this chapter; for thousands of years humanity lived in harmonious relationship with nature.

The Industrial Revolution marked a major turning point in earth's ecology and humans' relationship with their environment. The Industrial Revolution dramatically changed every aspect of human life and lifestyle. However, the impact on the world's psyche would not begin to register until the early 1960s, some 200 years after its beginnings. From human development, public health and life longevity, to societal changes, energy usage, consumption patterns and the modes of communication and transportation; the effects are profound. It wasn't that the Industrial Revolution became a stalwart juggernaut overnight. It started in the mid-1700s in Great Britain when machinery began to replace manual labor. Fossil fuels replaced wind, water and wood, used primarily for the manufacture of textiles and the development of iron making processes. The full impact of the Industrial Revolution started to register when the use of machines to replace human labor spread throughout Europe and North America. These processes gave rise to sweeping increases in production capacity and would affect all basic human needs, including food production, medicine, housing, and clothing. Mass production replaced small and cottage industries over time. The Industrial Revolution also altered medicine and living standards, resulting in the population explosion that would commence at that point and steamroll into the 20th and 21st centuries. In only 100 years after the onset of Industrial Revolution, the world population would grow 100 percent to two billion people in 1927 (McLamb, 2011). Continuing scientific innovations further accelerated the processes set in motion by the Industrial Revolution far beyond one could imagine in the 18th century.

Global population in 1900 was estimated at 1.5 billion (Our World in Data, 2017). During the 20th century, the world population increased at an exponential rate, growing to six billion people just before the start of the 21st century. That's almost 400 percent increase in population in a single century. Just in 250 years from the beginning of the Industrial Revolution until 2006, world's population increased by approximately six billion people. In 2016, global population was estimated at 7.4 billion (Population Reference Bureau, 2016). The United Nations estimates that it will further increase to 11.2 billion by 2100 (UN Population Division, 2015). Urbanization and increasing consumption are important factor affecting humans' relationship with environment. In 1800, only 3 percent of world population lived in urban areas. Today over 54 percent of total world population lives in cities (Population Reference Bureau, 2016). Commission on Growth and Development set up by the World Bank in 2008 has stated that the global Gross Domestic Product (GDP) went up from US\$ 5.31 trillion in 1950 to US\$ 77.6 trillion in 2014 (World Bank, 2014). According to IMF, in 2018 global GDP on purchasing power parity (PPP) basis was stood at US\$ 134.9 trillion (IMF, 2018). According to the International Energy Agency, global primary energy supply (TPES) has gone up from 6.101 million tons of oil equivalents (Mtoe) in 1971 to 13, 647 Mtoe in 2015 (IEA, 2017).

Unprecedented growth in population, massive migration to cities, manifold increase in Gross World Product (GWP) and growing energy consumption has given a quantum leap to human activities in the recent decades. Today we are in the midst of a rapid transition to a world where human population are more crowded, more consuming, more connected and more diverse than any time in the history of mankind. Most of the population growth is taking place in the developing societies of Africa, Asia and Latin America where there is urgent need to reduce poverty and hunger. Meeting even the basic needs of food, clothing, shelter and education of the rapidly increasing population implies greater production and consumption. Simultaneously, a section of the human society (less than 20%) is engaged in more and more (almost reckless) material consumption driven by their infinite desires and wealth. These human induced activities have given rise to unprecedented pollution of air, rivers, lakes and oceans, contamination of ground water aquifers, degradation and acidification of soil, decline in bio-diversity, massive deforestation and rise in temperatures endangering the global life support system. On the other hand, natural resources are fast depleting. Questions have been raised of nature's capacity to provide raw

material, sustain bio-diversity, and assimilate and absorb ever-increasing waste (National Research Council, US, 1999). Therefore, we must think whether it is sustainable to continue with rapid growth of consumption, unbridled exploitation of natural resources and reckless poisoning of air, water and soil.

The world has experienced human induced changes in the global environment for much of the past 10,000 years but most of those changes have occurred during our lifetime (Kates et al, 1990). Comparison of the modifications in the environment over the last 300 years to changes over the last 10,000 years demonstrate the unprecedented nature, scale and rate of human induced changes in the earth's environment. In the last 300 years, humankind has demonstrated the capacity to change the environment on a scale that far exceeds the rate of natural environmental changes, as human population, economic growth and technological capacity have combined to create human-influenced ecosystems on much of the land and coastal areas of the Earth. Human actions have significantly altered biogeochemical cycles, of both land and water along with biotic diversity. Overall, since the dawn of agriculture roughly 100 centuries ago, an area of the size of continental United States has been deforested by human actions (Turner et al., 1990).

Apart from contamination of air, water and soil, because of large scale and rapid industrialization, new modes of transport, increasing use of chemicals and use of chlorofluorocarbons; CO_2 emissions have reached levels never seen before. Annual CO_2 emissions went up to 32.5 Gt. in 2017 compared to 23 Gt. in 2000 (IEA, 2019). Increasing municipal waste has also become a serious problem. For example, in Canada per capita solid waste disposal by municipal authorities in 2008 was estimated at 777 kilograms (Canada Statistics, 2015). Moreover, this waste did not include discarded office and household equipment, furniture, washing machines, refrigerators, computers, motor vehicles and so on. Toxic chemicals, nuclear waste and nuclear radiation are poisoning the atmosphere never seen before. It has been estimated that half of the topsoil on the planet has been lost in the last 150 years in addition to degradation and salinity of soil (WWF, 2016).

Satisfaction of human needs and aspirations is a legitimate objective of development. However, as of now despite large-scale industrialization and manifold increase in global GDP even the essential needs of a vast majority of people in developing countries are not met. Based on "one and a quarter-dollar-a-day threshold", there are 1.2 billion extremely poor people in developing countries. Of these, 780 million suffer from chronic hunger, which means that their daily intake of calories is insufficient for them to live active and healthy life (FAO, 2015). Therefore, there is legitimate demand for further economic growth, which will naturally put more pressure on the fragile ecosystem. For example, agricultural production has gone up dramatically during the last few decades but so have desertification, soil erosion and salinization. Similarly, marine life is facing serious threat due to increasing seafood production and growing ocean pollution. Therefore, there is an urgent need for a balance between legitimate human needs and degradation of planet's life support system if we want to sustain life on Earth.

1.2 Sustainability:

The concept of sustainable development establishes link between what is to be developed and what is to be sustained. Of course, the emphasis differs from society to society and country to country. Developing countries put more emphasis on development and poverty eradication; since on per capita basis, resources used by these countries are extremely low compared to those by the developed nations. For them, sustainable development is a nascent concept imposed by the developed world who have already done considerable damage to the environment in their pursuit for economic supremacy. On the other hand, the developed North is more concerned for a balanced approach as they are already developed and their citizens enjoy a comfortable standard of living. For example, the US President's Council on Sustainable Development believes in "mutually reinforcing goals of economic growth, environmental protection and social equity" (PCSD, 1996). The Council sees these goals intrinsically linked together. The Council also believes that the humanity has responsibility in the interest of its own survival to protect and sustain quality of air, supply of fresh water and under-ground aquifers, oceans and marine life, forests and wild life, mineral resources, quality of soil and atmospheric temperatures.

Although the word sustainable development is of recent origin, the concept is as old as human existence. Since survival has always been a concern of human race, sustainability has been practiced over thousands of years by different civilizations in all part of the world. Such practices were first introduced in pastoralism, farming and aquaculture. Traditional practices in India, China, Egypt and Greece include; irrigation systems, organic farming, legume crops for nitrogen fixation, crop rotations and intercropping, terracing and the use of diverse crop varieties. Human, animal and crop wastes were systematically recycled to maintain soil fertility with no waste and no use of external inputs.

Describing the wisdom of our ancestors in the context of sustainable development, UNESCO states, "The industrial world is facing an ecological crisis. Yet few industrial economists would admit they could learn from indigenous people. Their economies are often called 'primitive', their technology dismissed as 'Stone Age', and most governments assume they can benefit only from salaried employment. Yet these traditional ways of life have proved highly durable. Hunting and fishing have allowed the Inuit to survive in the Arctic; nomadic pastoralism provides a livelihood for people in the arid Sahelian region of Africa; shifting cultivation has sustained hundreds of distinct cultures in the fragile ecosystem in the Amazon and the forests of South-East Asia. Non-indigenous people have not been able to survive in these extreme conditions without destroying the balance of the ecosystem. The key to this success is sustainability. Indigenous people today use the resources available without depleting them. They use their intimate knowledge of plants, soils, animals, climate, and seasons, not to exploit nature but to coexist alongside it. This involves careful management, control of population, the use of small quantities but a wide diversity of plants and animals, small surpluses, and minimum wastage. Plants provide food, medicines, pesticides, firewood, building materials; animals provide meat, clothes, string, implements, oil." (UNESCO, 2010). Similar views were expressed by many scholars who participated in an international conference on 'Sustainable Development and Sustainable Life Styles' held in New Delhi, India in April 2001 (Sundaram and Moni, 2003).

1.3 Glimpses of Ancient Practices for Sustainable Development:

The Vedic Hymn to the Earth, the Prithvi Sukta in Atharva Veda, is unquestionably the oldest and the most evocative environmental invocation in the world. The Vedic seer solemnly declares the enduring filial allegiance of humankind to Mother Earth: *'Mata Bhumih Putroham Prithivyah*: Earth is my mother; I am her son.' Mother Earth is celebrated for all her natural bounties and particularly for her gifts of herbs and vegetation. The Vedic seers regarded the Earth as 'sacred space'. Thus, worshipping mountains, birds, animals and plants is deeply rooted in Indian

traditions. This forms part of Indian ethos of compassion and non-violence towards other species of life and nature.

Agricultural practices in ancient India were highly developed in Indus Valley and Gangetic plains (Gopal and Srivastava, 2008). Agro-pastoral practices in ancient India included threshing, planting crops in rows—either of two or of six—and storing grain in granaries. Barley and wheat cultivation—along with the rearing of cattle, sheep and goat—was visible in Mehargarh by 8000-6000 BCE (Gregory1996 and 1999). Irrigation was developed in the Indus Valley Civilization by around 4500 BCE. The size and prosperity of the Indus Valley Civilization grew as a result of this innovation, which eventually led to more planned settlements making use of drainage and sewers. Sophisticated irrigation and water storage systems were developed by the Indus Valley Civilization, including artificial reservoirs at Girnar date back to 3000 BCE, and an early canal irrigation system from circa 2600 BCE (Rodda and Ubertini, 2004). Archeological evidence of an animal-drawn plough dates back to 2500 BCE in the Indus Valley Civilization (Lal, 2001). The Mauryan Empire (322–185 BCE) categorized soils and made meteorological observations for agricultural use. Other Mauryan facilitation included construction and maintenance of dams, and provision of horse-drawn chariots—quicker than traditional bullock carts. Construction of small water reservoirs called *talaabs* has been ancient Indian practice to recharge ground water aquifers.

The Greek diplomat Megasthenes (300 BCE)—in his book *Indika*— provides an eyewitness account of Indian agriculture in the following words:

"India has many huge mountains which abound in fruit-trees of every kind, and many vast plains of great fertility. . . . The greater part of the soil, moreover, is under irrigation, and consequently bears two crops in the course of the year. . . . In addition to cereals, there grows throughout India much millet . . . and much pulse of different sorts, and rice and what is called bosporum [Indian millet]. . . . Since there is a double rainfall [i.e., the two monsoons] in the course of each year . . . the inhabitants of India almost always gather in two harvests annually" (Encyclopedia Britannica, 2008).

In ancient Egypt, sustainable agricultural practices were developed in and around the Nile basin. Irrigation allowed the Egyptians to use the Nile's waters for a variety of purposes. Notably,

irrigation granted them greater control over their agricultural practices (Kees, 1961). Floodwaters were diverted away from certain areas, such as cities and gardens, to keep them from flooding. According to Postel; the earliest and most famous reference to irrigation in Egyptian archaeology has been found on the mace head of the Scorpion King, which has been roughly dated to about 3100 BCE. The mace head depicts the king cutting into a ditch that is part of a grid of basin irrigation. The association of the high-ranking king with irrigation highlights the importance of irrigation and agriculture to their society. Egyptians developed and utilized a form of water management known as basin irrigation. This practice allowed them to control the rise and fall of the river to best suit their agricultural needs. A crisscross network of earthen walls was formed in a field of crops that would be flooded by the river. When the floods came, the water would be trapped in the basins formed by the walls. This grid would hold water longer than it would have naturally stayed, allowing the earth to become fully saturated for later planting. Once the soil was fully watered, the floodwater that remained in the basin would simply be drained to another basin that was in need of more water (Postel, 1999).

As regards ancient Greece, Mark Cartwright in his article on Food and Agriculture in Ancient Greece states, "there is evidence of crop rotation, and fields were left fallow to allow soil nutrients to regenerate and moisture to build up. In more pressing times, some fields would have been used continuously throughout the year or planted with multiple crops at the same time. Such crops as beans and lentils were also grown and ploughed back into the field to re-fertilize it or weeds could be left to grow as food for grazing animals. Small plots used for growing fruit and vegetables would have been irrigated with small water channels and cisterns. Trenches, if labor were available, were dug around trees to hold precious rainwater for where it was most needed. Equipment used in Greek agriculture was basic with digging, weeding, and multiple ploughing done by hand using wooden or iron-tipped ploughs, mattocks, and hoes (there were no spades). Richer farmers had oxen to help plough their fields. Sickles were used to harvest crops, which were then winnowed using a flat shovel and baskets" (Cartwright, 2016 p.1-2).

Sustainable development practices were also followed in ancient China. Influenced by the traditional philosophy, Chinese FengShui displayed the concept of balance, harmony and order in the design of ancient living environment and development of traditional settlements. The community as a whole made efforts to protect natural resources through well organized and

prudent consumption behavior. Long-term stable social and natural environment, increase and saturation of population, and less developed agricultural technology encouraged the survival and development based completely upon perceivably scarce resources and their regeneration capability (Gadgil, 1985).

In his book Dark Emu (2014), author Bruce Pascoe provides evidence from the diaries of early Australian explorers that suggests that the sophisticated and enlightened systems of food production, irrigation, land management and food storage & preservation have been blatantly understated in modern retellings of early Aboriginal history of Australia (Bruce Pascoe, 2014). In Mongolia, there is considerable respect for nature. Mongolian nomads are highly conscious of animals, water bodies, mountains, and pastoral lands. They still preserve nature in the same way as we preserve our homes. Nomads worship water bodies and follow seasonal migratory practices to avoid excessive grazing in a particular area (Gupta, 2007 p.65-68).

1.4 New Thinking on Sustainable Development:

Thus, the problems, ideas and practices that we currently classify under the sustainability umbrella can be traced back to, many thousands of years. The search for a balance between the demand for raw materials for food, clothing, shelter, energy, and other goods, and the environmental limits of ecosystems is a constant concern throughout human history (Ponting, 2007). The structures of imperial and colonial power which dominated the world in the nineteenth and early twentieth century made little provision for economic and social advancement in what we now call the developing world. Colonial regions functioned primarily to supply imperial powers with raw materials and cheap labor – including slave labor and indentured workers as late as the mid-nineteenth century (Harris, 2000). During these years, the ancient time-tested concept of harmony between man and nature was lost under the clouds of colonial domination.

The concept of sustainability as we understand today has emerged primarily since 1950s. Soon after World War II and decolonization, economic growth paved the way for renewed optimism about the prospects of rising living standards worldwide and during the last decades of the 20th century many countries made remarkable progress in their development (Dalal-Clayton and Bass, 2002). It was also during this period of unprecedented economic growth and scientific and technological innovations, together with a rapid population growth, that humanity began to exceed the environmental limits of the earth (Ewing et al., 2009). People became aware of these threats and the terrible damage caused to the environment resulting in natural disasters, started to change their views and basic assumptions about economic growth (Du Pisani, 2006). In the last half of the twentieth century, four key themes emerged from the collective concerns and aspirations of the world's peoples: peace, freedom, development, and environment (National Research Council, US, 1999). Environmental concerns led to the concept of sustainable development which is often misunderstood and interpreted differently by different people (Rogers, Jalal, Boyd, 2008).

More recent history of sustainable development goes back to early 1970s. At global level conflict between environment and development was first acknowledged in the 1972 Stockholm Conference on Human Environment which led to the establishment of United Nations Environment Programme (UNEP). The Stockholm Conference adopted two documents. The Stockholm Declaration on the Human Environment and an Action Plan for the Human Environment (UNEP, 2016). However, there was a clear division between the North and the South at the conference. While the emphasis of the North was on environment that of South on development and equity. In 1980, the International Union for Conservation of Nature and Natural Resources (IUCN) came out with the World Conservation Strategy highlighting the interdependence between the ecosystem and human existence (IUCN, 1980, p.14). The Strategy particularly highlights the urgent need for maintenance of essential ecological processes and life support systems, preservation of genetic diversity and sustainable utilization of species and ecosystems. Subsequently the World Commission on Environment and Development was commissioned by the United Nations General Assembly in 1982. The Commission headed by Gro Harlem Brundtland, former Prime Minister of Norway presented its report titled "Our Common Future" in 1987. This report also known as Brundtland Report has created renewed global awareness for preservation of life support system on the planet.

The opening paragraph of the report states, "The Earth is one but the world is not. We all depend on one biosphere for sustaining our lives. Yet each community, each country, strives for survival and prosperity with little regard for its impact on others. Some consume the earth's resources at a rate that would leave little for future generations. Others, many more in number,

consume far too little and live with the prospect of hunger, squalor, disease and early death" (WCED Report 1987 p.27). The report defines sustainable development as follows:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- a. the concept of 'need', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- b. the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs".

Thus, the goal of economic and social development must be defined in terms of sustainability in all countries--developed or developing, market-oriented or centrally planned" (WCED Report, 1987 p.43). Albeit somewhat vague, this concept of sustainable development aims to maintain economic advancement and progress while protecting the long-term value of the environment; it provides a framework for the integration of environment policies and development strategies (United Nations General Assembly, 1987). The concept of conserving resources for future generations is one of the major features that distinguish sustainable development policy from traditional environmental policy, which also seeks to internalize the externalities of environmental degradation. Secondly, the concept of need is extremely important as against greed and desires. Hence, the economic development must aim to fulfil the legitimate needs of the people and unsustainable production should be curtailed. Desires are elastic and infinite and can never be satisfied.

Sustainability therefore can be defined as the practice of maintaining processes of productivity indefinitely—natural or human made—by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems (*Kahle and Gurel-Atay, 2014*). Sustainability is considered by many; the best way to address the vast, complex and interrelated environmental and societal problems and is deemed highly imperative for the sake of current and future generations. In this sense, sustainable development not only represents a solution for environmental and societal problems, but also offers a set of principles implying

positive objectives, a focus for positive change, and a critique on conventional thinking and practice (Gibson, Canadian Environmental Assessment Agency, 2000).

The above definitions provide a clear vision of the interdependence of development and environmental protection. This vision was further elaborated at the 1992 Rio Conference on Environment and Development (UNCED) often called as the "Earth Summit". The Rio Declaration and the "Agenda 21" adopted at Rio together sets forth detailed principles, action plans and resource needs for achieving sustainable development in the 21st century (UNEP, 2016). Subsequently the 2002 the World Summit on Sustainable Development at Johannesburg, South Africa, marked a further expansion of the standard definition with the widely used three pillars of sustainable development: economic, social, and environmental (UN, 2002). The Johannesburg Declaration created a collective responsibility of the humanity to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development—economic development, social development and environmental protection—at local, national, regional and global levels.

Image 1.



Three Pillars of Sustainability

Source: U.S. National Research Council, Our Common Journey: A Transition Towards Sustainability.
The documents adopted at these summit meetings clearly state that the developmental process and environmental protection are closely linked and cannot be divorced from each other. Therefore, resources taken from the nature for developmental activities must not exceed what could be naturally replenished. Similarly, the waste generated must not be more than what could be naturally absorbed and assimilated. Poverty and distributive justice are important aspects of sustainable development and therefore the developed countries must contribute towards eradication of poverty. Excessive wealth with some and large pockets of poverty cannot co-exist for long and are not sustainable. The race for more and more consumption with unsustainable patterns of production must be eliminated if the life support system of the planet has to survive. Global partnership is an essential requirement for enforcing this discipline. If we fail to unite in this pursuit, earth's ecosystem will continue to face gradual degradation. Stabilization of human population is vitally important. Infinite demographic growth cannot be sustained with finite resources. Similarly, economic growth has its limits and the race for higher and higher Gross Domestic Product is unsustainable with finite natural resources. Development on the other hand is possible through technological improvements. New technologies based on minimizing use of natural resources and reduction in contamination are needed to continue on the path of development.

The National Research Council of US (a body of the National Academy of Sciences, National Academy of Engineering and the Institute of Medicine) in its publication "Our Common Journey – A Transition Toward Sustainability" has concluded that "the primary goal of a transition towards sustainability over the next two generations should be to meet the needs of much larger but stabilizing human population, to sustain the life support system of the planet and to substantially reduce hunger and poverty". Under the heading "what is to be sustained," the publication identified three major categories—nature, life support systems, and community as stated in the chart given earlier. The publication further defines human needs as providing food and nutrition, nurturing children, finding shelter, providing education and finding employment. Life support system of the planet had been defined as ensuring the quality and supply of fresh water, controlling emissions into the atmosphere, protecting the oceans, and maintaining the species and ecosystem. Reducing hunger and poverty has been defined as ensuring income growth, employment services and essential safety net services (National Research Council, US, 1999 p.31).

To mark the beginning of new millennium a Summit meeting of Heads of Governments was held at UN Headquarters in New York in September 2000 where the United Nations General Assembly adopted about 60 new goals including those concerning sustainable development, environment and eight Millennium Development Goals (MDGs) towards reduction of poverty, illiteracy and malnutrition. These eight MDGs became the global agenda for 15 years to tackle the indignity of poverty and hunger and to protect environment. Twenty years after the Earth Summit in Rio, United Nations Conference on Sustainable Development (Rio+20) was held in Rio de Janeiro. The discussion during the conference focused on two main themes; (1) how to build green economy to achieve sustainable development and lift people out of poverty and (2) how to improve international coordination on sustainable development (United Nations, 2012).

1.5 Sustainable Development Goals:

In yet another significant development, 2030 agenda for sustainable development goals (SDGs) was adopted at the UN Sustainable Development Summit held at New York on 25-27 September 2015. This became possible following noticeable success on 8 Millennium Development Goals adopted at the UN Millennium Summit in 2000. Findings of the Millennium Development Goals Report 2015 (MGD, 2015, p.6) show that the MGDs produced the most powerful anti-poverty movement lifting a billion people out of extreme poverty with considerable improvement in health, education and gender equality. Number of people living in extreme poverty declined from 1.9 billion in 1990 to 836 million in 2015. Primary school enrolment increased from 60 to 80%. Considerable success was achieved against malaria, tuberculosis, HIV/AIDS. Child mortality rate registered a decline. However, environmental degradation worsened with 50% increase in emission of greenhouse gases, growing desertification, contamination of oceans and deforestation.

The 17 SDGs with 169 targets seek to eliminate extreme poverty and hunger, improve health and education, achieve gender equality, ensure supply of clean water and energy, achieve sustainable consumption and production patterns, reduce inequality among nations, promote innovation, make cities more sustainable and combat climate change and protect oceans, forests and ecosystem (UNGA, 2015). These 17 SDGs constitute a comprehensive and ambitious agenda for the next 15 years covering all the three pillars of sustainable development – economic

wellbeing, social inclusion and environmental sustainability. These targets are ambitious but not impossible to achieve but they do need a coordinated approach by governments, public and private sector institutions and civil societies. In this era of growing consumption and contamination, environmental sustainability remains the biggest challenge.

1.6 Paradox of Sustainable Development:

The concept of sustainable development envisions a future that includes environmental protection, economic growth, and social progress. This compelling vision has inspired useful collaboration of government, industry and civil society. However, is sustainable development really sustainable? Could they co-exist? Despite acceptance of sustainable development as a goal, it still remains a questionable concept and lacks universal acceptability. Many scholars hold the view that the entire concept of sustainable development is unsustainable. 'Sustain', 'sustainabile', 'sustainable development', and 'sustainable' are loaded word with no clear and acceptable definition. However, connected and globalized the world may be today, the sustainable development is being played out differently on a vast number of local stages (Gupta, 2017). What could be toxic in Japan could be sustainable in Egypt and vice--versa. Neither population growth, nor technology of production, nor the levels of consumption and emissions could be similar in two different societies or countries. There is no question of their being identical. Critics of sustainable development hold the view that 'one man's food could be another man's poison'. Therefore, what is considered sustainable by one society may not be so in another.

Prof. Serge Latouche, Economist at the University of Paris states, "The problem with sustainable development is not so much the word "sustainable" (it can even sound rather nice) as that of "development". Moreover, the association is explosive, toxic" (Latouche, 2003). He is of the view that sustainable does not refer as much to development as to reproduction. Sustainable development is an evolutionary process. For example, the quantum of resource base available, the state of technology, the production methods and the quantum and intensity of contamination all depend on the scientific advances and measurements available in these fields. With new discoveries in sciences, these parameters could undergo substantial change in the future. Bagheri and Hjorth assert that sustainability from the evolutionary viewpoint can only be defined as continuous development and learning of sustainability. There cannot be an ideal state of

sustainability (Bagheri and Hjorth, 2007 p.84-85). In this sense, it is a work-in progress in perpetuity.

Paradox of sustainable development has also been examined by Susan Baker (Baker, 1997) and by Rob J. Krueger and David Gibbs (Krueger and David, 2007). Dimitrov is of the view that the paradox of sustainability definitions lies in the parties who create them and not in the issues of sustainability and that, often sustainability definitions do not share the same goals (Dimitrov, 2010). A very appealing and conceptually clear summary of this paradox was provided in 1999 by Willard R. Fey and Ann C.W. Lam, who refer to it as the 'Ecocosm Paradox' (Fey and Lam, 2001, p.11). The Ecocosm Paradox is the set of dilemmas that arise from the compound hyper-exponential growth of annual world human consumption. The two main characteristics of the Ecocosm Paradox are:

- a. If human consumption growth continues, the planetary life support system will be disabled and the very existence of humanity will be endangered.
- b. If the consumption growth is stopped, the viability of the global economic and financial system will be threatened endangering the stability of governments, social systems and individuals.

Additionally, if sustainability is construed to preserving and protecting the environment as well as bio-diversity of other species (plant and animals) then the normative definition of sustainability would be loaded with notions of global environmental stability, ecological considerations and security of ecosystem as also elimination of hunger, poverty and deprivation. Unfortunately, the devil lies in the details. Finding consensus on these definitions is proving to be an arduous task. Attempts to devise acceptable sustainable development indicators have been made by many organisations, nations and NGOs including; Food and Agricultural Organization, World Health Organization, United Nations Environment Programme, Asian Development Bank; the national governments of Canada, the Netherlands, Norway, Denmark and USA and NGOs such as International Union for Conservation of Nature, World Wildlife Fund, World Resources Institute and so on (National Academy of Sciences USA, 1999 p.233-251). All these indicators have invited more criticism than acceptance. Moreover, many of these indicators are contradictory, conflicting and competitive. Therefore, drawing up a list of globally acceptable criteria or indicators seems to

be an impossible task in an international setting where each country comes out with their own set of criteria and interpretation of each one of them depending on their history, culture, experiences and national interest. Hence, till date we do not have a universally acceptable definition of sustainability despite a plethora of conferences and documents since the Earth Summit in Rio. This process is a Pandora's Box and hence unlikely to lead to a universally acceptable definition in the foreseeable future.

Nevertheless, we must not get lost into details overshadowing the principal objective of collective survival. Therefore, the notions of sustainability present as a comprehensive societal aggregate of human rights and obligations that are underpinned by theories of social justice (Dasgupta, 2004 p. 20). This spirit has been captured by the Brundtland Report as well; when it talks of poverty alleviation, equitable use of resources, quality of growth, sustainable level of population, new approaches to environmental protection and so on. Hence, desire for collective survival of the human race and justice have to guide our direction on this arduous path. When we have been faced with annihilation, we have to act collectively as a human race and not as rival nations. Moreover, these so-called paradoxes are neither incompatible nor insurmountable. If we look at human life closely, paradoxes and vicious circles are a regular and inevitable reality. Day and night, love and hatred, war and peace, poverty and prosperity are a few such examples. We need to reconcile and harmonize these apparent contradictions and move forward in our civilizational march as we do in our everyday life. Human right to healthy and productive life could be achieved only if we could use our natural resources prudently and judiciously. We all know the story of a hen that used to give one golden egg a day. One day the greedy owner decided to extract all the eggs at a time. To do so, he killed the hen and was deprived of, even one egg a day. This is ancient and eternal wisdom (Gupta, 2018 p.29).

"If the present trends in world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next 100 years. The most probable result will be a sudden and uncontrollable decline in both population and industrial capacity." Concludes a study commissioned by the Club of Rome (Meadows, Meadows and Randers, 1995 p. xiii).

Chapter 2

Economic Growth and Consumerism

2.1 Global Economic Growth:

The modern face of economic growth started with the Industrial Revolution in England in late 18th centuty. After decolonization and independence, other nations joined the process of economic development in the rest of Asia, Africa and the Latin America (Gillis et al., 1983). According to Maddison, from the year 1000 to 1820, the advance in per capita income was a slow crawl — the world average rose about 50 per cent in 820 years. Since 1820, world's development process has been much more dynamic. Over the past millennium, world population rose 22–fold. Per capita income increased 13–fold, world GDP nearly 300–fold. This contrasts sharply with the preceding millennium, when world population grew by only a sixth, and there was no advance in per capita income (Maddison, 2001). These statistics clearly indicate unprecedented growth in production and consumption.

Although the European economies recorded a spectacular growth since the beginning of the Industrial Revolution; global economic growth as a whole has been explosive since 1950s. The United Nations had declared 1960s as the 'Development Decade'. The current experience of economic growth is an absolute exception in the very long-run perspective of global social history. Growth in per capita income has been sustained at positive and apparently non-declining rates in many countries for prolonged periods of time (Grossman and Helpman, 1992). It now takes less than two weeks for the world to produce the same output as the whole of the year 1900 (George, 2004). As stated earlier, global GDP went up from US\$ 5.31 trillion in 1950 to US\$ 77.6 trillion in 2014 (World Bank 2014). As per the World Factbook, per capita PPP Gross World Product in 2014 amounted to US\$16,100 (The World Factbook 2014-15). According to IMF, in 2018 global GDP on purchasing power parity (PPP) basis stood at US\$ 134.9 trillion which amounts to 25-fold compared to 1950 (IMF, 2018). The developed countries have recorded a steady growth of 2 to 3 percent per annum over this period. GDP per capita in the US in 1960 was US\$3,007. In 2017, it had increased nearly 20-fold to more than \$59,531 (World Bank, 2019). Even the developing countries have recorded impressive growth during the last few decades as is apparent from the statistics given in subsequent pages.

The Commission on Growth and Development set up by the World Bank in April 2006 submitted a comprehensive report in 2008 on global economic growth titled 'The Growth Report - Strategies for Sustained Growth and Inclusive Development'. The report confirms that there has been unprecedented economic growth globally during the last few decades. Since 1950, while 13 economies have grown at an average rate of 7 percent a year or more for 25 years or longer, other economies including those from Sub-Saharan Africa have also recorded impressive economic growth (World Bank, 2014). Real GDP of the developing countries increased manyfold during this period. There have been multiple reasons for this unprecedented growth. The globalization and integration of the world economy allowed developing countries to import ideas, know-how, technologies and foreign investments and simultaneously offered them the advantage of labor cost and foreign markets for export of their products. Foreign education has allowed their citizens easy access to international business and technology networks. All this helped the developing countries to improve their productivity and multiply their production. Education has also allowed them to assimilate new technologies more easily. Some of them have been able to jump technological leap by 'catching up' bypassing the early and outdated technologies. These developmental processes in the developing countries also helped in reducing the North-South Divide to some extent.

Image 2.



Source: Maddison, Angus. 2007. Contours of the World Economy, 1–2030 AD. Oxford, UK: Oxford University Press.

Note: PPP = purchasing power parity.

Image 3.

Growth in Real Gross Domestic Product of Major Developing Countries between 1960 and 2006

	Deal		GDP growth rate***					Deal
	GDP* Share in		198	0–2006	1960-2006		Rank	GDP
	2006	total**	Real	Per capita	Real	Per capita	1960	1960
China	2092	25.4	9.8	8.6	7.7	6.1	5	70
Brazil	765	9.3	2.2	0.5	4.4	2.3	2	105
India	703	8.5	6.0	4.1	4.9	2.8	4	77
Mexico	666	8.1	2.6	0.9	4.3	2.0	3	94
Russian Federation	373	4.5	-0.4	-0.2	-	-	-	-
Argentina	340	4.1	1.8	0.5	2.5	1.1	1	108
Turkey	261	3.2	4.4	2.5	4.3	2.2	-	-
Indonesia	219	2.7	5.2	3.6	5.5	3.6	8	18
Poland	210	2.6	3.7	3.7	-	-	-	-
South Africa	169	2.0	2.2	0.1	3.3	1.0	7	38
Thailand	165	2.0	5.9	4.5	6.6	4.5	19	9
Venezuela, R. B. de	147	1.8	2.0	-0.3	2.8	0.0	6	41
Iran, Islamic Rep. of	140	1.7	3.5	1.3	4.4	1.8	-	-
Egypt, Arab Rep. of	128	1.5	4.7	2.6	5.3	3.0	17	12
Malaysia	119	1.4	6.1	3.6	6.6	3.9	22	6
Colombia	106	1.3	3.2	1.4	4.2	1.9	11	16
Philippines	99	1.2	2.9	0.7	4.0	1.4	9	17
Pakistan	99	1.2	5.1	2.5	5.5	2.7	20	9
Chile	96	1.2	4.9	3.3	4.3	2.5	12	14
Algeria	72	0.9	2.8	0.5	3.6	1.1	13	14
Peru	71	0.9	2.3	0.4	3.2	0.9	10	16
Bangladesh	65	0.8	4.6	2.3	3.6	1.3	16	13
Nigeria	64	0.8	2.7	0.0	3.5	0.8	15	13
Hungary	62	0.7	1.7	2.0	3.4	3.4	14	13
Romania	53	0.6	1.0	1.1	-	-	-	-
Others	965	11.7	-	-	-	-	-	-

Source: World Bank, World Development Indicators 2007.

Note: The table excludes countries that were developing in 1960 and have already reached industrialized countries' income levels. Numbers in italics and red indicate different time periods due to data availability: Russia (1989–2006), Turkey (1968–2006), Poland (1990–2006), Iran (1965–2006).

*Real and per capita GDP in constant 2000 US dollars, billions.

**Shares in total developing countries' real GDP in 2006.

***Period growth rate in CAGR (compound annual growth rate).

Image 4.

Gross Domestic Product (GDP) in 2015 of the 18 Largest Countries, Globally.



Last updated:Wednesday, 29 March 2017

Source: World Bank Quoted by KNOEMA Website.

The three tables/charts given above provide a clear view of the evolution of Global GDP. The first chart from Maddison provides the evolution of global GDP during AD 1 to 2000. The second chart provides the details of the GDP increase between 1960 and 2006 of the major developing countries. For example, real GDP of China increased from 70 billion US dollars in 1960 to 2092 billion US dollars in 2006. Similarly, GDP of Brazil went up from 105 billion US dollars to 765 billion US dollars while that of India from 77 billion US dollars to 703 billion US dollars during the same period (World Bank, 2014). The third table taken from KNOEMA website

provides total Gross Domestic Product of the 18 largest countries for 2015. The original chart at the KNOEMA Website is interactive and can depict all the statistics of GDP for these countries since 1960.

From the above statistics it is clear that humanity is engaged in the process of exponential growth. During the last few decades, particularly since early 1980s, some developing countries particularly China, India and East Asian nations started to grow at high rates to catch up with industrialized countries, thus contributing to the unprecedented growth of world GDP. The two charts given below shows how different groups of countries and regions have contributed to the world's GDP since 1960. This also shows relative decline of the United States, Canada, the European Union, and Japan as the developing countries are developing at a faster pace. Nevertheless, the economies of the developed countries still accounted for well over half the global GDP in 2006 despite increasing share of the developing countries. However, developing economies today have a collective importance in the global economy, which is steadily growing.

Image 5.



Trend in Relative GDP Share of Developed and Developing Countries

Source: World Bank, World Development Indicators 2007.

Image 6.



Growth of world gross product and gross domestic product by country grouping, 2007–2017

Source: UN/DESA. Note: Data for 2015 are estimated; data for 2016 and 2017 are forecast.

Source: World Economic Situation and Prospects, 2016. United Nations 2016.

From the facts given above it is crystal clear that global GDP as well as per capita income have gone up manifold during the last few decades and more so since 1960. GDP both for the developed and developing countries has recorded very healthy growth implying that global prosperity has reached a new high during the last few decades. To sum up we are engaged in a race for infinite growth for infinite time with finite resources available on the Earth. Let us therefore have a brief look at the extraction and use of natural resources for achieving this unprecended economic growth.

2.2 Extraction/Use of Natural Reources:

The unprecedented global growth has led to massive exploitation of natural resources. Extraction process has surpassed all physical boundaries and has even reached the Arctic, the Antarctica and the ocean beds. Outer space seems to be the next target for this human expedition. Increasing extraction of oil and mineral resources, deforestation and massive use of fresh water resources are having unprecedented repercussions for the entire ecosystem. A report prepared jointly by the Friends of Earth Europe, Global 2000 and the Sustainable Europe Research Institute titled "Overconsumption - Our Use of World's Natural Resources"; brings out some stark facts. The amount of net natural resources extracted for the production of goods and services have been

steadily increasing and stood around 60-65 billion tons in 2008. Humans extract and use about 50% more than only 30 years ago. Moreover, if the present trend continues natural resource extraction would increase to 100 billion tons by 2030. Almost half of global resource extraction takes place in Asia, followed by North America with almost 20%, and Europe and Latin America with 13% each. Global annual extraction of natural resources equals the weight of more than 41,000 Empire State Buildings, each weighing around 365,000 tons or 112 Empire State Buildings every day. While there is far more extraction of natural resources in Africa and Latin America, consumption is higher in North America and Europe due to industrialization. Consumption in Asia roughly equals the extraction. Technological innovations have helped tremendously in this process of exploitation of natural resources (Overconsumption? Our use of the World's Natural Resources).





Figure 1. Global material resource extraction



All in all, we move over 100 billion tons of material each year including unused extracted material or overburden. Each person on the planet uses on average over 8 tons of natural resources per year or 22 kg per day. If we include the unused extraction of materials (overburden), each inhabitant of the planet uses almost 40 kg per day. People in the developed countries consume 10 times more resources than those in the poorer nations. The natural resource base our societies are built on, is in severe danger of over-exploitation and collapse. Naturally, the more we use the more we contaminate air, water and soil as explained in the subsequent chapters. Natural resources, including materials, water, energy and fertile land, are the basis for our life on earth. Humanity's rapidly growing consumption of the planet's natural resources far exceeds the rate of their replenishment endangering the future generations. The nature's capacity to provide us biotic resources such as clean air, fresh water, fertility of soil, food, fish and timber and to absorb the waste and emissions we generate is called 'bio-capacity'. According to the scientific calculations based on ecological footprints, illustrate that the world is already using 30 percent more bio-capacity than the global ecosystem can provide in a sustainable manner (Overconsumption? Our use of the World's Natural Resources).

According to another study undertaken by OECD (Organization for Economic Cooperation and Development) countries in 2013; titled 'Material Resources, Productivity and Environment' the last decades have witnessed unprecedented growth in demands for raw materials worldwide, driven in particular by the rapid industrialization of emerging economies and continued high levels of material consumption in developed countries. By 2050, the world economy is expected to quadruple and the global population to grow from 7.4 billion today to over 9.2 billion. A growing population with higher average income requires more food, more industrial products, more energy and more water. This creates formidable challenges for sustainable economic development and containing environmental degradation. The amount of materials extracted and consumed worldwide increased by 60 percent since 1980, reaching nearly 62 billion metric tons per year in 2008, some eight-fold increase since the early 1900s. OECD countries accounted for 38% of domestic extraction of used materials (DEU) worldwide in 2008. The BRIICS (Brazil, Russia, India, Indonesia, China and South Africa) accounted for 35% with major share by China. While more updated global figures are not yet available, current material use is estimated around 65 metric tons and is projected to reach 100 metric tons by 2030 (OECD, 2013). As the use of natural resources increases further, the risk of higher contamination of air, water and soil, bio-degradation and climate change increase too.

2.3 Evolution of Consumerism:

To live means to consume. It is a constant process, 24 hours a day. If we go back in time to the beginning of the 19th century human consumption was primarily confined to essentials such as water, food, clothing and habitation. However, since the Industrial Revolution and in particular in the recent decades our consumption basket has expanded substantially. With steady economic growth and technological innovations over decades global consumption patterns have recorded exponential growth. Today in addition to the essentials, we consume an ever-increasing amount of goods and services – large mansions, aircrafts, luxury cruises, cars, motorbikes, office equipment, appliances (TV, refrigerators, washing machines, cooking range, computers, mobile phones etc.), sports equipment, perfumes, wines and liquors, cigars and cigarettes, electricity, furniture, décor, books, travel, and a large variety of entertainment products. The list of things and services we have come to depend upon is large and growing endlessly. The market system depends on our continued and increased consumption, so it does its best to make us want more, desire more, buy more, upgrade more, pollute more and waste more.

Consumption is the sole end and purpose of all production (Adam Smith, 1937). A rudimentary definition of consumption emphasizes the purchase and use of goods or services, noting that the point of expenditure on such items and the instant of their usage constitute the act of consumption. This understanding of consumption reflects a utilitarian, economic approach to consumption that should be seen as a starting point, since the range of theoretical and empirical innovations within the field of consumption studies—which exists within sociology, as well as having disciplinary expressions within anthropology, history, geography, business, and marketing studies—has established an understanding of consumption as a complex, widespread process (Miller, 1995). The desire to acquire luxury goods and leisure services is a basic force in modern life (Stearns, 2001). Thus, consumption is the process driven by human desires by which goods and services are, at last, put to final use by people. Consumption is at the end of the line of economic activities that starts with an evaluation of demand and available resources and proceeds through production and distribution of goods and services. Consumerism is a cultural model that

promotes the acquisition of goods and especially the purchase of goods, as a vehicle for personal satisfaction, social status and economic stimulation.

According to Joel Magnuson, generating a measurable rate of return for investors is the core element of any capitalist economy. Investors derive their income from percentage returns on stocks, bonds, or other business investments. If investors do not get these expected returns, they will sell their investments and seek returns elsewhere. By disinvesting, or cashing out, investors can drive down the book value of a company, which can ultimately cause the business to fail. To prevent this outcome, the prime directive of a capitalist business is to sustain robust returns and growth of financial wealth for their investors. This is the paramount goal of capitalist enterprise. In other words, driven by the financial necessity of providing investors with a robust rate of return, capitalist businesses must also sustain a robust rate of growth in the production and sale of goods and services (Magnuson, 2007).

Mass mechanized production, declining costs, constant product innovations, rise in per capita income, credit card culture, easy loans form the banking institutions, seductive advertisements and innovative marketing techniques have gradually given birth to what we call consumer society or consumerism. Demands are created to achieve growth in sales irrespective of consumer needs and over-exploitation of natural resources. Though consumerism started soon after the Industrial Revolution, it recorded a spectacular rise since the Second World War with steady economic growth and advanced technological innovations. According to Matsuyama, the development process follows the Flying Geese pattern, in which a series of industries take off one after another. As productivity improves in these industries, each consumer good becomes affordable to an increasingly large number of households, which constantly expand the range of goods they consume. This in turn generates larger markets for consumer goods, which leads to further improvement in productivity (Matsuyama, 2002). Decades of relatively steady growth in Europe have changed the way we live. We produce and consume more goods and services. We travel more and live longer. But the environmental impacts of our economic activities at home and abroad have become bigger and more visible (European Environmental Agency, 2016).

The average U.S. resident, in a year, consumes 275 pounds of meat, uses 635 pounds of paper, and consumes energy equivalent to 7.8 metric tons of oil. Forty-five years ago, the average American ate 197 pounds of meat, used 366 pounds of paper, and used energy equivalent to 5.5

metric tons of oil. In the U.S., there is about 1 passenger car for every two people (Goodwin et al. 2008). This was the situation way back in 2007. Today the volumes are much higher and basket of consumption much bigger. Moreover, this trend is universally true as the developing countries are trying hard to catch up in this race of consumption. New shopping malls and massive supermarkets offer a vast choice to consumers ably supported by innovative marketing techniques.

Consumerism has also become a symbol of social status, development and excellence. The more lavish the life-style is the more publicity and social attention it draws. Therefore, the wealthier sections of the society create demand for new luxury goods and services to demonstrate their wealth and to add to their social status. Such demand for luxury goods and services is also good for business enterprises as they are able to earn exorbitant profits from their wealthy customers. Overtime, these luxury goods and services are also accessed by other citizens losing their status symbol, as they become part of new consumption patterns in the society. By this time, the wealthier section moves up to a new ladder creating new demands for so-called exclusive goods and services to retain their social status. Thus, the consumption patterns keep moving to higher and higher levels. Business enterprises also join in the process producing new and new luxury goods attracting wealthier customers to maintain their profitability. Hence, the process of demand and production works both ways. New demand giving rise to production and new products giving rise to demand, both supporting and promoting the consumerism.

Rise in consumption also suits the national governments as it is an essential condition for achieving higher GDP growth for which all governments across the globe are trying hard. Higher GDP not only adds to the tax revenue of the governments it is also projected as an important economic achievement for their re-election to power. Higher consumption patterns are also projected as a symbol of development. In common parlance, the higher the per capita consumption the higher the level of development. Even the textbooks in the developing countries project the higher level of per capita consumption of water, food, electricity, telephones, and travel and so on as a sign of higher development. Hence, all nations, societies and enterprises are contributing to this process of consumerism knowingly or unknowingly. The following tables provide a glimpse of this global trend of rising consumption cutting across all sectors of the global economy.

Look at the consumption of motor vehicles alone. Global use of motor vehicles has been growing at a fast pace. The number of vehicles in operation surpassed one billion mark in 2010.

This number has increased at a rate of 3.6 percent per annum since 2000. The following chart provides the statistics of growth in motor vehicles globally since 1960. Total number of registered motor vehicles recorded a staggering increase from 127 million in 1960 to 1.12 billion in 2012; registering an increase of almost 10 time (Davis, Diegel and Boundy, 2016). In 2016 the total number of globally registered vehicles increased to 1,322,372 recording an increase of over 200 million vehicles over 2012.

Image 8.

Type of vehicle	1960	1970	1980	1990	2000	2005	2007	2010	2012	
Car registrations ⁽¹⁾	<mark>98,30</mark> 5	193,479	320,390	444,900	548,558	617,914	684,570	723,567	773,323	
Truck and bus registrations	28,583	52,899	90,592	138,082	203,272	245,798	295,115	<mark>3</mark> 09,395	341,235	
World total	126,888	246,378	410,982	582,982	751,830	863,712	979,685	1,032,962	1,114,558	
Note (1) Cars registrations do not include U.S. light trucks (SUVs, minivan and pickups) that are used for personal travel. These vehicles are accounted among trucks.										

Total Number of Registered Motor Vehicles (1960-2012)

Source: Transport Energy Data Book 35 by Davis, Diegel and Boundy, 2016.

As per the statistics obtained from the European Automobile Manufacturers Association, 91.5 million motor vehicles were produced globally during 2015 which were approximately 3 percent more than 2014 (ACEA, 2017). This number was 66.7 million ten years ago in 2005 and 58.4 million in 2000 (OICA, 2017). This amounts to nearly 57 percent growth in production between 2000 and 2014. In 2016, total number of vehicles produced went up to 94.6 million recording 3.38% increase (Statista, 2019).

Image 9.



91.5 million motor vehicles were produced globally in 2015.

/orld Production

Source: European Automobile Manufacturers Association.

Similarly, the number of TV sets connected to the internet around the world have gone up from 114.9 million in 2010 to 673.4 million in 2017 as is evident from the statistics given below. Of course, in addition there are millions of TV sets that are not connected to the internet. In effect, they are many times more. Nearly 90 million TV sets are sold globally each year. Sale of smart phones alone is likely to cross 1.5 billion mark in 2017. Globally total connected devices are estimated at 20 billion.

Image 10.



Global TV sets connected to the Internet

Source: mediaentertainmentinfo.com

The next chart obtained from Energy Information Administration, US provides growth trend on world energy consumption since 1990. The past growth and future trends clearly indicate spectacular increase in all forms of energy.



Image 11.

Source: Energy Information Administration, USA.

The chart given below from Zion Research Analysis provides the projected growth of the refrigeration industry over 2015-2021. The trend shows that just in 7 years the market is going to grow by about 68 percent. Production of other domestic appliances are also expected to record similar growth trends.



Image 12.

Service industries are also following a similar pattern of growth. Most service industries across the globe are growing at a healthy rate including; transport industry, hotel industry and travel & tourism. According to the World Tourism Organization, international tourist arrivals grew by 3.9% in 2016 to reach a total of 1.235 billion. Some 46 million more tourists travelled internationally in 2016 compared to 2015. In 1980, total tourist arrival was approximately 300 million only. 2016 was the seventh consecutive year of sustained growth in tourism following the 2009 global economic and financial crisis. 300 million more international tourists travelled the world in 2016 as compared to the pre-crisis record in 2008 (UNWTO, 2017).

Richard Howard Robbins in his book 'Global Problems and the Culture of Capitalism' opines that our consumption of goods obviously is a function of our culture. Only by producing and selling things and services does capitalism in its present form work, and the more that is produced and the more that is purchased the more we have progress and prosper. The single most important measure of economic growth is, after all, the Gross National Product (GNP), the sum total of goods and services produced by a given society in a given year. It is a measure of the success of a consumer society, obviously, to consume. He further adds that the production, processing and consumption of commodities requires the extraction and use of natural resources (wood, ore, fossil fuels, and water); it requires the creation of factories and factory complexes whose operation creates toxic byproducts, while the use of commodities themselves (e.g. automobiles) creates pollutants and waste. Yet of the three factors environmentalists often point to; as responsible for environmental pollution — population, technology, and consumption consumption seems to get the least attention. One reason, no doubt, is that it may be the most difficult to change; our consumption patterns are so much a part of our lives that to change them would require a massive cultural overhaul, not to mention severe economic dislocation. A drop, in demand for products, as economists note, brings on economic recession or even depression, along with massive unemployment (Robbins, 1999).

According to the Global Issues, William Rees, an urban planner at the University of British Columbia, estimated that it requires four to six hectares of land to maintain the consumption level of the average person from a high-consumption country. The problem is that in 1990, worldwide there were only 1.7 hectares of ecologically productive land for each person. He concluded that the deficit is made up in core countries by drawing down the natural resources of their own

countries and expropriating the resources, through trade, of peripheral countries. In other words, someone has to pay for our consumption levels (Global Issues, 2005). If the consumption levels of the entire global population were to rise to those of US, we would need FIVE Earths to meet their demand (Statista, 2017). This growing consumerism is naturally leading to increasing contamination of soil, water bodies and air in a three-stage process – at the time of extracting natural resources, at the time of production and finally when the consumed products are disposed of as waste.

Chapter 3

Plenty, Poverty and Hunger

3.1 Poverty and Sustainability:

Both environmental degradation and poverty alleviation are urgent global issues that have a lot in common. Both these issues are on global agenda at least since early 1980s. Eradicating poverty in all its forms and dimensions is the greatest global challenge and has been recognized as an indispensable requirement for sustainable development. The opening sentence of the Agenda-21, adopted at Rio Summit states, "Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being" (UN Documents). Ten years later in view of the gravity of the situation, poverty eradication was addressed in Chapter II of the Johannesburg Plan of Implementation (2002), stressing the need for eradication of poverty as an indispensable requirement for sustainable development, particularly for the developing countries (UN, Sustainable Development, 2012). Subsequently twenty years later in "The Future We Want", the outcome document of Rio+20, member states once again emphasized the need to accord the highest priority to poverty eradication and promoting sustainable patterns of consumption and production within the United Nations development agenda, addressing the root causes and challenges of poverty through integrated, coordinated and coherent strategies at all levels. The document succinctly states, "eradicating poverty is the greatest global challenge facing the world today and an indispensable requirement for sustainable development" (The Future We Want, 2012 p.1).

For 15 years from 2000 to 2015, Millennium Development Goals have helped in reduction of poverty in many parts of the world. The 2030 Agenda for Sustainable Development further resolves to free the human race from the tyranny of poverty and to heal and secure our planet in the following words, "we are determined to end poverty and hunger in all their forms and dimensions and to ensure that all human beings can fulfil their potential in dignity and equality in a healthy environment. We are determined to protect the planet from degradation, including through sustainable consumption and production, suitably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations. We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature" (United Nations, the 2030 Agenda for Sustainable Development p.3). The summit leaders resolved to end poverty and hunger everywhere; to combat inequalities within and among countries and to ensure the lasting protection of the planet and its natural resources. They further resolved to create conditions for sustainable, inclusive and sustained economic growth, shared prosperity and decent work for all, considering different levels of national development and capacities.

Therefore, it is clear that the efforts to bring the three strands of sustainable development (social, environmental and economic) into a single policy lens have a long history, dating back to the 1980s and ranging up to more recent Sustainable Development Agenda 2030 adopted in September 2015 at the United Nations General Assembly. Unfortunately, despite some progress in poverty reduction under the Millennium Development Goals, such plans have struggled to bring about enduring social, economic and institutional changes for sustainable development.

3.2 Increase in Global Wealth:

As detailed in Chapter 2, global GDP has increased in leaps and bounds following the Industrial Revolution and more so after the World War II. Simultaneously, given unprecedented growth in global GDP; per capita income has also gone up manifold despite massive population growth from 2.6 billion in 1950 to 7.4 billion in 2015. As stated earlier, according to the World Bank, Global GDP went up from US\$ 5.31 trillion in 1950 to US\$ 77.6 trillion in 2014 (World Bank 2014). According to IMF in 2018, global GDP on purchasing power parity (PPP) basis was estimated at US\$ 134.9 trillion (IMF, 2018). If we take the current figures based on PPP the global GDP since 1950 has grown by 25 times.

From the above statistics it is quite clear that economic growth during the period 1950 to 2018 has been unprecedented in the history of mankind. Since 1950, while 13 economies have grown at an average rate of 7 percent a year or more for 25 years or longer, other economies including those from Sub-Saharan Africa have also recorded impressive economic growth (World Bank, 2014). Real GDP of the developing countries increased manifold during this period. However, despite the era of plenty; poverty, hunger and inequality continue to haunt the humanity as will be clear from the subsequent sections of this chapter.

3.3 Poverty and Hunger:

Equality and justice are not new ideas. Even in absolutist time there were ideals of fairness and justice that prescribed normative laws for kingdoms (Kasliwal, 1995). Encyclopaedia Britannica defines equality as "generally, an ideal of uniformity in treatment or status by those in a position to affect either. Social or religious inequality is deeply ingrained in some cultures and thus difficult to overcome. Government efforts to achieve economic equality include enhancing opportunities through tax policy" (Encyclopaedia Britannica). In general terms poverty is the condition of having insufficient resources or income. In its most extreme form, poverty is a lack of resources to sustain basic human needs of health, housing and education. In other words, inadequate food (quantity and quality), clothing, and housing, clean water and health services could lead to extreme poverty. According to the United Nations Human Development Report, poverty is defined as a complex phenomenon that generally refers to inadequacy of resources and deprivation of choices that would enable people to enjoy decent living conditions (UNDP, Human Development Report, 1998). Human development is the process of enlarging people's choices. The three essential conditions for human development are, people to live long and healthy lives, to be knowledgeable and to have access to the resources needed for a decent standard of living (UNDP, Human Development Report, 1998).

In monetary terms the World Bank is the main source for global information on extreme poverty and sets the International Poverty Line. This poverty line was revised in 2015 – since then a person is considered to be below povery line if he or she is living on less than 1.90 international dollars per day. An international dollar would buy in the cited country a comparable amount of goods and services a U.S. dollar would buy in the United States. This term is often used in conjunction with Purchasing Power Parity (PPP) data (The World Bank Group, 2017). Prior to 2015 poverty line was set at 1.25 international dollars per day and hence all statistics until 2015 should be interpreted in this context.

Governments first committed to the goal of removal of global poverty and hunger in 1948 when the UN General Assembly adopted the Universal Declaration of Human Rights, which states in Article 25 (1): "Everyone has the right to a standard of living adequate for the health and wellbeing of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control" (UN, Universal Declaration of Human Rights, 1948). Almost 70 years later, achieving these basic entitlements for all, still remains a distant hope and vague aspiration of the international community despite manifold economic growth since then. Altogether, 95 percent of people who live in developing countries survive on the equivalent of less than \$10 a day (comparable to what \$10 would buy in the United States) or \$300 a month - an almost impossible task for someone living in a high-income country. Even in many of the richest countries poverty rates have been rising for a decade, and the situation is rapidly deteriorating as austerity measures are rolling back social safety nets and weakening essential public services (Share the World's Resources, 2017).

Increasing global poverty and hunger despite manifold increase in global GDP has been confirmed by a variety of authentic sources. According to the report of the World Commission on Environment and Development (WECD), "there are more hungry people in the world today than ever before in human history and their numbers are growing. In 1980 there were 340 million people in 87 developing countries not getting enough calories to prevent stunted growth and serious health risks (this number has been rising since then and presently stands close to one billion depending on the source). Simultaneously the number of people living in slums and shanty towns has been rising, not falling. A growing number lack access to clean water and sanitation and hence are prey to the disease that arise from this lack. There is some progress, impressive in places, but on balance, poverty persists and its victims multiply" (WCED, 1987 p.29). United Nations Conference on Sustainable Development better known as Rio+20 identified and highlighted the following major issues (UNCSD, 2012).

- a. The world today has 7 billion people by 2050, there will be 9 billion.
- b. One out of every five people -1.4 billion currently lives on \$1.25 a day or less.
- c. A billion and half people in the world don't have access to electricity.
- d. Two and a half billion people don't have a toilet.
- e. Almost a billion people go hungry every day.
- f. Greenhouse gas emissions continue to rise and more than a third of all known species could go extinct if climate change continues unchecked which will further accelerate the incidence of poverty.

The United Nations Food and Agriculture Organization in its report on "The Future of Food

and Agriculture – Trends and Challenges" states that despite global economic growth and a reduction in poverty over the last 30 years, about 2.1 billion people are still living in poverty, with over 780 million in extreme poverty. High and rising inequality is hindering progress towards the eradication of poverty. Even in countries where poverty has been reduced, pervasive inequalities remain between rural and urban areas, between regions, between ethnic groups, and between men and women. Most of the world's poor and hungry are rural people who earn meagre livings from agriculture, fisheries and forestry. Poor people's reliance on agriculture for their livelihoods, and the high share of their expenditure on food in their household budgets, make agriculture the key to poverty and hunger alleviation. Moreover, higher inequality undermines the resilience of societies to possible shocks in development patterns and leave larger shares of the population vulnerable to poverty. A recent World Bank report stresses that it is doubtful whether accelerated economic growth will be sufficient to eradicate extreme poverty by 2030, without reductions in inequality within countries. (FAO, 2015).

Children are the most visible victims of undernutrition. Black et al. estimate that undernutrition in the aggregate—including foetal growth restriction, stunting, wasting, and deficiencies of vitamin A and zinc along with sub-optimum breastfeeding—is a cause of 3.1 million child deaths annually or 45% of all child deaths in 2011 (Black et al., 2013). Globally 165 million underfive year olds were estimated to be stunted in 2013. In 2013, about half of all stunted children lived in Asia and over one third in Africa (WHO, 2013).

Food loss is yet another area exacerbating poverty and hunger. Globally, around one-third of all food produced is lost or wasted along the food chain, from production to consumption (FAO, HLPE, 2011). In a world where hundreds of millions of people go hungry, that is a stark indication of the inefficiency of current food systems. Food losses and waste often translate into economic losses for farmers and others stakeholders within the food value chain, and higher prices for consumers, both of which affect food insecurity by making food less accessible for vulnerable groups. Reducing food losses and waste would increase the supply of available food and strengthen global food security. Food losses and waste also hold back the transition to environmentally sustainable food systems. They represent a considerable waste of land, water, energy and agricultural inputs, and cause the emission of millions of tonnes of greenhouse gases. Future efforts to address climate change will need to find ways to reduce food losses and waste. Because food

production is responsible for a large share of GHG emissions, reducing food losses and waste contributes to climate change mitigation (FAO, 2015).

World Bank in its brief for Rio+20 admits that despite many gains under the Millennium Development Goals (MGDs) and decline of poverty in some developing countries, the war on poverty has not been won and many challenges remain. Around 1.3 billion people still live on less than \$1.25 a day, with the majority in emerging economies. In addition, a large number of people remain vulnerable to falling into poverty when disaster or misfortune strikes. These are people on low incomes with little or no protection against loss of income or assets, whether due to disease, conflict, or climatic or economic shocks. Climate change, natural hazards, and environmental degradation are further drivers of vulnerability. Severe environmental degradation reduces the rate of economic growth and disproportionately affects the poor, including sometimes minority groups depending on degraded resources. The health of the poor in urban centres of developing countries is often adversely affected by pollution, water-borne diseases, and other environmental hazards, while the continued use of solid biomass fuels for cooking undermines the respiratory health of women and infants. Drought, flood, and other climatic shocks are leading sources of vulnerability and hard for communities to protect against using traditional informal approaches. With anthropogenic climate change causing more extreme climate events, the incidence and severity of climate-related disasters will grow in the future unless adequate adaptation responses are taken (World Bank Group, 2012). The following chart taken from the World Bank website indicates increase in the incidence of poverty between 1981 and 2004 in all countries and regions except China where poverty recorded a decline.





Source: Development Economics Research Group, World Bank.

3.4 Urban Slums:

As the world continues to urbanize and globalize at the most rapid pace in modern history, the global population of slum dwellers also continues to grow tremendously. Rapid industrial growth, mechanization of agriculture and the systems of mass production and marketing have gradually led to the demise of rural and small-scale industries. In 35 years between 1950 and 1985 the number of people living in cities almost tripled increasing by 1.25 billion. In developing countries, it quadrupled from 286 million to 1.14 billion. Population of many of Sub Saharan Africa's larger cities - Nairobi, Dar es Salaam, Lagos, Lusaka and Kinshasa - increased more than seven-fold between 1950 and 1985. During the same period population of large cities in Asia and Latin America – Soul, Bombay, Dhaka, Jakarta, Manila, Mexico City, Sao Paulo, and Bogota– tripled or quadrupled. (WCED, 1987). Over the last few decades, Asia in particular has seen some enormous demographic changes. In 1990 the Asia-Pacific region had an urban population of just over 1 billion. In the next twenty years by 2010 that number had grown by more than 75 percent to 1.76 billion and the trend continues. By 2030 Asian cities are projected to be home to some 2.6 billion people. While Asia is not expected to reach the 50 percent urbanization mark before 2026, the proportion of Asia's urban population increased from 31.5 percent in 1990 to 42.2 percent in 2010, the highest percentage increase (10.7 percent) amongst all regions in the world (UN Habitat, 2012).

Unplanned and massive migration to cities since 1950s has resulted in large scale slums in major cities around the world. Living conditions in these slums are beyond the imagination of a person living in a developed country. According to UN-Habitat, around 33% of the urban population in the developing world in 2012, or about 863 million people, lived in slums. The proportion of urban population living in slums was highest in Sub-Saharan Africa (61.7%), followed by South Asia (35%), Southeast Asia (31%), East Asia (28.2%), West Asia (24.6%), Oceania (24.1%), Latin America and the Caribbean (23.5%), and North Africa (13.3%). Over 40 per cent of Asia's urban dwellers live in sub-standard housing and overcrowded spaces. Lack of adequate shelter and education, over-crowding, absence of sanitation and clean drinking water, vulnerability to health problems and violence characterize these mega-slums (State of the World Cities 2012/13 - UN Habitat).

Orangi Town, Karachi, Pakistan with a population of 2.4 million; Rocinha Favela in Rio de Janeiro, Brazil with a population of 1.5 million; Ciudad Neza, Mexico City, Mexico with a population of 1.2 million; Dharavi, Mumbai, India with a population of one million; Kibera, Nairobi, Kenya with a population of 700,000 and Khayelitsha, Cape Town, South Africa with a population of 400,000 are considered to be the six biggest slums in the world. Other big slums around the world include; Ezbet el Haggana, Egypt; Makoko and Ajegunle Nigeria; Tondo, Philippines; Alexandra Gauteng, South Africa; Nima Slum, Ghana; Cazenga, Angola; Mukuru Kwa Njenga, Kenya; Clara Town and West point, Liberia; and Cite Solei, Haiti. According to Mike Davis, author of *Planet of Slums*, nearly 80% of Nigeria's urban population, or some 41.6 million people, live in slums (Forbes, 2007).



Image 14.

Source: Frost and Sullivan

It is indeed ironic and sad that most of these slums have developed parallel with the massive industrialization and economic growth since 1960s and that these very slum dwellers have contributed substantially to the economic development of these countries. Studies conducted on the living conditions prevailing in these slums have revealed appalling conditions in most slums around the world. They cannot even be called sub-human in true sense. A large number of slum dwellers do not have more than a single room. Their habitation are thick clusters of small, dilapidated mud huts, the roofs and ceilings of which are made of scraps of wood, gunny sacks, metal or some sort of waste material. Sometimes, 10 to 12 people live, eat and sleep in the same room. The streets are narrow and the sewage water stagnates in open surface drains, which emit bad smell. The children often play in places where the drains are used as open latrines. By 2030, an estimated 5 billion of the world's 8.1 billion people will live in cities. About 2 billion of them will live in slums, primarily in Africa, Asia and the Latin America, lacking access to clean drinking water and working toilets, surrounded by desperation and crime. Children in these slums are born and brought up in sub-human conditions unthinkable in the developed world. As a result, some of them end up becoming criminals and drug addicts. These conditions are the direct consequence of massive economic development witnessed around the world since 1950s. The picture given below can provide better idea of the living conditions in these slums than pages of written text. Such pictures speak volumes about the 'civilized and developed world' we live in. Can we really call it 'civilized and developed' is a big question mark? Is this sustainable?

Image 15.



Source: Internet Public Domain.

3.5. Inequality:

In addition to poverty and hunger, inequality remains a serious challenge. Generally, inequality is the condition of being unequal. In economic terms inequality is disparity in income and wealth. According to Greig et al. inequality is about the differing share of income or wealth that the people of a particular country or across the countries have. It is also about differences in educational level, access to health services and perhaps probability of having one's children die (Greig, Hulme and Turner, 2007). Some inequality within reasonable limits are acceptable and perhaps unavoidable in human societies but rapidly growing inequality of income and wealth during the last few decades has been recognized as the biggest challenge of the 21st century the world over.

Over the last three hundred years, the market economy has brought prosperity and a dignified life to hundreds of millions of people across Europe, North America and East Asia. However, as economist Thomas Piketty stated in 'Capital in the Twenty-First Century', without government intervention, the market economy tends to concentrate wealth in the hands of a small minority, causing inequality to rise (Piketty, 2014). Oxfam Report "Even it Up" published in 2014 states that unless we close the gap between the haves and the have-nots, we will not win the battle against extreme poverty, and the injustice to millions of families living in extreme poverty alongside great wealth and prosperity, will continue. Today, the rich can buy longer, safer lives and better education, and can secure jobs for their children, while those without money and influence are much more likely to be denied even their basic rights. When disasters strike or food prices spike, those who lack wealth and power suffer the most, and find it most difficult to recover (Oxfam America, 2014).

While the economic data points to the perpetuation, or even extension, of social inequality across the globe, it is equally valid to maintain that the world has never seen so much wealth, innovation and ingenuity (Greig, Hulme and Turner, 2007). However, this form of growth has also brought phenomenal gaps between the richest and the poorest, gaps that were simply impossible when poverty gripped the entire world (Sachs, 2005). The key challenge therefore involves addressing this gap between 'unprecedented opulence' and 'remarkable deprivation' (Sen, 2001). The central paradox of the contemporary world is the simultaneous presence of wealth on an unprecedented scale, and mass poverty (Selwyn, 2014). According to the best available measures'

per capita income in the richest countries are more than 20 times as high as in the poorest (Olson Jr., 2003). Human Development Report 1998 also confirms that the 20th century's growth in consumption, unprecedented in its scale and diversity, has been badly distributed, leaving a backlog of shortfalls and gaping inequalities. According to OECD Secretary General we have reached a tipping point. Inequality can no longer be treated as an afterthought. We need to focus the debate on how the benefits of growth are distributed (OECD, 2016).

The World Bank Commission on Growth and Development admits that income inequality is rising in a surprising number of countries across the globe and incidence of poverty has not declined in absolute terms. To combat the widening inequality, the Commission recommends that strategies succeed without commitment growth cannot а to equality of opportunity, giving everyone a fair chance to enjoy the fruits of growth. But equal opportunities are no guarantee of equal outcomes. Indeed, in the early stages of growth, there is a natural tendency for income gaps to widen. Governments should seek to contain this inequality at the bottom and top ends of the income spectrum. The Commission is of the view that inequality in longer term could be toxic. Quoting former Mexican President Earnest Zedillo, the report says, "In speaking about human progress, there is much to celebrate, but there is also much to deplore, because almost half of the world's people are still living in poverty. We have focused on economic growth because without it the polarization between the haves and the have-nots in our world would continue to widen and remain a cause of conflict and instability." (World Bank, 2014). Income inequality in OECD countries is at its highest level for the past half century. The average income of the richest 10% of the population is about nine times that of the poorest 10% across the OECD, up from seven times 25 years ago. In emerging economies, such as China and India, a sustained period of strong economic growth has helped lift millions of people out of absolute poverty. But the benefits of growth have not been evenly distributed and high levels of income inequality have risen further (OECD, 2016).

Global inequality – the inequality between countries – rose rapidly between 1980 and 2004, but has fallen slightly since then due to growth in emerging countries, particularly China and India. The bottom billion have increased their share of world income by 0.2 percent since 1990, to just short of one percent, but to increase their share to 10 percent at the same rate would take more than eight centuries (Cummins and Ortiz, 2011). Reproduced below is the UNICEF's analysis in the

graph – dubbed as the 'Champagne Glass' – showing how much global income is concentrated at the very top, while the vast majority of people take a comparatively meagre share of global income that forms the 'stem' of the glass.

UNICEF's Champagne Glass

FIGURE 1. Global income distribution by percentile of population (5)

Image 16.

Source: Oxfam America, 2014

Similarly, the Penn World Table given below provides an overview of glaring disparity in global per capita GDP based on country-wise figures (Our World in Data, 2017).

Image 17.

Disparity in Global per capita GDP

I.4 GDP Growth since 1950

🤊 Penn World Table



For decades the majority of development economists and policy makers maintained that inequality had little or no impact on a country's growth prospects. This was based on the understanding that inequality inevitably accompanies the early stages of economic growth, but that it would be short-lived, as growth would gradually 'trickle down' through the layers of society, from the richest to the poorest. A mass of more recent evidence has overwhelmingly refuted this assumption and shown that extremes of inequality are, in fact, bad for growth. Inequality is linked to shorter, unhealthier and unhappier lives, and higher rates of obesity, teenage pregnancy, crime (particularly violent crime), mental illness, imprisonment and addiction (Berg and Ostry, 2011 and Wilkinson R. and Pickett K., 2010). Moreover, the social divisions reinforced by higher levels of economic inequality become self-perpetuating, as the rich increasingly share fewer interests with those who are less well-off. When the wealthy physically separate themselves from the less well-off, fear and distrust tend to grow and hence the society gets divided with the rise of social distrust and unrest. Thus, the growing inequality cannot be sustained any more. It appears to have already passed the limit of tolerance in many countries.

3.6 Extreme Inequality:

Now let us have a look at some of stark facts regarding extreme inequality across the globe. According to Oxfam, eight men own the same wealth as the 3.6 billion people who make up the poorest half of humanity. Moreover, tax havens are fuelling inequality and poverty (Oxfam International, 2017). In the world we live in, 1% people control more than 40% of global assets. The three richest individuals have more financial assets than the combined assets of the 48 poorest nations of the world (Gupta, 2012). Moreover, inequality of income and wealth is on the rise. India, home to more than 250 million poor people (surviving on less than \$2 a day), has 101 billionaires in dollar terms (Forbes Billionaire List, 2017). Similar pattern of inequality could be seen in many other parts of the world. According to Kofi Annan former Secretary General of the United Nations, the widening gap between rich and poor is at a tipping point. It can either take deeper root, jeopardizing our efforts to reduce poverty, or we can make concrete changes now to reverse it (Quoted by Oxfam America, 2014). Extreme inequality is also apparent when we look at the global consumption pattern given below (Global Issues, 2014).

Image 18.


Inequalities in consumption are stark. As shown in the above chart taken from the World Bank Development Indicators 2008, globally, the 20 percent of the world's people in the highest-income countries account for 76.6 percent of total private consumption expenditures while the poorest 20 percent a minuscule 1.5 percent (Global Issues, 2014).

According to the Nobel Laureate Prof Joseph Stiglitz the extreme inequalities in incomes and assets we see in much of the world today harm our economies, our societies, and undermine our politics. Whilst we should all worry about this, it is of course the poorest who suffer most, experiencing not just vastly unequal outcomes in their lives, but vastly unequal opportunities too (Quoted by Oxfam America, 2014). The last decades have seen incredible human progress across Africa and the world. But this progress is under threat from the scourge of rapidly rising inequality (Oxfam America, 2014). Extreme economic inequality has exploded across the world in the last 30 years, making it one of the biggest economic, social and political challenges of our time. Ageold inequalities on the basis of gender, caste, race and religion-injustices in themselves – are exacerbated by the growing gap between the haves and the have-nots. Today's extremes of inequality are bad for everyone. For the poorest people in society, whether they live in sub-Saharan Africa or the richest country in the world, the opportunity to emerge from poverty and live a dignified life is fundamentally blocked by extreme inequality. The consequences are corrosive for everyone. Extreme inequality corrupts politics, hinders economic growth and stifles social mobility. It fuels crime and even violent conflict. Homicide rates are almost four times higher in countries with extreme economic inequality than in more equal nations. It squanders talent, thwarts potential and undermines the foundations of society (Oxfam America, 2014).

Large inequalities exist not only across countries, but also between population groups within each country. Unfortunately, extreme inequalities are much worse in the developing world compared to the industrialized nations. Mass poverty and deprivation which can be seen in the developing world are not so extreme in the developed world due to basic medical and educational facilities and social security covering old age pension and unemployment allowances. Developing countries are yet to put in place social security system, old age pension and unemployment allowances. Moreover, the rapid growth of population in the developing countries has been a major hurdle in this process. Even China, although still a communist state, is characterized by extreme inequality of income. Top 10 percent of the population accounts for 40 percent of the total income

while the bottom 50 percent account only for 15 percent of the total (World Inequality Database, 2017). Inequality of income in South Africa is even worse where top 10 percent of the population accounts for 65 percent of total income (World Inequality Database, 2017). Inequality in other major developing countries like India, Indonesia, Nigeria, Mexico and Brazil are equally glaring and rising year after year. Massive wealth and mass poverty characterized by five-star culture and vast slums exist side by side in most of these counties. Such skewed distribution of income is going to lead to far more inequalities in income and wealth in the years to follow with consequences that could be devastating.

Extreme inequality of wealth is surpassing all limits setting new records. The number of dollar millionaires – known as High Net Worth Individuals –rose from 10 million in 2009 to 13.7 million in 2013 (Capgemini, World Wealth Report, 2013). Since the global financial crisis of 2009, the ranks of the world's billionaires have almost tripled, swelling to 2208 from 72 countries (Forbes, The Billionaire 2018). Americans lead the way with a record 585 billionaires, followed by mainland China with 373. The elite group is worth US\$ 9.1 trillion which is almost four times the GDP of France. In one year alone their assets have gone up from US\$ 7.67 trillion to US\$ 9.1 trillion. The billionaire boom is not just a rich country story: the number of India's billionaires increased from just two in 1990 with a combined worth of \$3.2 billion to 46 in 2012 with a total net worth of \$176.3 billion (Gandhi and Walton, 2012). According to the Forbes list currently there are 120 billionaires in India. There are 16 billionaires in sub-Saharan Africa alongside the 358 million people living in extreme poverty (Nsehe M. Forbes, 2014). In 2013 the 85 richest individuals in the world had as much wealth as the poorest half of the global population (Credit Suisse, 2013).

The number of billionaires and their combined wealth has increased so rapidly that in 2014 a tax of 1.5 percent could fill the annual gaps in funding needed to get every child into school and to deliver health services in those poorest countries. Oxfam has calculated that a tax of just 1.5 percent on the wealth of the world's billionaires, if implemented directly after the financial crisis, could have saved 23 million lives across the world's poorest 49 countries, by providing them with money to invest in healthcare. The rapid rise of economic inequality is a significant barrier to eliminating poverty and to sharing prosperity where it does exist so that the poorest and needy could benefit from it. Extreme inequality both undermines economic growth and the ability of

growth to reduce poverty. Oxfam holds the view that in Kenya, Indonesia and India, millions more people could be lifted out of poverty if income inequality are reduced (Oxfam America, 2014).

The Global Wealth Report, 2016 by Credit Suisse, establishes that wealth inequality, measured by the share of the wealthiest 1 percent and wealthiest 10 percent of adults, as compared to the rest of the world's adult population, continues to rise. While the bottom half collectively own less than 1 percent of total wealth, the wealthiest top 10 percent own 89 percent of all global assets. Moreover, since the beginning of the century, emerging economies have significantly influenced the global allocation of wealth. In 2000, emerging economies accounted for a mere 12 percent of global wealth, but have contributed nearly 25 percent towards global growth since. Today, emerging nations are home to 18 percent of the world's ultra-high net worth population. China alone accounts for 9 percent of the top decile of global wealth holders, which is well above France, Germany, Italy, and the United Kingdom. (Credit Suisse, 2016). The following table based on Forbes data shows the growth of billionaires since 2012.

Year	Total Number of Billionaires	Combined Wealth
2012	1226	\$4.6 trillion
2013	1426	\$5.4 trillion
2014	1643	\$6.4 trillion
2015	1826	\$7.05 trillion
2017	2043	\$7.67 trillion
2018	2208	\$9.10 trillion

Table 1.

Once accumulated, the wealth of the world's billionaires takes on a momentum of its own, growing much faster than the broader economy in most cases. In the recent years vulgar display of this wealth has also become a new phenomenon. The culture of five and seven-star hotels, residences, bars, cruise ships is gradually turning into a parasite. This is not only accentuating the gap between the rich and the poor but also leading to criminal waste of natural resources. Each individual living in such comforts consumes disproportionate amount of resources in terms of

energy, water, minerals, agricultural produce and so on. It damages our ability to live within the planet's resources and succeed in the fight against climate change. Often it is the poorest that are hit first and hardest by environmental destruction and the impacts of climate change. Yet it is the wealthiest who most impact on our planet's fragile and finite resources. **The richest seven percent** of world's population (equal to half a billion people) are responsible for 50 percent of global CO₂ emissions; whereas the poorest 50 percent emit only seven percent of worldwide emissions. Such inequalities in emissions have a parallel in the disproportionate use of the world's resources. Just 12 percent of the world's people use 85 percent of the world's water (Oxfam America, 2014). Similarly, huge quantity of food is wasted every day in five-star restaurants and hotels as during the parties organised by the rich and the powerful. Per capita food-waste by consumers is between 95-115 kg a year in Europe and North America, while consumers in Sub-Saharan Africa, South and South-eastern Asia, each throw away only 6-11 kg a year. Even if just one-fourth of the food currently lost or wasted globally could be saved, it would be enough to feed 870 million hungry people in the world (FAO, 2017. Save Food). The table given below provides the statistics of food waste region wise.

Image 19.

Per capita food losses and waste, at consumption and pre-consumptions stages, in different regions



Source: FAO, 2017.

While the billions of individuals living in poverty are struggling to get a loaf of bread, a few litres of water and a roof over their head; the filthy rich living in vast estates equipped with seven-star comforts consume (or waste) thousands of litres of water, thousands of watts of electricity, massive quantity of food and other innumerable luxury good every day. Intoxicated with this new culture, the rich and powerful are responsible for (a) criminal waste of natural resources, (b) large-scale pollution and contamination, (c) vulgar display of wealth, (d) accentuation and legitimization of disparity between the rich and the poor and (d) encouragement to corrupt, illegal and unethical practices for accumulation of wealth. Such five/seven-star culture is nothing but a cruel joke on the billions who are living in sub-human conditions and a crime against the Mother Nature. Excessive consumption is vulgarity. Excessive wealth is the source and cause of large number of criminal activities, financial frauds, drug addiction, alcoholism, domestic violence and life-style diseases (Gupta, 2017). Can humanity sustain such vulgar practices in 21st century? The following two pictures demonstrate this harsh reality. With this kind of vulgar inequality existing side by side, can we call ourselves a 'civilized society'?

Images 20 and 21.



Extreme Poverty amidst Vulgar Display of Wealth



Source: Internet Public Domain.

Chapter 4 Soil Degradation and Agriculture

Land sustains all life on earth. Soil is the most precious of all resources as it sustains plants and vegetation which is the source of food for all living beings. During the last few decades due to human induced activities pressure on land has mounted manifold. As a result of intensive agriculture, over-grazing and increasing use of fertilizers and pesticides, top soil has degraded considerably with increasing salinization, loss of fertility and desertification. Deforestation is resulting in loss of top soil causing massive soil erosion. Pollution of ground water aquifers and increasing amount of non-biodegradable waste is also causing soil degradation.

4.1 Soil Formation:

Total land area of the Earth is estimated at 148,940,000 km2 with arable land of 13,958,000 km2 or 1.4 billion hectares. Thus, the arable land (crop land) constitutes less than 10 percent of the total land area of the Earth (Our World in Data, 2018). Based on the current global population, arable land per person works out to only 0.1956 hectare. According to FAO terminology, total agricultural area has been estimated at 4.889 billion hectares consisting of arable land (28%), permanent crops (3%) and meadows and pastures (69%) (Our World in Data, 2018).

Soil is the most significant asset of the arable land as it determines the fertility of land and supports all life on Earth. According to FAO, "soil is the natural medium for the growth of plants. Soil has been defined as a natural body consisting of layers (soil horizons) that are composed of weathered mineral materials, organic material, air and water. Soil is the end product of the combined influence of climate, topography, organisms (flora, fauna and human) on parent materials (original rocks and minerals) over time. As a result, soil differs from its parent material in texture, structure, consistency, color, chemical, biological and physical characteristics" (FAO, 2017). Soil is called the skin of the Earth (Miller 1953). Soil is a mixture of minerals, silt and clay particles, organic matter, gases, liquids and innumerable organisms that together support life on Earth. It is a natural body called pedosphere which performs four important functions. It is the foundation for plant growth, a medium for water storage and supply, a modifier of Earth's atmosphere and a habitat for organisms (Dominati, Patterson and Mackay, 2010).

Soils provide anchorage for roots, holds water and nutrients. Soils are home to myriad micro-organisms that fix nitrogen and decompose organic matter, and armies of microscopic animals as well as earthworms and termites. We build on soil as well as with it and in it (ISRIC, 2016). The world's ecosystems are impacted in a far-reaching way by the processes carried out in the soil such as ozone depletion, global warming, rainforest destruction, loss of bio-diversity and water contamination (Pouyat et al., 2002). Following the atmosphere, the soil is the next largest carbon reservoir on earth. It is also potentially the most reactive to human disturbance and climate change.

4.2 Soil Degradation:

According to Costanza et al., nearly 97 percent of our food comes from land rather than from aquatic and ocean systems. 35 percent of earth's land has already been degraded and further degradation continues unabated. Unsustainable agriculture is leading to erosion, salinization or water-logging of possibly 6 million hectares per year. This is a crisis, which may seriously affect the sustainability of the world's food supply (Costanza et al., 1997 p.13). Soils in 11 percent of the vegetative area and 38 percent of the cultivated area in the world have been degraded since 1945 (Gardiner and Miller 2004). This is an area of the size of China and India put together. Approximately 24 billion tons of topsoil is lost annually, which is equivalent to about 9.6 million hectares of land (Bakker 1990). According to the National Research Council of the United States; during the 20th century the rate of loss of productive land has accelerated sharply to a rate of 70,000 km² per year, an annual loss of the size of Sierra Leone (National Research Council of US, 1999 p.94).

The World Commission on Environment and Development is of the view that the shortsighted policies are leading to degradation of the agricultural resource base on almost every continent: soil erosion in North America; soil acidification in Europe; deforestation and desertification in Asia, Africa and Latin America; and waste and pollution of water almost everywhere (WCED, 1987 p.125). According to World Wildlife Fund (WWF), "Soil is the earth's fragile skin that anchors all life on Earth. It is comprised of countless species that create a dynamic and complex ecosystem and is among the most precious resources to humans. Increased demand for agriculture commodities generates incentives to convert forests and grasslands to farm fields and pastures. The transition to agriculture from natural vegetation often cannot hold onto the soil and many of these plants, such as coffee, cotton, palm oil, soybean and wheat, can actually increase soil erosion beyond the soil's ability to maintain itself. Half of the topsoil on the planet has been lost in the last 150 years. In addition to erosion, soil quality is affected by other aspects of agriculture. These impacts include compaction, loss of soil structure, nutrient degradation, and soil salinity. These are very real and at times severe issues" (WWF, 2016).

According to European Environment Agency, "damage to Europe's soils from modern human activities is increasing and leads to irreversible losses due to soil erosion, local and diffuse contamination and the sealing of soil surfaces. Population growth coupled with urbanization is putting soils under pressure, while agricultural intensification is making soils more prone to erosion. Sealing of soil surfaces due to an increased urbanization and new infrastructures is the main cause of soil degradation in the most industrialized and populated countries of western and northern Europe. Soil deterioration by contamination is an important issue in central, western and northern Europe. For 12 of EU countries, the estimated number of potentially contaminated sites adds up to 1,500,000, of which more than 300,000 have been identified" (EEA, 2016).

A study funded by Ghent University, Belgium and undertaken by Liming Ye and Eric Van Ranst on "Production scenarios and the effect of soil degradation on long-term food security in China" in 2009; concluded that food crops in China may experience a 9 percent loss in productivity by 2030 if the land degradation continues at the present rate while the productivity losses will increase to the unbearable level of 30 percent by 2050 should the soil be degraded at twice the present rate. The loss of cropland is predicted to cause a 13–18 percent decrease in China's food production capacity by 2030–2050 relative to its 2005 level of 482 Mt. Thus, food supply may deteriorate considerably from 18 percent surplus in 2005 to up to 22 to 32 percent deficit by 2050. The study concludes that the present-day production capacity will not sustain the long-term needs of a growing population under the current management level (Ye and Ranst, 2009 p.464-481).

A comprehensive study on land degradation in India undertaken by the Space Application Centre (SAC), Indian Space Research Organization (ISRO), Ahmedabad, based on satellite data collected by IRS AWiFS (Indian Remote Sensing Satellite -- Advanced Wide Field Sensor) data for 2003-05 and 2011-13 has been published in 2016. The study by the Government of India covers all states of India and is part of a project titled "Desertification Status Mapping of India". This is the most comprehensive study on land degradation in India so far. The study reveals that 96.40 mha (million hectare) area of the country is undergoing process of land degradation i.e., 29.32% of the Total Geographic Area (TGA) of the country during 2011-13, while during 2003-05 the area undergoing process of land degradation is 94.53 mha (28.76% of the TGA). Analysis shows that around 23.95% (2011-13) and 23.64% (2003-05) of desertification/land degradation with respect to total TGA is contributed by Rajasthan, Maharashtra, Gujarat, Jammu & Kashmir, Karnataka, Jharkhand, Odisha, Madhya Pradesh and Telangana in descending order. All other remaining states are contributing less than 1% (individually) of desertification/land degradation. However, the analysis with respect to TGA of the individual states show that Jharkhand, Rajasthan, Delhi, Gujarat and Goa are showing more than 50% area under desertification/land degradation, whereas states with less than 10% area under desertification/land degradation are Kerala, Assam, Mizoram, Haryana, Bihar, Uttar Pradesh, Punjab and Arunachal Pradesh.

There is a cumulative increase of 1.87 mha area undergoing process of desertification/land degradation in the country (constituting 0.57% of the TGA of the country) during the time frame 2003-05 and 2011-13. The change analysis carried out for 2011-13 and 2003-05, time frames indicates that around 1.95 mha land has been reclaimed and 0.44 mha land has been converted from high severity to low severity degradation class, indicating improvement. On the other hand, around 3.63 mha productive land has degraded and 0.74 mha land has converted from low severity to high severity degradation class. Further, during this time frame, high desertification/land

degradation changes are observed in the states of Delhi, Tripura, Nagaland, Himachal Pradesh and Mizoram ranging between 4.34% to 11.03%, whereas Odisha, Rajasthan, Telangana and Uttar Pradesh have shown improvement (from -0.11 to -1.27 %). The most significant process of desertification/ land degradation in the country is water erosion (10.98% in 2011-13 and 10.83% in 2003-05). The second most significant process is vegetation degradation (8.91% in 2011-13 and 8.60% in 2003-05), which is followed by wind erosion (5.55 % in 2011-13 and 5.58 % in 2003-05) (SAC, 2016).

In 1980s based on global data and expert judgements, 1964 million hectares of land was found degraded in varying degrees world-wise, constituting about 22 percent of agriculture, pasture, woodlands and forests (Oldeman et al., 1992). A comprehensive study undertaken by ISRIC (International Soil Reference and Information Centre) between 1987 and 1990 revealed that soil is constantly at risk from degradation by erosion, salinity, contamination and other results of mismanagement. Some 17 percent of the land surface has already been strongly degraded and the affected area is still growing, even though there is a wealth of know-how related to land management, improvement of soil fertility and protection of soil resources. Over-exploitation, over-grazing, inappropriate clearing techniques and unsuitable land use practices have resulted in severe nutrient decline, water and wind erosion, compaction and salinization. The resulting decrease in productivity has especially affected marginally suitable land that was taken into cultivation due to population pressure, or that was not given the opportunity to recuperate for a sufficiently long time after prolonged cultivation.

The Global Assessment of Soil Degradation (GLASOD) project jointly undertaken by ISRIC and UNEP has produced a world map of human-induced soil degradation. Although, undertaken two decades ago, GLASOD has been the most important and most comprehensive global survey of land degradation so far. Global data were compiled with the help of 290 national collaborators and moderated by 23 regional scientists, using uniform guidelines and international correlation during 1987-1990. The status of soil degradation was mapped within loosely defined physiographic units (polygons), based on expert judgement (ISRIC, 2016).

While the GLASOD is not without criticism, the study provides a comprehensive data base of global land degradation. There is an urgent need for a similar study to ascertain the current global status of soil degradation. The type, extent, degree, rate and main causes of degradation have been printed on a global map (copied below), at a scale of 1:10 million, and documented in a downloadable database. The GLASOD study concluded that (a) the past and present human intervention in the utilization and manipulation of environmental resources have been poorly understood and are having unanticipated consequences, (b) indiscriminate destruction of forests and woodlands is resulting in large-scale degradation of land and (c) that the soils are being rendered sterile or contaminated with toxic chemicals at a rate that cannot be sustained (d) loss of soil organic carbon and nitrogen related to degradation reduces the ability of the agricultural sector to produce enough food for growing global population and significantly contributes to climate change and (e) soil degradation needs to be recognized, along with climate change, as one of the most pressing problems facing humanity.

Image 22.



World Map Showing Human Induced Soil Degradation

Source: Global Assessment of Human-induced Soil Degradation (GLASOD).

Four principal causes of soil degradation identified in the project are; (a) water erosion, (b) wind erosion, (c) chemical deterioration and (d) physical deterioration. Deforestation and removal of natural vegetation for land reclamation, commercial forestry and urban development; overgrazing by livestock leading to wind and water erosion; agricultural activities with excessive use of fertilizers, improper and poor-quality irrigation and insufficient fallow period in case of

shifting cultivation and bio-industrial activities including pollution and disposal of waste have been identified as the major causes for human induced soil degradation.

Degradation of soil can impact in a variety of ways. Slight degradation of soil can reduce the crop yield by 10%. Moderate degradation can cause crop losses somewhere between 10 and 50% while severely degraded soil can reduce the crop yield by over 50%. Natural disasters like flooding and landslides can occur more frequently due to soil degradation. Deterioration of water quality is yet another adverse impact of soil degradation. This can result in turbidity of water and the contribution of nitrogen and phosphorus can result in eutrophication. Soil degradation may involve perturbation of microbial communities, disappearance of the climax vegetation and decrease in animal habitat, thus leading to a bio-diversity loss and animal extinction. According to Food and Agriculture Organization (FAO, 2014) land degradation is defined as a change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries.

Despite negative indicators and global pessimism, there is still a ray of hope. Given the technological advances that have been made in recent years and the greater scientific understanding of the issues today, all types of soil degradation are potentially reversible, as long as there is sufficient public support, understanding and political will (Sustainable Food Trust, 2015). Governments, scientific community and the civil society must come together to tackle this menace before it's too late.

4.3 Economic Consequences of Soil Degradation:

Natural resource accounting is a relatively new concept. While the accounting of minerals is generally based on their market value, accounting for soil and water are not easy to arrive at. So far, there are no universally accepted norms for arriving at the economic cost of land degradation. The replacement cost method estimates the amount of soil nutrients lost each year and the cost of buying fertilizers to replace these nutrients. On the other hand, loss of production method is based on the economic cost of annual crop-loss due to reduced soil productivity. Many scientists believe that the cost of soil degradation must also take into account the other adverse consequences of land degradation such as flooding, erosion, loss of bio-diversity, loss of unique landscape and so on. Hence the third method is based on total economic value. Since the factors causing impoverishment of land are multiple with chain reaction and complex interaction and

unanticipated consequences, it will never be easy to arrive at an accurate assessment of cost and the agreed method of accounting. Moreover, since the estimates concerning intensity of soil degradation themselves vary considerably, arriving at the economic cost of soil degradation is a daunting task. Given these ground realities, wide variations in the economic cost of land degradation are natural (Gupta, 2019).

The first estimate of the global cost of soil degradation, based on the loss of production method, was \$26 billion per annum for world drylands, made by UNEP in 1980, shortly after the UN Plan of Action to Combat Desertification was agreed to, at the United Nations Conference on Desertification (UNCOD) in 1977 (UNEP, n.a.). This estimate was based on reports by consultants/experts submitted to UNEP. FAO's Land Degradation Assessment in Drylands (LADA) Project estimated annual global cost of land degradation at US\$40 billion in 1992 without taking into account the hidden costs of increased fertilizer use, loss of biodiversity, water quality, regulating the global carbon cycle and loss of unique landscapes. Global reduction in soil services as a result of unsustainable management of land has been estimated at \$1 trillion annually (FAO, Land and Water, 2018).

In some cases, the estimates of economic costs of land degradation have calculated as percentage of Gross Domestic Product. They vary widely from country to country and region to region. United Nations Convention to Combat Desertification (UNCCD) in its While Paper I on Economic and Social Impacts of Desertification, Land Degradation and Drought presented in 2013 in Bonn, Germany estimated land degradation costs for Burkina Faso 9%, Niger 8%, Mali 12.5%, India 2%, and US 0.4% of GDP for 1980s. In case of China the direct economic cost was estimated at RMB 40 billion in 1999 (UNCCD, 2013). Tata Energy and Resources Institute (TERI) has projected the economic cost of land degradation in India in 2014-15 at 2.54 percent of GDP (TERI, 2018).

According to a study by Eswaran, Lal and Reich undertaken in 2001 and posted on the United States Department of Agriculture's website, puts the total cost due to soil degradation in US alone, at \$44 billion annually @ \$247 per hectare of cropland and pasture. The study further states that globally, annual loss of 75 billion tons of soil, costs about \$400 billion each year. As regards Africa, the study estimates an average decline of crop yield @ 8.2 percent for the continent as a whole. In South Asia annual loss of productivity has been estimated at 36 million tons of

cereal equivalent amounting to \$ 7.2 billion. The study concludes that globally about 2.5 million km2 of land are under low risk, 3.6 million km2 are under moderate risk, 4.6 million km2 are under high risk, and 2.9 million km2 are under very high risk (USDA, 2016). Ephraim Nkonya et al., had arrived at the global cost of land degradation due to land use and land cover change (LUCC) based on total economic value approach at \$231 billion per year or 0.46 percent of global GDP of \$56.49 trillion in 2007 (Nkonya et al., 2016).

In addition to the direct economic costs of land degradation illustrated above, there is a large element of indirect consequential cost based on a complex matrix resulting in a chain of influences. For example, soil erosion by water can result in silting of rivers and reservoirs, soil erosion by wind can cause dust storm leading to health hazards. Soil erosion can also cause flooding and landslides which in turn can adversely affect bio-diversity and future precipitation. Loss of income, unemployment and food shortages due to reduced productivity can have serious social and economic consequences. 1.5 billion people mainly in the developing countries of sub-Saharan Africa and South Asia, are dependent for their livelihood on degrading agricultural land (UNCCD, 2018). They run the risk of losing their livelihood. Since the indirect influences of land degradation are highly complex and interwoven, it is not easy to fully grasp and anticipate their economic costs and social consequences.

Prevention is better than cure. Given a long and arduous process of soil formation, prevention is the best option to mitigate land degradation. Hence, sustainable land management (SLM) must be adopted as an important global strategy for combating land degradation. SLM has tremendous potential to help and support small and marginal farmers, reduce poverty and hunger, prevent erosion, mitigate loss of biodiversity and risk of climate change, improve management of water resources and increase food security. Degraded land is costly to reclaim and, if severely degraded, may no longer provide a range of ecosystem functions and services. Land Degradation Assessment in Dryland (LADA) undertaken by FAO in China, Philippines, Tunisia, South Africa, the Netherlands and Argentina between 2006 and 2010 have confirmed such adverse impacts of soil/land degradation (FAO, Land Degradation Assessment in Dryland, 2014). UNCCD issued a warning on June 15, 2018 that the global economy could lose \$ 23 trillion by 2050 due to land degradation. Preventive action if taken immediately, would cost \$ 4.6 trillion only (UNCCD,

2018). Global cooperation to introduce sustainable land management is therefore essential and must be accorded high priority.

Voicing similar concerns Scientific American quoting a senior FAO Official Maria Helena Semedo says 'generating three centimeters of top soil takes 1,000 years, and if current rates of degradation continue all of the world's top soil could be gone within 60 years and that about a third of the world's soil has already been degraded (Scientific American, 2016). Land degradation has received considerable attention worldwide and has received attention of many scholars over the years. These include; Johnson and Lewis, 1995; Oldeman et al., 1992; Middleton and Thomas, 1997; Dregne, 1992; Maingnet, 1994; Lal and Stewart, 1994; Eswaran et al., 1997.

According to a recent study undertaken by the United States Department of Agriculture, land degradation, a decline in land quality caused by human activities, has been a major global issue during the 20th century and will remain high on the international agenda in the 21st century. Important among physical processes are a decline in soil structure leading to crusting, compaction, erosion, desertification, anaerobism, environmental pollution, and unsustainable use of natural resources. Significant chemical processes include acidification, leaching, salinization, decrease in cation retention capacity, and fertility depletion. Biological processes include reduction in total and biomass carbon, and decline in land biodiversity. The latter comprises important concerns related to eutrophication of surface water, contamination of groundwater, and emissions of trace gases (CO2, CH4, N2O, NOx) from terrestrial/aquatic eco-systems to the atmosphere. Soil structure is the important property that affects all degradative processes. Thus, land degradation is a biophysical process driven by socio-economic and political causes. The productivity of some lands has declined by 50% due to soil erosion and desertification. Yield reduction in Africa due to past soil erosion may range from 2 to 40%, with a mean loss of 8.2% for the continent. (USDA, 2016).

4.4 Food for Growing Population:

Food is basic human need. Agriculture is the primary source of our food. Fast growing global population has put unprecedented demand on agriculture. Global population in 1900 was estimated at 1.5 billion (Our World in Data, 2017). In 2016 global population is estimated at 7.4

billion (Population Reference Bureau, 2016). The United Nations estimates that it will further increase to 9.1 billion by 2050 and 11.2 billion by 2100 (UN Population Division, 2015).

Image 23.

.





Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2007) (1).

Table 2.

	Population (millions)			
Major area	2015	2030	2050	2100
World	7 349	8 501	9 725	11 213
Africa	1 186	1 679	2 478	4 387
Asia	4 393	4 923	5 267	4 889
Europe	738	734	707	646
Latin America and the Caribbean	634	721	784	721
Northern America	358	396	433	500
Oceania	39	47	57	71

TABLE 1. POPULATION OF THE WORLD AND MAJOR AREAS, 2015, 2030, 2050 AND 2100, ACCORDING TO THE MEDIUM-VARIANT PROJECTION

Source: United Nations, Department of Economic and Social Affairs, Population Division (2015). *World Population Prospects: The 2015 Revision*. New York: United Nations.

The task of feeding an additional several billion people by 2050 with increasing degradation of soil is a major challenge facing the humanity. The projections show that feeding a world population of 9.1 billion people in 2050 would require raising overall food production by some 70 percent between 2005/07 and 2050. Production in the developing countries would need to almost double. This implies significant increases in the production of several key commodities. Annual cereal production, for instance, would have to grow by almost one billion tons, meat production by over 200 million tons to a total of 470 million tons in 2050, 72 percent of which in the developing countries, up from 58% today. Feeding the world population adequately would also mean producing the kinds of foods that are lacking to ensure nutrition security (FAO, 2009).

In addition to the task of feeding the growing population, the challenge of feeding undernourished and hungry put additional burden on food production. Despite encouraging progress under Millennium Development Goals (MGDs), vast pockets of hunger and poverty are still prevalent across the globe. The United Nations Food and Agriculture Organization (FAO) estimates that about 795 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic undernourishment in 2014-2016. Almost all the hungry people, 784 million, live in developing countries, representing 12.9 percent, or one in eight, of the population of developing counties. There are 11 million people undernourished in developed countries (FAO 2015). To add salt to the wound; a large quantity of food is wasted every single day due to five-star culture of the rich. According to a recent report by United Nations Environment Programme (UNEP) and the World Resources Institute (WRI), about one-third of all food produced worldwide, worth around US\$1 trillion, gets lost or wasted in food production and consumption systems. When this figure is converted to calories, this means that about 1 in 4 calories intended for consumption is never actually eaten. In a world full of hunger, volatile food prices, and social injustice, these statistics are more than just shocking: they are environmentally, morally and economically outrageous.

According to this report; every year, consumers in industrialized countries waste almost as much food as the entire net food production of sub-Saharan Africa (222 million vs. 230 million tons). In addition to food wasted, there are heavy losses of food grain during storage and transportation. The amount of food lost and wasted every year is equal to more than half of the world's annual cereals crops (2.3 billion tons in 2009/10). In the USA, 30-40% of the food supply is wasted, equaling more than 20 pounds of food per person per month. As a result, organic waste is the second highest component of landfills in US, which are the largest source of methane emissions (UNEP, 2015). Children are the most adversely affected section of humanity due to hunger and malnutrition. Globally, every year 3.1 million children are estimated to die due to hunger and malnutrition while another 161 million under the age of five are stunted (World Hunger, 2016).

Increasing production without much attention to sustainability is fraught with ecological consequences. Between 1950 and 1985 cereal production outstripped population growth, increasing from around 700 million tons to over 1800 million tons, an annual growth rate of around 2.7 percent. This increase helped to meet escalating demand for cereal caused by population growth and rising income in the developing countries and by growing need for animal feed in the developed countries. This unprecedented growth in food production was achieved partly by an extension of the production base but mainly due to rise in productivity through high yielding pest resistant seed varieties, use of more chemical fertilizers (increase by 9 times), use of more pesticides (increase by 32 times) and increased irrigated area (WECD, 1987 pp.118-123).

However, increase in food production through increased area, more irrigation, high yielding varieties and use of more chemical fertilizers and pesticides is reaching its saturation. WECD report state the following stark fact;

- a. Decline in soil quality due to intensive soil cultivation and overuse of chemical fertilizers and pesticides.
- b. Destruction of countryside due to clearing of hedgerows, park belt and other protective cover and the levelling, occupation and cultivation of marginal land and watershed protection areas.
- c. Nitrate pollution of ground water aquifers due to the often-subsidized overuse of nitrate fertilizers.
- d. Degradation of soil due to deforestations and desertification due to shortage of rainfall and declining ground water table.



Image 24.

Source: Earth Policy Institute, USDA

According to FAO, agriculture in the 21st century faces multiple challenges: it has to produce more food and fiber to feed a growing population with a smaller rural labor force, more

feed stocks for a potentially huge bioenergy market, contribute to overall development in the many agriculture-dependent developing countries, adopt more efficient and sustainable production methods and adapt to climate change. Demand for food would continue to grow. Demand for cereals, for both food and animal feed uses is projected to reach some 3 billion tons by 2050, up from today's nearly 2.1 billion tons (FAO, 2009). These challenges are indeed massive particularly when the arable land is shrinking and soil degradation is increasing every passing day.

Chapter 5 Water Stress and Contamination

5.1 Water and Life:

Existence of life is unconceivable without water. If we look at the human history, all major ancient civilizations have developed on the river banks. Egyptian – Nile, Mesopotamia – Tigris and Euphrates, Indian – Indus, Ganges and Brahmaputra, Chinese – Yangtze and Yellow River. All the major cities of the world are located either on river banks or on the shores of fresh water lakes or coastal areas. Thus, life and water are closely linked. Over two-thirds of earth's space is covered with water. Similarly, water constitutes approximately two-thirds of human body. Space scientists who are searching for existence of life in other planets are looking for traces of water, for no life is possible without water. Apart from direct consumption of water for drinking, cleaning and cooking, water is an essential pre-requisite for food production, vegetation and navigation. Hence, water cycle is intrinsically linked to life cycle (Gupta and Orban, 2018 p.82).

When we think of earth's water resources, we think of oceans, seas, lakes, and rivers. Not all of earth's water sits on its surface, however. A great deal of water is held in underground rock structures known as aquifers, which we cannot see and seldom think about. Water stored underground in aquifers is known as groundwater. Groundwater represents about 30 percent of total fresh water (Pennington and Cech, 2010 p.4). Earth contains approximately 1.40 billion cubic kilometers of water, with 96.5 percent in the oceans. The amount of fresh water is approximately 36 million cubic kilometers constituting only 2.6 percent of total. Of this only 11 million cubic kilometers or 0.77 percent counts as part of water cycle while the rest is locked in glaciers, polar ice caps and permanent snow (Barlow and Clarke, 2002, p.5). According to another estimate approximately 1.7 percent of total water is stored in glaciers, permanent snow and polar ice caps while another 1.7 percent exists as ground water and in rivers, lakes, wetlands and soil. The remaining 0.1 percent is constitute a very small quantity of total water resources. Oceans, sun heat, clouds and rain form the critical mass of the hydrological cycle. Hydrological cycle keeps continuously recharging both the surface and the ground water sources to sustain life on the Earth.

Globally, availability of fresh water is enough. However, it is not evenly distributed across the continents and the availability varies from season to season and year to year. For example, in much of India 90 percent of its rainfall occurs during the monsoon season between June and September. Similarly, Amazon River Basin of South America receives approximately 15 percent of world's surface water runoff but inhabits only 0.4 percent of earth's population. Asia on the other hand inhabits 69 percent of the world's population but receives only 36 percent of earth's surface water runoff (Pennington and Cech, 2010 p.2). Uneven distribution of water over seasons and continents requires prudent management of water resources.

5.2 Water Stress:

A country is said to be water stressed when available water is lower than 1000 cubic meters per person per year. Below this level the health and economic well-being of a nation is compromised (Shiva, 2000 p.1). According to the World Water Vision Report for 21st Century, industrial and private water demands have grown to exceed natural supplies in many parts of the world. Without dramatic changes in water management, this local scarcity will soon extend to regional or global proportion transforming into a "water shock" and then to "water famine" displacing millions or perhaps billions of people. In 1998, twenty-eight countries experienced water stress or scarcity. This number is expected to rise to 56 by 2025 (Shiva, 2000 p.1). According to the report of the World Commission on Water, as of now agriculture accounts for roughly 70

percent of water utilization, industries 20 percent and domestic or municipal consumption 10 percent (World Water Vision, 2000).



Image 25. Source: World Water Vision

During the 20th century, the world witnessed a surge in total population by a factor of 3.8, in urban population by 12.8 and in water use by 9 (Boberg, 2009). Per capita water consumption is multiplying, roughly doubling every 20 years. From 1940 to 1990 withdrawals of water for human consumption increased by more than a factor of four reflecting long-term trend of increasing withdrawals per capita (National Research Council, 1999). Per capita availability of fresh water on a global basis fell from 17,000m³ in 1950 to 7,300m³ in 1995 (National Research Council, 1999). Increasing industrial use of water, growing needs for agriculture, flushing of toilets for growing urban inhabitants and leakages in municipal infrastructure are taking a severe toll on fresh water supplies. The following table taken from UN Water Report provides the global water consumption patterns.

Image 26.

Global Water Consumption Patterns



Source: UN World Water Report, 2006.

As the technology developed, communities gained easier access to water. Instead of people following the water by settling near rivers, lakes and springs, communities moved the water to their settlement centers by constructing reservoirs and pipe lines. Most of world's large dams have been built in the post-World War II period redirecting the rivers and channeling water for irrigation and municipal consumption (Chellaney, 2013, p.61). Thus, human efforts to control and redirect water and easy availability due to mechanized systems to pump water have resulted in multifold increase in use as also misuse of water. The average Canadian household consumes 500,000 liters of water every year (Barlow and Clarke, 2002). The above table clearly indicates much higher quantities of water usage in the developed countries compared to the poorer countries in Asia and Africa.

Industry claims the next big chunk of world's fresh water accounting for over 20 percent. Massive growth of large industries with mass production facilities, to achieve the goals of higher and higher Gross Domestic Product has become the heaviest drain on fresh water resources. Massive industrialization is throwing off, the balance between humans and nature on many continents, especially in the Latin America and Asia where export-oriented manufacturing zones and agri-business are claiming more and more of fresh water once used by small farmers for food self-sufficiency. Despite technological innovations most of the world's growing industries are water intensive. For example, it takes about 400,000 liters of water to make one car (Barlow and Clarke, 2002). Soft drink plants are water guzzlers. Manufacturers of computer and other electronic goods use massive quantities of de-ionized fresh water to produce their goods. To create an integrated circuit on a 30cm wafer requires approximately 2,200 gallons of water, including 1,500 gallons of Ultra-Pure Water (UPW). A large fabrication facility that processes say, 40,000 wafers a month, can use up 4.8 million gallons of water per day, this equates to the annual water consumption of a city of 60,000 people (Global Water Intelligence, 2009). Clearly, the manufacture of semiconductors is highly water intensive.

Chemical and pharmaceutical industries and manufacturers of beverages consume very large quantities of fresh water. Electricity generation is also a major water juggler. Originally thought to be 'clean' industries many high-tech industries have left a staggering pollution legacy in its short history. In the United States alone, the industry will soon be using over 1,500 billion liters of water and produce over 300 billion liters of waste water. Silicon Valley alone has more than 150 ground water contamination sites, most related to high-tech manufacturing. Close to 30 percent of ground water around Phoenix, Arizona has been contaminated. (Barlow and Clarke, 2002, p.5-9). Nuclear power plants also need massive supply of fresh water. Similarly, extraction of minerals is also highly water-intensive. With growing appetite for minerals, fresh water supplies are dwindling in mineral extraction belts.

Image 27.



Source: SASI Group (University of Sheffield) and Mark Newman (University of Michigan)

Obviously, the industrialized countries are the principal user of water for industrial use as is apparent from the chart given above (SASI Group, 2006). Growing demand for food due to increasing population and higher per capita consumption has led to substantial increase in use of fresh water for agriculture. Powered by technological innovations, new irrigation techniques based on diversion of rivers through dams and reservoirs, construction of canals, pump irrigation and drip irrigation came into being. As a result, total irrigated land area has gone up manifold. According to Food and Agriculture Organization, in 2012 a total of 324 million hectares of land area was equipped for irrigation, compared to estimated 40 million hectares in 1900 (FAO, 2016). Industrial farming has become another big drain on fresh water resources across the globe. Use of water for agriculture has also gone up substantially due to introduction of high yielding variety of food grains and increasing use of chemical fertilizers which are water intensive.

Production of 'bio-fuel' is the most water intensive. As much as 2500 liters of water is needed to grow enough corn to refine just one liter of ethanol (Chellaney, 2013 p.67). Therefore, the new fashion for bio-fuel in the name of green energy is a big drain on fresh water resources of the planet. Supply of electric power in many areas of India, China and Africa enabled mechanized

withdrawal of groundwater by a large section of population contributing to higher water consumption both for agriculture and domestic use. Similarly, industrial production of meat and poultry is highly water intensive as given in the table below. Compared to normal food grain crops water usage for beef, meat and poultry could be ten to fifteen times more. The table given below based on the research done by Lenntech B.V. provides the basic pattern of water consumption, though, actual water requirements of different food products may vary considerably depending on soil condition, climate and irrigation techniques (Lenntech B.V., 2017). Thus, the growing consumption of meat and poultry products is becoming a drain on fresh water globally. Since some of these industrial farming practices are even subsidized, they are in fact promoting over-use of fresh water.

Table 3.

Average Water Requirements of Main Food Products

Water required $(m^3 \text{ per kg.})$

Beef	15
Lamb	10
Poultry	6
Palm Oil	2
Cereals	1.5
Citrus Fruits	1
Pulses, roots and tubers	1
Per Cattle	4000

In view of the facts given above global water consumption has grown more than double the rate of population growth in the last century. Global water use soared from estimated 770 billion cubic meters in 1900 to 3853 billion cubic meters in 2010 and is projected to climb to 5000 billion cubic meters by 2025 (FAO, 2016). The following two charts taken from FAO AQUASTAT site provide a clear view of increasing consumption of fresh water globally.





Image 29.



Source: FAO AQUASTAT

Growing water consumption has threatened planet's finite fresh water resources. Major river systems are under stress. The Nile in Egypt, the Ganges in India, the Yellow River in China and the Colorado River in the United States are reported to be the worst victims. They are so much over tapped that very little or no fresh water reaches their final destination. Other river systems are also under stress. Studies have revealed that all the major lakes are shrinking and their water levels are declining substantially. "more than one-half of the world's major rivers are being seriously depleted and polluted degrading and poisoning the surrounding ecosystems, thus threatening the health and livelihood of people," said, Ismail Serageldin (SASI Group, 2006). In addition, several smaller lakes have dried up completely as if they never existed. Groundwater has also recorded substantial depletion all over the world. The problem with groundwater is that its depletion can't be seen unlike rivers and lakes. Massive groundwater extraction not only causes depletion of finite aquifer reserves, it also dramatically reduces the water table in the surrounding areas. If the extraction continues to exceed recharge, over time water also becomes contaminated with dissolved minerals. Mining, production and oil extraction are major culprits in this process.

Maude Barlow and Tony Clarke in their book Blue Gold have given many instances of excessive use of groundwater across the globe. For example, in the Canadian province of Alberta alone, 204 billion liters of water is pumped into oil wells every year to increase pressure in the reservoir to enhance production. Similarly, the process of separating oil from Tar Sand is highly water intensive. Coal-bed methane production in several parts of the United States also involves

withdrawing massive volume of highly saline groundwater from coal-seam aquifers. In Arabian Peninsula in order to promote agriculture groundwater use is nearly three times more than recharge. This is resulting in fast depletion of aquifers which are the only source of fresh water in many countries of the region. Groundwater table in China has recorded considerable depletion during the last three decades due to growing industrialization resulting in drying up of wells, rivers and streams. African Sahara continues to suffer desertification.

According to a recent report by Vishwa Mohan; over-exploitation and misuse of water resources in India is rampant due to absence of a central regulatory regime and poor enforcement of laws. Since under the Indian Constitution the subject comes under the jurisdiction of states, there are no national laws regulating water bodies and water uses. On the other hand, states have failed to regulate and enforce laws regulating proper use of water resources. Moreover, India's share in global water resources is merely 4 percent; while the country accounts for 18% of global population. As a result, pressure on scarce water resources is tremendous. River pollution is constantly on the rise due to growing urbanization and industrialization and poor enforcement of laws. Many rivers have already dried up while many more are drying up. Groundwater is depleting fast as over 80 percent of domestic/municipal water needs are met through use of ground water. Inter-state water disputes, poor monsoons, unseasonal flooding, deforestation and poor recharge of groundwater aquifers are further compounding the water woes and reducing per capita water availability in the country. Per capita availability of water in India in 2011 was estimated at 1545 cubic meters as against 6042 cubic meters in 1947 at the time of country's independence. It is expected to reduce further to 1140 cubic meters by 2050 putting more stress on water resources. Therefore, of all these factors water shortages are likely to become more severe in the coming decades (Mohan, 2017).

Even in the developed world periodic water shortages have been experienced in Spain (Catalonia), Australia, Germany and the United States (Chellaney, 2013). If we continue on this path, sooner than later we are doomed to face serious water shortages severely impacting on human life across the globe. By 2025, it is estimated that 800 million people will live in regions of severe water scarcity. Even today most countries in the Near East and North Africa, as well as, Mexico, Pakistan, South Africa, and many parts of China and India are suffering from serious water shortages. In many of these countries' ladies are forced to spend a large part of their day

transporting water in plastic buckets (Pennington and Cech, 2010). According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP), 32 per cent of the world's population – 2.5 billion people or roughly 34 percent of global population lack safe drinking water and about 3.4 million people die every year due to water related diseases (WHO, UNICEF, 2013).

5.3 Water Pollution:

Growing water consumption and scarcity of water is not the only problem. Increasing pollution of water bodies poses even more serious ecological threat. Water is an easy solvent, enabling most pollutants to dissolve in it easily and contaminate it. When toxic substances dissolve in bodies of water such as streams, rivers and lakes, water becomes polluted. When water loses its natural composition owing to encroachment of any unwanted compound into it, then it does not remain as pure water and called the polluted water (Pollution Pollution, 2017). Thus, water pollution occurs when water is contaminated with chemicals and foreign substances that are harmful to humans, plants and animals. Water pollutants include chemical contamination from waste sites, chemical wastes from industrial discharges, heavy metals such as mercury and lead, sewage waste, food processing waste, fertilizers and pesticides (Reference, 2017). UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, Report of the First Session, March 1969 (GESAMP, 2017, p.5), defined marine pollution as follows:

"The introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities, including fishing, impairment of quality for use of sea water and reduction of amenities."

5.3a. Sewage and Wastewater:

The single biggest threat of water pollution comes from the enormous amount of sewage generated in ever-growing cities all over the world. Sewage is a complex mix of used water, food, agro-waste, chemicals, human waste, and a variety of household materials. In some places medical waste, building materials, solid waste in the form of metals, used household goods, electronic waste and even waste from small industrial and agro-processing units could form part of sewage. Wastewater, on the other hand is defined as "a combination of one or more of:

- a) domestic effluent consisting of blackwater (excreta, urine and faecal sludge) and greywater (kitchen and bathing wastewater);
- b) water from commercial establishments and institutions, including hospitals;
- c) industrial effluent, storm water and other urban run-off; and
- d) agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter" (Corcoran et al. 2010).

More than two-thirds of the domestic sewage and wastewater in the sixty percent countries of this world is directly dumped into the various water bodies - rivers, streams, lakes and seas. Percentage of domestic sewage and waste water discharge into water bodies in the developing counties is much higher, in many cases up to 100%. A global estimate by UNDP and UN-Habitat is that 90% of all wastewater generated is released into the environment untreated (Corcoran et al, 2010). The following picture taken from the public domain on internet speaks for themselves.

Image 30.



Water Pollution

Source: Internet Public Domain

Given its complex mix, sewage has many distinctive chemical characteristics. These include high concentrations of ammonium, nitrate, phosphorus, high conductivity due to dissolved

solids, high alkalinity and so on. When these toxic substances enter a body of water, they are dissolved, become suspended in water or get deposited on the bed of the water body. They also contribute disease carrying pathogens. Due to growing urbanization, the intensity of sewage discharge in water bodies has acquired an alarming proportion threatening supply of clean water in many parts of the world. It has been estimated that 330 KM³ of municipal sewage is produced annually which is enough to irrigate and fertilize millions of hectares of land and to produce biogas for millions of households (Mateo-Sagasta et al., 2015).

Apart from sewage an increasing amount of municipal solid waste (MSW) is generated in urban areas around the world. Most of this waste is disposed of without reprocessing, contaminating both soil and water. According to the World Bank global MSW generation levels in 2010 were approximately 1.3 billion tons per year, and are expected to increase to approximately 2.2 billion tons per year by 2025. This represents a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per person per day in the next fifteen years (2010 to 2025). Urban residents produce about twice as much solid waste as their counterparts in rural areas. As the disposable incomes and living standards increase, consumption of goods and services correspondingly increases, so does the amount of waste generate. This clearly establishes a direct correlation between affluence and MSW (World Bank, 2016). However, global averages are broad estimates only, as rates vary considerably by region, country, city, and even within cities. OEDC countries are the largest MSW generators and they alone generate over 44% of global MSW.

Table 4.

lessons Level	Waste Generation Per Capita (kg/capita/day)			
Income Lever	Lower Boundary	Upper Boundary	Average	
High	0.70	14	2.1	
Upper Middle	0.11	5.5	1.2	
Lower Middle	0.16	5.3	0.79	
Lower	0.09	4.3	0.60	

Generation of Waste Globally by Income Levels

Source: World Bank, 2016

The above chart reflects the general trend prevailing in the OECD countries as a whole. There seems to be direct correlation between the affluence and the waste generated because the affluent societies consume far more products and services than the poorer societies. Hence the more the affluence the more the consumption and consequently the more the waste generation. Modern system of packaging also involved considerable amount of waste. Most products sold in supermarkets involve considerable packaging material. Sometimes the contents of the products are insignificant compared to the packaging material. Thus, each household discards considerable amount of waste on daily basis. Tourism and transport sectors also discard considerable amount of waste on daily basis due to packaging of convenience. Developing counties generate much lower amount of solid waste as is apparent from the chart given below. Lowest MSW is generated in Africa and South Asia. The two charts given below taken from the World Bank site clearly prove the direct relationship between the affluence and MSW generated.

Image 31.



[AFR – Africa, SAR – South Asian Region, MENA – Middle East and North Africa, ECA – East and Central Asia, LAC – Latin America and the Caribbean, EAP – East Asia and the Pacific, OECD Organization for Economic Cooperation and Development]

Source: World Bank, 2016

5.3b. Industrial Effluent:

Industrial effluent is the second major cause of the water contamination all around the world. Each manufacturing activity brings its own baggage in the form of industrial effluents. While the polluting agents differ from industry to industry, industrial effluent from industries such as pesticides, oil refineries, pharmaceuticals, paints and dyes, petrochemicals, detergents, plastics and paper are highly toxic and harmful for all living organisms. Most intractable hazardous wastes are human synthesized chemicals. There are over 65,000 such industrial chemicals in regular use. Eighty percent of them are not tested for their toxicity. Both water and soil are poisoned by the waste as well as use of these hazardous chemicals (Meadows et al., 1992).

Industrial waste from semiconductor fabrication facilities, coal fired plants, iron and steel industry, other metal industries and mining industries are also highly toxic. Food processing waste from slaughter houses, freezer plants, pulp from sugar beet factories and waste from brewing and distilleries have also increased considerably in the recent decades. While no reliable global statistics are available on the size of annual industrial effluent, the UN Water estimates that 70% of industrial discharges in developing countries are dumped untreated (UN Water, Wastewater Management, n.a.). According to one government study 75 percent of all maquiladoras along US-Mexico border are dumping toxic waste directly into rivers and streams (Barlow and Clarke, 2002).

Image 32.

Industrial Waste



Source: Internet public domain

Apart from direct industrial effluent the manufacturing units also use bugs, germs and bacteria in their manufacturing processes. Quoting National Geographic, Maude Barlow and Tony Clarke in their book Blue Gold (p.29) report that one billion pounds of industrial weed and bug killers are used throughout the United States every year and most of it runs off into the country's water system. Nearly 40 percent US Rivers and streams are dangerous for fishing, swimming or drinking, as a result of pollutants like these. 30% of fresh water fish are at risk of extinction, while 64% of crayfish and 40% of amphibians are imperilled (Barlow and Clarke, 2002).

5.3c. Marine Pollution:

In the earth's wheel of life, the oceans provide the balance and stability. Covering over 70 percent of the planet's surface, they play a critical role in maintaining its life support system, in moderating its climate, and in sustaining animals and plants, including minute oxygen-producing phytoplankton. Oceans also provide the ultimate sink for the by-products of human activities. In the last few decades, the growth of world economy, the burgeoning demand for food and fuel, and accumulating discharges of waste have begun to press against the bountiful limits of the oceans (WCED, 1987). According to the European Commission, marine litter is a global concern, affecting all the oceans of the world. Every year, millions and millions of tons of litter end up in the oceans worldwide, posing environmental, economic, health and aesthetic problems. Poor practices of solid waste management, wastewater (including storm water) collection and treatment, lack of infrastructure and awareness of the public at large about the consequences of their actions aggravate substantially the situation (European Commission, Environment, 2017).

Marine pollution is resulting from a large number of human induced activities including deep sea mining, oil spills, dumping of untreated sewage, heavy siltation and increased sedimentation due to declining river flows, eutrophication (nutrient enrichment), invasive species, persistent organic pollutants (POP's), heavy metals from mine tailings and other sources, acidification, radioactive substances, marine litter, overfishing and destruction of coastal and marine habitats. According to UNEP marine litter (or debris) is waste created by humans that has been discharged into the coastal or marine environment and could be defined as "any anthropogenic, manufactured, or processed solid material (regardless of size) discarded, disposed of, or abandoned in the environment, including all materials discarded into the sea, on the shore, or brought indirectly to the sea by rivers, sewage, storm water, waves, or winds" (UNEP, 2005).

UNEP estimates that the total input of marine litter into the oceans and seas worldwide is estimated at 6.4 million tons per year consisting of 8 million items every day and 13,000 pieces of plastic on every square kilometer (UNEP, 2005). Around 60% of the wastewater discharged into the Caspian Sea is untreated, in Latin America and the Caribbean the figure is close to 80%, and in large parts of Africa and the Indo-Pacific the proportion is as high as 80-90% (UNEP, 2006). It is estimated that more than 150 million tons of plastics have accumulated in the world's oceans, while 4.6-12.7 million tons are added every year (Jambeck et al., 2015). According to UNEP the growing plastic production could choke the oceans in the coming decades. The chart given below estimates that the plastic production could go up to 33 billion tons by 2050 (UNEP, 2016). Since oceans are the final destination, all litter, sewage and effluent whether discharged into rivers, lakes, streams, soil and air finally ends up in oceans in course of time. It is broadly assumed that approximately 80% of marine litter is land-based, with regional fluctuations. Humans have also extensively altered coastal zones with increasing pollution as an indirect effect of developing adjoining land and littoral areas. Pressure on coastal zones will further intensify as the near-coastal human population continues to increase with increasing recreation and tourism (National Research Council, 1999).



Image 33.

UNEP admits that the quantum of marine litter into the oceans and seas is increasing despite international, regional and national efforts. Today's deterioration of the global environment

Source: UNEP
is closely linked to unsustainable patterns of consumption and production. The exponential increase in production and consumption over the last 50 years has seen a rapid transformation of the relationship between humans and the natural world – more so than in any other period in our history – with escalating use of natural resources leading to environmental degradation (UNEP, 2015). The increase in production and consumption is across all sectors and generates a vast amount of waste, much of it contributing to marine litter. This includes waste streams such as wood, textiles, metal, glass, ceramics, rubber and above all, plastic.

Growing marine pollution is becoming a serious threat to marine life, coral reefs, coastal life and the eco-system as a whole. Between 60 and 90 per cent – sometimes as much as 100 per cent – of the litter that accumulates on shorelines, the sea surface and the sea floor is made up of one or a combination of different plastic polymers (UNEP, 2017). In addition to polymers, additives such as flame retardants (e.g. polybrominated diphenyl ethers), and plasticizers (e.g. phthalates) are also mixed into synthetic materials to increase their flexibility, transparency, durability, and longevity. Some of these substances, present in most plastic objects found in the marine environment, are known to be toxic to marine organisms and to humans (Rochman et al., 2013).

Many of the wastes entering the sea are plant nutrients. Decaying organic matter and nitrates and phosphates in sewage; enhance plant growth. Over-fertilization of the sea, known as eutrophication could lead to massive growth of green algae which can choke beaches and alter marine life (Clark, 1992). Arrival of excess algae has been observed in many parts of the world. I have seen this phenomenon on many beaches in the Caribbean adversely affecting the marine life. Loss of tourism has resulted in reduction in jobs directly impacting on the livelihood of thousands of people inhabiting those areas. Unsustainable fishing during the last six decades has also adversely affected marine ecosystems by changing bottom topography and associated ethnic communities. Large-scale changes in coral reef ecosystems in the Caribbean and in community structure in the Bering, Barents and the Baltic Seas and in other regions have been attributed to over-fishing (National Research Council, 1999).

There has been widespread publicity about pollution of the marine environment by plastic debris and its impact on organisms. Images of the brightly colored plastic stomach contents of dead seabirds and countless whales, dolphins and turtles caught in floating debris or wearing discarded plastic rubbish are routine. But this is not only about large marine creatures swallowing or getting entangled in rubbish; organisms at every trophic level, living both on the seabed and in the water column, are also affected. Apart from the physical risk from plastic, there is also concern that marine organisms are at risk from the ingestion of hazardous chemicals that are in the plastic or adsorbed on its surface. The ability of plastic particles in the ocean to attract organic chemicals that don't dissolve, which include many well-known toxic substances, has led to a growing number of studies looking at plastics as a source of toxic chemicals in marine organisms. Gradually this plastic is becoming a perpetual part of the food chain directly affecting marine life and human health in a variety of ways.

The shipping industry is also taking a heavy toll due to growing marine litter. Marine litter can damage vessels by fouling ship propulsion equipment or cooling systems to the point of causing breakdowns and delays. Growth of algae could also adversely affect shipping industry. Loss of coral reefs have been observed and documented in many parts of the world. However, apart from these visible and measurable adverse effects there could be many more that could appear in the future if the marine pollution continues at the present rate. Excessive marine pollution could even affect the hydrological cycle as a whole causing severe water shortages all over the world.

5.3d. Other Water Pollutants:

Increasing discharge of chemical fertilizer and pesticides from agriculture, radioactive waste from nuclear plants, and oil spills are some other major water pollutants. Most radioactive waste comes from the spent fuel in nuclear plants. Some amount of nuclear waste also comes from nuclear medicines and other radioactive substances. This waste is highly dangerous for all living species. All these pollutants are primarily a direct result of the increasing mining, industrial agriculture and manufacturing activities. With intensity of industrialization these pollutants are becoming more and more potent and dangerous. However, it is sufficed to understand that unprecedented growth in industrialization, ever growing consumption and increasing urbanisation coupled with growth in population are the major factors affecting water pollution globally.

5.4 Challenges Ahead:

Since the Second World War increasing discharge of toxic waste in the form of industrial effluent and municipal sewage into water bodies, is emerging as the single biggest threat to fresh water bodies, water species and to human life. Apart from direct discharge of toxic waste into the water bodies, many of the industrial pollutants enter water through the air. They enter the atmosphere through the industrial chimneys and then come back as acid rain dissolving into water bodies. The human race for more comforts and higher GDP is therefore gradually choking all sources of fresh water supply. All the water bodies including underground aquifers are under increasing pressure both in terms of demand for fresh water and polluting agents.

Africa's Lake Victoria is imperilled due to massive industrial and municipal waste from Kenya, Tanzania and Uganda. The Great Lakes on US-Canada border are also receiving their share of toxic waste. The International Joint Commission that oversees the US-Canada management of lakes has observed serious build-up of radioactive waste in the Great Lakes from the nuclear power industry. The US Environmental Protection Agency has indicated that roughly hundred thousand sites around the lakes are discharging industrial/municipal waste containing dangerous chemical substances into these lakes, some of them directly (Barlow and Clarke, 2002). Several major rivers across the globe – Amazon in Latin America, Colorado in US, Congo and Niger in Africa, Yangtze and Mekong in China, Indus, Ganges and Brahmaputra in India, Rhine and Danube in Europe, Tigris and Euphrates in the Middle East and Nile in Egypt -- are receiving industrial waste in varying quantities constantly eroding the quality of their water and their carrying capacity. Vast industrialization of China during the last four decades has caused serious contamination of water bodies. Water shortages and water pollution in China are such a problem that the World Bank warns of "catastrophic consequences for future generations." Half of China's population lacks safe drinking water. Nearly two thirds of China's rural population---more than 500 million people--use water contaminated by human and industrial waste (Water Pollution in China, 2017).

"Managing Water under Uncertainty and Risk", United Nations World Water Development Report 4 published by UNESCO in 2012 highlighting the problems of water stress due to overconsumption, urbanization and industrialization; massive contamination of water bodies; depletion of ground water aquifers and the declining quality of water; states that there are major uncertainties about the amount of water required to meet demand for food, energy and other human uses and to sustain ecosystem. These uncertainties are compounded by the impact of climate change on the available water resources. The report states, "Water is a critical resource upon which all social and economic activities and ecosystem functions depend. Managing water well requires appropriate governance arrangement that move considerations of water from the margins of government to the center of society." (United Nations Water Development Report 4, 2012). Recently released World Water Development Report, 2017 confirms overconsumption, growing water stress and large-scale water contamination and states that a large proportion of wastewater still released into environment without being either collected or treated resulting into water contamination by bacteria, nitrates, phosphates and solvents with negative consequences for the environment and public health. The report describes the wastewater generation as one of the biggest challenges associated with the growth of informal settlements (slums) in the developing world (World Water Development Report, 2017).

We know that the battles of yester-years were fought over land to build empires and colonies. Those of today are being fought over energy resources and theft of technology. However, the battles of tomorrow are likely to be fought over water. Investment strategists envisage water as potentially becoming the single most important physical-commodity asset class in a water-scarce world (Citigroup Global Markets, The Global Themes Strategy, 2011). According to Brahma Chellaney; water wars are no longer just the stuff of Hollywood melodramas. With water stress spreading across much of the world, the next flash point could well be water. Water wars – in political, diplomatic and economic sense – are already being waged between riparian neighbors in several regions, fueling a cycle of bitter recrimination and fostering mistrust (Chellaney, 2013). Water scarcity and declining water quality are now reaching an alarming proportion in several parts of the world threatening societal conflict and national and international water wars.

Chapter 6

Air Pollution, Global Warming and Climate Change

6.1 Air Pollution:

Air sustains breathing which signifies life. However how clean is the air we are breathing? Air pollution has emerged as a major health hazard since the Industrial Revolution and in particular during the last 5-6 decades. Quality of air has deteriorated in all the major cities and more so in Asia. Air pollution is considered the single largest environmentally related global health risk of our time (UN Environment, 2017). According to the World Health Organization (WHO) "air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Household combustion devices, motor vehicles, industrial facilities and forest fires are common sources of air pollution. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulphur dioxide" (WHO, 2017). According to the National Geographic, "Generally any substance that people introduce into the atmosphere that has damaging effects on living things and the environment, is considered air pollution" (National Geographic, 2017).

Image 34.

Air Pollution



Source: National Geographic Website

By composition, Earth's atmosphere is made up of nitrogen (78%), oxygen (21%), and other trace gases (such as argon and carbon dioxide). This balance is essential to all life on Earth. Therefore, introduction of pollutants can have a profound and damaging effect. Major sources of air pollution include; power plants, manufacturing facilities (factories), waste incinerators, fuel burning heating devices, air conditioning, emissions from motor vehicles, marine vessels and aircrafts, fumes from paint, hair spray, varnish, aerosol sprays and other solvents, forest fires, controlled fires, traditional biomass and coal burning, landfills, nuclear waste, hazardous waste of human synthesized chemicals, nuclear radiation and biological/germ warfare (Universe Today, 2017). In the recent years it has become increasingly clear that expanding economic activity can impose environmental damage that is global in dimension and irreversible over long time horizons. Stratospheric ozone depletion by chlorofluorocarbons (CFCs) is a major example (Cline, 1992).

A study conducted by the Union of Concerned Scientists (UCS) in 2013 showed that transportation accounted for more than half of the carbon monoxide and nitrogen oxides, and almost a quarter of the hydrocarbons emitted into the air in the US (Union of Concerned Scientists, 2017). Vehicle emissions are the main source of outdoor air pollution – including particulate matter (PM) which includes black carbon (UN Environment, 2017). With increasing vehicular population (numbering 1.3 billion) the situation continues to worsen day by day. Cattle breeding for meat production is yet another major source of CO_2 emission. Among the major challenges of urban development is air pollution, produced largely by the interaction of hydrocarbons and nitrogen

oxides produced in industrial and transportation processes as well as by heating and cooking (National Research Council, 1999).

According to the European Environment Agency (EEA); in Europe emissions of many air pollutants have decreased substantially over the past decades, resulting in improved air quality across the region. However, air pollutant concentrations are still too high and air quality problems persist. A significant proportion of Europe's population live in areas, especially cities, where exceedances of air quality standards occur (EEA, 2017). The fossil fuel combustion associated with transportation results in emissions of pollutants that cause damage to human health, agriculture and sensitive ecosystems, and contribute to global climate change. Transportation can also contribute to the degradation of urban environments, with loss of quality of life and economic productivity from the delays and frustration caused by congestion and stress from traffic noise. The share of fossil fuel used in the transport sector varies widely from region to region and city to city. A study of six cities in developing countries found that the share of fossil fuel consumption in the transport sector ranged from 4 to 35 per cent (UN, 2002).

Image 35.



A general view through smog of the Canary Wharf financial district on April 2, 2014 in London, England. Dan Kitwood—Getty Images.

Source: Time.

Given below is the global air quality map dated 1st December 2016 produced by Berkeley Earth. The map assigns qualitative categories to the numerical values, with air pollution concentrations rated "good," "moderate," "unhealthy for sensitive groups," "unhealthy," "very unhealthy," and "hazardous." The map clearly shows that air quality is the worst in Asian countries; particularly in most of China and many parts of India ranging between very unhealthy to hazardous. Unfortunately, these are also the countries that are most densely populated. Surprisingly air quality in certain European countries also falls in the category of unhealthy. A new WHO air quality model confirms that 92% of the world's population lives in places where air quality levels exceed WHO limits and about half of the urban population being monitored is exposed to air pollution that is at least 2.5 times higher than the levels WHO recommends - putting those people at additional risk of serious, long-term health problems (WHO, 2017). Nearly 90% of air-pollution-related deaths occur in low and middle-income countries, with nearly 2 out of 3 occurring in South-East Asia and Western Pacific regions. Ninety-four per cent are due to noncommunicable diseases – notably cardiovascular diseases, stroke, chronic obstructive pulmonary disease and lung cancer. Air pollution also increases the risks for acute respiratory infections (WHO, 2016).

Image 36.

Global Pollution Map December 1st, 2016



Source: Forbes Website

6.2 Health Hazards of Air Pollution:

Over the past 30 years, researchers have unearthed a wide array of health effects which are believed to be associated with air pollution exposure. Among them are respiratory diseases (including asthma and changes in lung function), cardiovascular diseases, adverse pregnancy outcomes (such as preterm birth), and even death (National Institute of Environmental Health Sciences US, 2017). According to the 2018 WHO report, air pollution in 2017 caused the deaths of around 8 million people worldwide. This finding more than doubles previous estimates and confirms that air pollution is now the world's largest single environmental health risk. Air pollution is also a major environment-related health threat to children and a risk factor for both acute and chronic respiratory diseases (WHO, 2018). The report further confirms a stronger link between both indoor and outdoor air pollution exposure and cardiovascular diseases, such as strokes and ischaemic heart disease, as well as between air pollution and cancer; in addition to air pollution's role in the development of respiratory diseases, including acute respiratory infections and chronic obstructive pulmonary diseases. An estimated 4.2 million premature deaths globally are linked to ambient air pollution, mainly from heart disease, stroke, chronic obstructive pulmonary disease,

lung cancer, and acute respiratory infections in children. Worldwide ambient air pollution accounts for:

- 29% of all deaths and disease from lung cancer
- 17% of all deaths and disease from acute lower respiratory infection
- 24% of all deaths from stroke
- 25% of all deaths and disease from ischaemic heart disease
- 43% of all deaths and disease from chronic obstructive pulmonary disease

One can imagine the enormous amount of expenditure on medical services, hospitalization and hardship to families on account of these diseases which are increasing every passing day. No reliable global study is available on this. However according to a study conducted by the World Bank in 2013; exposure to ambient and household air pollution cost the world's economy some \$5.11 trillion in welfare losses. In terms of magnitude, welfare losses in South Asia and East Asia and the Pacific were the equivalent of 7.4 percent and 7.5 percent of the regional gross domestic product (GDP), respectively (World Bank, 2016)

6.3 Global Warming and Climate Change:

Air contamination and diseases caused directly by such contamination is of course very important issue. However, far more important is the long-term ecological changes because of such contamination which could play havoc on life on the planet Earth. These concerns led to the Stockholm Conference on Human Environment in 1972 which gave birth to the United Nations Environment Programme (UNEP) gradually raising global environmental consciousness. Since the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, global warming and climate change are fairly high on global agenda. In a landmark development at Rio, negotiations on the United Nations Framework Convention on Climate Change (UNFCCC) were concluded. The Convention was opened for signatures on 4th June, 1992 and entered into force on 21st March, 1994. 24 Conferences of Parties to the Convention have been held so far, the last being in Poland in December 2018. Kyoto Protocol and The Paris Agreement are important landmarks in the journey of UNFCCC since 1994. As a result of these conferences and negotiations over international agreements the phrase 'global warming' has become familiar to many people. Is global warming a reality? If so what are the principal causes of global warming? Are human induced activities indeed altering the climate? Could they cause major ecological

disasters? These are some of the questions often asked. The Earth's climate system is highly complex and because human behavior and reaction to change is even more complex, providing answers to these questions is an enormous challenge to the world's scientists (Houghton, 1997).

6.3a Deforestation:

According to Richard Houghton, humans have over many centuries been exploiting the Earth and its resources. It was at the beginning of the Industrial Revolution some two hundred years ago that the potential of Earth's minerals began to be realized. Coal emerged as the main source of energy with other minerals like iron ore, zinc, copper and so on. Around 1960, oil took over from coal as the dominant world source of energy. Subsequently the Earth's biological and marine resources were also attacked with large scale deforestation for agriculture and human habitat and over exploitation of fisheries. Tropical forests are especially important as they are estimated to support half of Earth's biological species. These resources were laid down over millions of years but have been destroyed just over a few decades. In doing so, it seems that we are causing a rapid change in Earth's climate. Tropical deforestation, including both the permanent conversion of forests to croplands and pastures and the temporary or partial removal of forests for shifting cultivation and selective logging, is estimated to have released of the order of 15-35% of annual fossil fuel emissions during the 1990s. The magnitude of emissions depends on the rates of deforestation, the biomass of the forests deforested, and other reductions in biomass that result from forest use. If, in addition to carbon dioxide, one considers the emissions of methane, nitrous oxide, and other chemically reactive gases that result from deforestation and subsequent uses of the land, annual emissions during the 1990s accounted for about 25% of the total anthropogenic emissions of greenhouse gases (Houghton R, 2005 p.143).

According to the Environmental Defense Fund (EDF), a leading green group, 32 million acres of tropical rainforest were cut down each year between 2000 and 2009—and the pace of deforestation is only increasing. "Unless we change the present system that rewards forest destruction, forest clearing will put another 200 billion tons of carbon into the atmosphere in coming decades...," says EDF (The Press, 2014). Forests purify the air we breathe, help keep our water safe to drink, protect soil from erosion, provide us with timber and medical plants, and are home to 80% of the world's terrestrial biodiversity including many threatened and endangered

species. In addition, nearly 1.6 billion people all over the world depend on forests for their livelihoods, with 60 million indigenous people relying directly on forests for their living. Forests also help us tackle climate change by reducing the amount of greenhouse gases in the atmosphere. The Amazon, Earth's largest rainforest, lost 20% of its forest in the last 40 years due to human activities. The Island of Sumatra (Indonesia) lost 85% of its forests – mainly because of conversion for oil palm and pulp plantations. Many other forest areas across the planet are in the same danger including Russia's boreal forest and the Congo basin (Greentumble, 2015).

The global forest area fell by 129 million hectares (3.1 percent) in the period 1990–2015, to just under 4 billion hectares. There was a net forest loss of 7 million hectares per year in tropical countries in 2000–2010 and a net gain in agricultural land of 6 million hectares per year. The greatest net loss of forests and net gain in agricultural land over the period was in the low-income group of countries, where rural populations are growing. Large-scale commercial agriculture accounts for about 40 percent of deforestation in the tropics and subtropics. The challenge of feeding a global population projected to increase from more than 7 billion people today to more than 9 billion by 2050 is made more difficult by the threats of climate change, growing water and land scarcity, and soil and land degradation. This could lead to further deforestation in the coming decades. It is time for a change in consciousness – it is a fact that agriculture and forestry can no longer be treated in isolation. Linking the two is imperative for socioeconomic development in the 21st century (FAO, 2016 State of World's Forests).

6.3b IPCC Findings:

The Inter-Governmental Panel on Climate Change (IPCC) set up in 1988 to undertake credible scientific assessment on global warming and climate change is the key international body. Currently 195 UN member countries are members of IPCC. The Panel has developed a network with a wide range of international scientific institutions to collect, collate and synthesize data on global warming and climate change. Since 1988 IPCC has met 46 time, the last being in Alberta, Canada during March 5-7, 2018 and has presented five assessment reports so far. The fifth assessment report was presented in two parts in 2013 and 2014. The sixth report is under preparation and is likely to be presented in 2022 (IPCC, 2018). Since IPCC's reports are based on credible scientific data obtained from a variety of reputed institutions and observatories, they are

considered most authentic. For example, over 600 experts were appointed to collect and collate data for the Fourth Assessment Report. This report presented in 2007 states, **"warming of climate system is unequivocal as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global mean sea level."** In 2014 the Fifth Assessment Report of IPCC was made public which reconfirms these facts in no uncertain terms. The Report in its 'Foreword' itself confirms that human influence on the climate system is clear and growing, with impacts observed across all continents and oceans. Many of the observed changes since the 1950s are unprecedented over decades to millennia. **The IPCC is now 95 percent certain that human induced activities are the main cause of current global warming.** In addition, the Report finds that the more the human activities disrupt the climate, the greater the risks of severe, pervasive and irreversible impacts for people and ecosystems, and long-lasting changes in all components of the climate system.

6.3c Findings by NASA:

According to NASA the 10 warmest years in the 136-year record all have occurred since 2000 excepting 1998. Most of the warming occurred in the past 35 years, with 16 of the 17 warmest years on record occurring since 2001. 1998 and all the years of 21st century have been the warmest breaking all previous records. The year 2016 ranks as the warmest on record. Globally-averaged temperatures in 2016 were 1.78 degrees Fahrenheit (0.99 degrees Celsius) warmer than the mid-20th century mean (NASA, 2017).

Image 37.



Source: Climate Central

Temperatures measured on land and at sea for more than a century show that Earth's globally averaged surface temperature is rising. For the last 45 years, global surface temperature rose at an average rate of about 0.17° C (around 0.3° Fahrenheit) per decade—more than twice as fast as the 0.07° C per decade increase observed for the entire period of recorded observations (1880-2015). Although warming has not been uniform across the planet, the upward trend in the globally averaged temperature shows that more areas are warming than cooling. Since 1976, every year including 2015 has had an average global temperature warmer than the long-term average. Over this 38-year period, temperature warmed at an average of 0.50 °F (0.28 °C) per decade over land and 0.22 °F (0.12 °C) per decade over the ocean (NOAA, Climate Change, Global Temperatures, 2015).

Globally averaged surface temperatures have increased about 0.7 degree centigrade over the 20th century with the hottest year on average coming later and later. The average sea level has risen by an annual rate of nearly 2 mm since 1960, with the rate increasing to about 3 mm per year between 1993 and 2003. The increase is partly due to thermal expansion and partly due to melting glaciers and losses from the ice sheets of Greenland and Antarctica (Garvey, 2008).

According to an ongoing temperature analysis conducted by scientists at NASA's Goddard Institute for Space Studies (GISS), the average global temperature on earth has increased by about 0.8° Celsius (1.4° Fahrenheit) since 1880. Two-thirds of the warming has occurred since 1975. A one-degree global change is significant because it provides vast amount of heat to warm all the oceans, atmosphere, and land. In the past, a one- to two-degree drop was all it took to plunge the Earth into the Little Ice Age. A five-degree drop was enough to bury a large part of North America under a towering mass of ice 20,000 years ago (NASA, Global Observatory). Arctic sea ice reaches its minimum each September. September Arctic sea ice is now declining at a rate of 13.3 percent per decade, relative to the 1981 to 2010 average. The 2012 sea ice extent is the lowest in the satellite record. Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves (NASA, 2017).

6.4 Current Status:

The IPCC Synthesis Report "Climate Change, 2014" summarizes the current situation on global warming and climate change as SMP1 (Synthesis for Policy Makers1) as follows (IPCC, Climate Change, 2014)).

1. Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.

1.1 Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.

1.2 Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century.

1.3 In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.

1.4 Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions.

The Report further confirms the following:

- a. Each of the last three decades has been successively warmer at the earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere, where such assessment is possible. The globally averaged combined land and ocean surface temperature as calculated by a linear trend show a warming of 0.85 [0.65 to 1.06] °C over the period 1880 to 2012, when multiple independently produced data sets exist. The global oceans will continue to warm during the 21st century, with the strongest warming projected for the surface in tropical and Northern Hemisphere subtropical regions.
- b. Since the beginning of the industrial era, oceanic uptake of CO_2 has resulted in acidification of the ocean; the pH of ocean surface water has decreased by 0.1, corresponding to a 26% increase in acidity, measured as hydrogen ion concentration.
- c. Over the period 1992 to 2011, the Greenland and Antarctic ice sheets have been losing mass, likely at a larger rate over 2002 to 2011. Glaciers have continued to shrink almost worldwide. Northern Hemisphere spring snow cover has continued to decrease in extent. There is high confidence that permafrost temperatures have increased in most regions since the early 1980s in response to increased surface temperature and changing snow cover.
- d. The annual mean Arctic sea-ice extent decreased over the period 1979 to 2012, with a rate that was very likely in the range 3.5 to 4.1% per decade. Arctic sea-ice extent has decreased in every season and in every successive decade since 1979, with the most rapid decrease in decadal mean extent in summer. It is very likely that the annual mean

Antarctic sea-ice extent increased in the range of 1.2 to 1.8% per decade between 1979 and 2012. However, there is high confidence that there are strong regional differences in Antarctica, with extent increasing in some regions and decreasing in others.

- e. Over the period 1901 to 2010, global mean sea level rose by 0.19 [0.17 to 0.21] m. The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia.
- f. Evidence of observed climate change impacts is strongest and most comprehensive for natural systems. In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality. Many terrestrial, freshwater and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances and species interactions in response to ongoing climate change.
- g. Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability.

The above facts have been confirmed by several independent studies as well. According to European Environment Agency, "global climate change impacts Europe in many ways, including: changes in average and extreme temperature and precipitation, warmer oceans, rising sea level and shrinking snow and ice cover on land and at sea. These have led to a range of impacts on ecosystems, socio-economic sectors and human health (EEA, 2015). United States Environment Protection Agency has concluded that, "increased concentrations are expected to increase earth's average temperature, influence the patterns and amounts of precipitation, reduce ice and snow cover, as well as permafrost, raise sea level, increase the acidity of the oceans, increase the frequency, intensity, and/or duration of extreme events, shift ecosystem characteristics, and increase threats to human health. These changes will impact our food supply, water resources, infrastructure, ecosystems, and even our own health" (EPA, 2017). The National Geographic is of the view that "torrential hurricanes, devastating droughts, crippling ice storms, and raging heat waves—all are extreme weather phenomena that can claim lives and cause untold damage are likely to happen. Climate change influences severe weather by causing longer droughts and higher temperatures in some regions and more intense deluges in others, say climate experts. Among the most vulnerable are communities in exposed mountain and coastal regions. In those settings

worldwide, citizens are adjusting to new weather realities by strengthening warning, shelter, and protection systems (National Geographic, Climate Change, 2017).

These facts have also been confirmed by several scholars coming from different continents and cultures in their independent writings in a volume edited by Ernesto Zedillo, former President of Mexico (Zedillo, 2008). These writings include; The IPCC: Establishing the Evidence (Pachauri R.K.), Is the Global Warming Alarm Founded on Fact? (Lindzen Richard S.), Anthropogenic Climate Change: Revisiting the Facts (Rahmstorf Stefan), 'Dangerous' Climate Change: Key Vulnerabilities (Schneider Stephen H.), Controversies of Russian Climate Policy and Opportunities for Greenhouse Gas Reduction (Golub Alexander), Climate Policy in the United Kingdom (Dalton Howard), Canada's Approach to Tackling Climate Change (Stone John M.R.), India and Climate Change: Mitigation, Adaptation and a Way Forward (Parikh Jyoti) and Correct Choices for China: Energy Conservation, a Cyclic Economy, and a Conservation - Minded Society (Longhai Shen). Similarly, many other global scholars in their scientific writings contained in the edited volumes (Held, Hervey and Theros, 2011), (Gardiner et al., 2010) and (Biermann, Pattberg and Zelli, 2010) have confirmed these alarming facts and realities facing the humanity.

Well respected National Academies of the United States (a body consisting of the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine and the National Research Council) has stated, "the physical processes that cause climate change are scientifically well documented: both human activities and natural variability are contributing to global and regional warming. According to IPCC, whose documents are considered the most authoritative source for information on the 'state of the science' on climate change, it is very likely that most of the observed warming over the past 50 years is the result of increased greenhouse gases generated by human activities. Numerous expert reports from the National Research Council have supported this conclusion as well" (National Academies US, 2008).

The release of greenhouse gases has increased significantly since the Industrial Revolution, mostly from the burning of fossil fuels for energy, agriculture-particularly cattle breeding, industrial processes, and transportation. Carbon dioxide, a major greenhouse gas, is increasing in the atmosphere faster than at any time measured in the past, having grown by about 35 percent since 1850. Two other greenhouse gases, methane and nitrous oxide, are present in the atmosphere at much lower concentrations than carbon dioxide but have increased rapidly. Methane has

increased by 150 percent; which is 25 times more effective per molecule at trapping heat than carbon dioxide. Nitrous oxide, nearly 300 times more effective, has increased by more than 20 percent states the National Research Council, on "Ecological Impact of Climate Change" (National Academies US, 2008). The document further amplifies and reconfirms what IPCC has stated:

- a. A relatively rapid increase in temperature has been documented during the past century, both at earth's surface and in the oceans. The average surface temperature for Earth as a whole has risen some 1.3°F since 1850, the starting point for a global network of thermometers. If emission rates for greenhouse gases continue on their current track, models indicate that the globe will be 4.3 to 11.5°F warmer by 2100 than it was in 1990.
- b. Warmer temperatures not only cause glaciers and land ice to melt (adding more volume to oceans) but also cause seawater to expand in volume as it warms. The global average sea level rose by just under .07 inches per year during the 20th century, but that number has risen to .12 inches per year since the early 1990s. Under a "business-as-usual" greenhouse gas emissions scenario, models indicate that sea levels could rise 2 feet or more by 2100 compared to 1990 levels.
- c. Climate change may mean that some places will experience more days with very heavy rain; other places may see more frequent, intense, and long-lasting droughts. Warmer temperatures also mean higher evaporation rates and thirstier plants and people, increasing demands for water. A warmer world will experience more precipitation on a global scale, but the changes will not be the same everywhere. Projections indicate that on average dry areas will tend to get drier, and wet areas will tend to get wetter.
- d. Much of the carbon dioxide emitted by human activity has already been taken up by the ocean, thus moderating the increase of carbon dioxide in the atmosphere. However, as carbon dioxide dissolves in seawater, it forms carbonic acid, acidifying the ocean. Ocean acidification will cause serious harm to such treasured marine organisms as corals, lobsters, and sea urchins.
- e. It is considered very likely that increasing global temperatures will lead to higher maximum temperatures, more heat waves, and fewer cold days over most land areas. More severe drought in some areas, combined with other factors, has contributed to larger and more frequent wildfires.

Based on the above analysis it is crystal clear that global warming is a reality with far reaching and perhaps devastating consequences for the human life and the ecosystem as a whole. It is also unambiguously clear that human induced activities particularly since the industrial revolution are primarily responsible for global warming. We have a climate crisis. We don't mean the danger that human modifications of the earth atmosphere will modify the Earth's climate with grave consequences for people and the planet. Rather we see as the crisis the inadequacy of society's response to this threat (Jaeger et al., 2012).

6.5 Greenhouse Gases (GHG):

Greenhouse gases are those gases in the atmosphere which, by absorbing thermal radiation emitted by the Earth's surface have a blanketing effect upon it. Carbon dioxide is the most important of the greenhouse gases which are increasing in atmospheric concentration because of human activities (Houghton, 1997). Any warm object radiates energy in the form of electromagnetic waves. The hotter it is, the shorter the wavelength of its radiation. Radiation from the hot sun warms the Earth. Because the Earth is cooler, it emits long wavelength infrared radiation. The Earth's temperature is determined by the balance of incoming energy radiated by the sun and its own outgoing radiant energy.

Earth's atmosphere with its highly complex and delicate structure lets through incoming visible light from the sun, but absorbs some of the outgoing infrared radiation. The atmosphere thus acts like a blanket to keep the Earth at a temperature hospitable to life. After the last ice age until the industrial revolution the atmospheric temperature was fairly steady (Broome, 2012). Greenhouse gases – carbon dioxide, chlorofluorocarbons (CFCs), methane, nitrous oxide and ozone are relatively transparent to shortwave radiation but much more opaque to longwave permitting about half of sun's radiation to reach the Earth's surface but trapping 80 to 90 percent of outbound radiation from the Earth. This trapping influence is called "greenhouse effect" (Cline, 1992). The two most abundant gases in the atmosphere, nitrogen (comprising 78%) and oxygen (comprising 21%), exert almost no greenhouse effect. Instead, the greenhouse effect comes from molecules that are more complex and much less common. Water vapor is the most important greenhouse gas and carbon dioxide (CO_2) is the second-most important one. Methane, nitrous oxide, ozone and several other gases present in the atmosphere in small amounts also contribute to the greenhouse effect. Adding more of a greenhouse gas, such as CO_2 , to the atmosphere

intensifies the greenhouse effect, thus warming Earth's climate. The amount of warming depends on various feedback mechanisms (IPCC, 2014).

The world has experienced human induced changes in local, regional and global environment for much of the past 10,000 years, but most of that change has occurred during our life time (Our Common Journey, 1999). For several thousand years before the beginning of industrial revolution around 1750 a steady balance was maintained with mean value of concentration of carbon dioxide kept within about 280 parts per million (ppm) by volume. The Industrial Revolution disturbed this balance and has resulted in concentration of carbon dioxide to over 360 ppm by volume (Houghton, 1997). For a period of ten thousand years until the Industrial Revolution, concentration of carbon dioxide in the air was highly stable around 275 ppm which now stands around 390 ppm (Broome, 2012). The pre-industrial concentration of CO₂ was about 280 ppm which reached 340 in 1980 and is expected to double to 560 between the middle and the 21st century (WCED Report, 1987). Emissions from industrial and manufacturing processes, transportation, commercial agriculture and deforestation are the major contributors of greenhouse gases with maximum contribution coming from the industrial processes.

A factor capable of influencing climate, but not in a strict sense part of the natural climate system, is the effect of humans on climate, referred to as anthropogenic forcing. This forcing is an unintended by-product of agricultural, industrial and other human activities and it occurs mainly by way of additions to the atmosphere, materials such as carbon dioxide and other greenhouse gases, sulphate particles and soot (Ruddiman, 2008). The warming will be unequally distributed, more near the poles than near the equator because Earth's weather and climate are largely driven by temperature difference between the poles and the equator, wind, rain and the ocean currents will shift in strength and direction (Meadows et al., 1992). Anthropogenic greenhouse gas (GHG) emissions since the pre-industrial era have driven large increases in the atmospheric concentrations of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Between 1750 and 2011, cumulative anthropogenic CO₂ emissions to the atmosphere were 2040 ± 310 GtCO₂. About 40% of these emissions have remained in the atmosphere (880 ± 35 GtCO₂); the rest was removed from the atmosphere and stored on land (in plants and soils) and in the ocean. The ocean has absorbed about 30% of the emitted anthropogenic CO₂, causing ocean acidification. About half of the

anthropogenic CO₂ emissions between 1750 and 2011 have occurred in the last 40 years as shown in the graph below (IPCC, 2014).

Image 38.



Figure SPM.2 | Total annual anthropogenic greenhouse gas (GHG) emissions (gigatonne of CO₂-equivalent per year, GtCO₂-eq/yr) for the period 1970 to 2010 by gases: CO₂ from fossil fuel combustion and industrial processes; CO₂ from Forestry and Other Land Use (FOLU); methane (CH₄); nitrous oxide (N₂O); fluorinated gases covered under the Kyoto Protocol (F-gases). Right hand side shows 2010 emissions, using alternatively CO₂-equivalent emission weightings based on IPCC Second Assessment Report (SAR) and AR5 values. Unless otherwise stated, CO₂-equivalent emissions in this report include the basket of Kyoto gases (CO₂, CH₄, N₂O as well as F-gases) calculated based on 100-year Global Warming Potential (GWP₁₀₀) values from the SAR (see Glossary). Using the most recent GWP₁₀₀ values from the AR5 (right-hand bars) would result in higher total annual GHG emissions (52 GtCO₂-eq/yr) from an increased contribution of methane, but does not change the long-term trend significantly. [Figure 1.6, Box 3.2]

Source: IPCC Climate Change 2014. Synthesis Report.

Total anthropogenic greenhouse gas emissions have continued to increase over 1970 to 2010 with larger absolute increases between 2000 and 2010, despite a growing number of climate change mitigation policies. Anthropogenic greenhouse gas emissions in 2010 have reached 49 ± 4.5 GtCO₂-eq/yr. Emissions of CO₂ from fossil fuel combustion and industrial processes contributed about 78% of the total greenhouse gas emissions increase from 1970 to 2010, with a similar percentage contribution for the increase during the period 2000 to 2010 as shown in the graph below. Globally, economic and population growth continued to be the most important drivers of increases in CO₂ emissions from fossil fuel combustion. The contribution of population growth between 2000 and 2010 remained roughly identical to the previous three decades, while

the contribution of economic growth has risen sharply. Increased use of coal has reversed the longstanding trend of gradual decarburization (IPCC, 2014).

Image 39.



Source: IPCC Climate Change 2014. Synthesis Report.

6.6 Relative Discharge of Greenhouse Gases:

Globally industry accounted for 21 percent of total greenhouse gas emissions, electricity and heat production for another 25 percent, transportation accounted for 14 percent and agriculture and forestry about 24 percent (IPCC, 2014). Hence burning of coal, natural gas and oil for electricity, heating and for manufacturing is the single most important source of greenhouse gases. Manufacturing sector also includes emissions from chemical, metallurgical, and mineral transformation processes not associated with energy consumption and emissions from waste management activities. Deforestation, livestock and commercial crop production are also significant contributors. Nowadays, motor vehicles discharge 900 million tons of carbon dioxide a year - about 15 per cent of our total output. More vehicles can make more global warming. If numbers of automobiles keep increasing at the current rate, it will be more than two billion vehicles on the road by 2025 with far more discharge of carbon dioxide.

Image 40.





In terms of individual greenhouse gases discharged in Earth's atmosphere carbon dioxide remains dominant, accounting for 76 percent of total greenhouse emissions. Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions. Fossil fuel used for power plants, manufacturing, agriculture and domestic use is the major source of carbon dioxide. CO₂ can also be emitted from direct human-induced impacts on forestry and other land use, such as through deforestation, land clearing for agriculture, and degradation of soils. If we look at the trend of the global carbon emissions from fossil fuels, they have registered significant increase since 1900. Since 1970, CO₂ emissions have increased by about 90 percent, with emissions from fossil fuel combustion and industrial processes contributing about 78 percent of the total greenhouse gas emissions increase from 1970 to 2011. Methane, accounting for 16 percent of the greenhouse

gases, is emitted during the production and transport of coal, natural gas, and oil. Methane, emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills (EPA, 2017).



Image 41.



In terms of national entities in 2011, the top carbon dioxide (CO_2) emitters were China, the United States, the European Union, India, the Russian Federation, Japan, and Canada. China, United States and European Union accounted for 54 percent of global CO_2 emissions. India and Russia accounted for 6 percent each. Brazil, Mexico and Indonesia are other major emitters of CO_2 . These data include CO_2 emissions from fossil fuel combustion, as well as cement manufacturing and gas flaring but exclude emissions and sinks related to changes in land use (EPA, 2017).

Image 42.



Source quoted by EPA: Boden, T.A., Marland, G., and Andres, R.J. (2015). National CO₂ Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2011, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, doi 10.3334/CDIAC/00001_V2015.

The emission statistics given above are for absolute total emissions. The picture changes considerably if we take into account the population of the country concerned. Per capita emission of greenhouse gas from the developed countries is far too high; in fact, manifold compared to those of the developing world. These relative figures for 2011 are given in the following chart taken from the National Resource Institute 2011.

Image 43.



Per Capita Emissions for Top 10 Emitters

6.7 Challenges of Climate Change:

"We have a full repairing lease on the Earth. With the work of the IPCC, we can now say we have a surveyor report; and it shows there are faults and that the repair work needs to start without delay. The problems do not lie in the future, they are here and now: and it is our children and grandchildren who are already growing up, who will be affected."

> Margaret Thatcher, Former British Prime Minister (Quoted Houghton, 2009)

Over the past 150 years, we have changed the balance of our planet by living beyond our means. We have burnt huge amounts of fossil fuels (such as coal, oil, and gas), bred huge amounts of methane-producing livestock and cut down vast swathes of forests, which would naturally absorb carbon dioxide from the air. Therefore, we are facing the biggest environment challenge of our time (WWF, 2016). Assessment of future impact of global warming and climate change is not an easy task as the functioning of nature is highly complex matrix. However, there is a consensus that climate change will further aggravate the problems of soil erosion, water pollution, air contamination and ecosystem through erratic weather patterns endangering the existence of life on the Earth. Based on the current trends in Earth's climate, erratic weather patterns and depleting

Source: World Resource Institute

natural resources the scientific community has arrived at fairly accurate assessment of what lies ahead. Let us have a brief look at the future trends.

IPCC 5th Assessment Report based on the contribution of over 600 scientists from all over the world confirms these facts stating that the surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise. Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gases are stopped. The risks of abrupt or irreversible changes increase as the magnitude of the warming increases. Future climate will depend on committed warming caused by past anthropogenic emissions, as well as future anthropogenic emissions and natural climate variability. However, it is virtually certain that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales, as global mean surface temperature increases (IPCC, 2014).

Image 44.



Scientific Consensus: Earth's climate is warming

Temperature data from four international science institutions. All show rapid warming in the past few decades and that the last decade has been the warmest on record. Data sources: NASA's Goddard Institute for Space Studies, NOAA National Climatic Data Center, Met Office Hadley Centre/Climatic Research Unit and the Japanese Meteorological Agency. Source: NASA Website

IPCC 5th Report has projected the following scenarios for rise in temperatures and rise in sea levels from 2006 to 2100 as determined by multi-model simulations. All changes are relative to 1986–2005. Time series of projections and a measure of uncertainty (shading) are shown for scenarios RCP2.6 (blue) and RCP8.5 (red). The mean and associated uncertainties averaged over 2081–2100 are given for all RCP scenarios as colored vertical bars at the right-hand side of each panel. The number of Coupled Model Inter-comparison Project Phase 5 (CMIP5) models used to calculate the multi-model mean is indicated.

Image 45.



Source: IPCC 5th Assessment Report, 2014.

All the scientific studies therefore clearly indicate considerable rise in temperatures and sea levels during the coming decades. This would mean thousands of islands will be submerged, glaciers will continue to deplete, rivers and lakes will gradually dry up and erratic weather patterns will result in massive flooding in some parts while severe droughts in others. These changes will have serious adverse effect on fresh water supplies, ground water aquifers, agriculture and ecosystem as a whole. These changes are also likely to have serious and far reaching impact on human health and survival due to new and more persistent variety of diseases.

Chapter 7

Conferences, Declarations and Agreements

7.1 Historical Perspective:

The concept of sustainable development is as old as human existence. It has engaged human mind since times immemorial giving birth to the idea of 'peaceful co-existence' with nature. However in the recent decades, large scale industrialization and mechanization; unprecedented increase in production and consumption; massive increase in use of Earth's natural resources; increasing use of chemicals and pesticides; growing contamination of air, water bodies and soil; large-scale emission of greenhouse gases and global warming; massive deforestation and loss of bio-diversity; decline of rural industries with increasing poverty and economic inequalities; and steady migration to cities with large slums have added a new dimension to this issue during the last few decades, particularly since 1950s. In this context, we shall have a brief look at the collective efforts of the international community in the form of international conferences, negotiations and declarations to mitigate global warming and their impact so far.

The recent history of sustainable development goes back to early 1960s. Silent Spring by Rachel Carlson first published in September 1962 documented the detrimental effects of indiscriminate use of chemicals and pesticides (Carlson, 1962). The book became an instant hit and eventually led to establishment of US Environmental Protection Agency (EPA) in December 1970. In September 1968 United Nations Educational Scientific and Cultural Organization (UNESCO) organized the first ever International Conference on the Biosphere in Paris to deal with "the rational use and conservation of the resources of the biosphere". More than 300 delegates from 60 countries took part in this conference (UNESCO, MAB, 1993). This Conference led to the setting up of UNESCO's Programme on Man and Biosphere.

In the same year, 1968, Paul Ehrlich professor at Stanford University wrote his best seller 'The Population Bomb' highlighting the detrimental effects of population growth, toxification of the Earth through chemicals and over use of resources (Ehrlich, 1968). For the first time he advocated that population should be counted in terms of numbers and consumption put together when he said "America is the world's most overpopulated country. While only the third most populous, we use far more resources than any other country, and thus, in terms of impact, we have the largest footprint." In 1969 a citizen movement in the form of "Friends of the Earth" was launched with the objective that the natural resources are used in a fair way so that all people can lead healthy, fulfilling lives, and breathe clean air, drink clean water and enjoy a stable climate (Friends of the Earth). Subsequently the First Earth Day was observed on 22 April, 1970 in the United States which eventually gave rise to the Earth Day Network spreading over 196 countries. Since then the Earth Day is observed every year on April, 22. This was followed by the Greenpeace Movement in Canada and the International Institute for Environment and Development in UK in 1971.

Starting 1972, a spate of international conferences and declarations have taken place on sustainable development and climate change. It is not my intention to go into the details of each of these conferences and declarations as they are too numerous. Nevertheless, in the following sections I shall summarize the important international conferences, declarations and treaties. This brief analysis will make it clear that despite innumerable international conferences, declarations, treaties and plethora of other documentation; march towards sustainability has been fairly limited as the nations have been hesitant to take hard decision that can make visible difference on the ground.

7.2 Stockholm Conference on Human Environment 1972:

At global level need for harmony between environment and development was first acknowledged in the 1972 Stockholm Conference on Human Environment. The conference initiated by the United Nations General Assembly and attended by 114 countries; adopted a declaration, a plan of action and a resolution on institutional and financial arrangements in addition to several other resolutions and led to the establishment of United Nations Environment Programme (UNEP). Many developing countries at the conference were of the view that environment was another ploy by the developed world to hamper development and perpetuate poverty in the developing countries after decades of colonization. Nevertheless, almost all the speakers expressed serious concern over ruthless exploitation of nature and contamination of environment.

Indian Prime Minister Indira Gandhi echoed this sentiment when she said: "One cannot be truly human and civilized unless one looks upon not only all fellow-men but all creation with the eyes of a friend. Throughout India, edicts carved on rocks and iron pillars are reminders that 22 centuries ago the Emperor Ashoka defined a King's duty as not merely to protect citizens and punish wrongdoers but also to preserve animal life and forest trees." She further added, "It is said

that in country after country, progress should become synonymous with an assault on nature. We, who are a part of nature and dependent on her for very need, speak constantly about "exploiting" nature. Life is one and the world is one, and all these questions are inter-linked" (Indira Gandhi at Stockholm Conference, 1972). The conference adopted 26 principles and 109 recommendations including setting up of an environment fund. The first six principles adopted at the conference form core of the declaration. They are as follows (United Nations Conference on Human Environment, 1972).

1. Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations. In this respect, policies promoting or perpetuating apartheid, racial segregation, discrimination, colonial and other forms of oppression and foreign domination stand condemned and must be eliminated.

2. The natural resources of the Earth, including the air, water, land, flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate.

3. Man has a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat, which are now gravely imperiled by a combination of adverse factors. Nature conservation, including wildlife, must therefore receive importance in planning for economic development.

4. The non-renewable resources of the Earth must be employed in such a way as to guard against the danger of their future exhaustion and to ensure that benefits from such employment are shared by all mankind.

5. The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems. The just struggle of the peoples of all countries against pollution should be supported.

7.3 Enhanced Awareness:

The conference succeeded in raising the awareness on the urgent need to protect the environment. The Club of Rome came out with a publication titled "The Limits to Growth" highlighting the earth's interlocking resources – the global system of nature in which we all live – probably cannot support present rates of economic and population growth much beyond the year 2100, if that long, even with advanced technology and that piecemeal approaches to solving the individual problems will not be successful (Meadows et al., 1972). In 1973 Chipko movement was born in India in response to deforestation and environmental degradation. The tribal women resisted deforestation by embracing the trees like their own children. Women spent sleepless nights in guarding the trees. Some notable names of those who led the movement include, Sarala Behn, Mira Behn, Gopeswar, Sundarlal Bahuguna and Chandi Prasad Bhatt. This movement initiated by tribal women influenced preservation of forests and women's participation in environmental issues. In 1970s environmental laws were enacted in many countries and the ministries of environment or environmental agencies were set up around the world. The US Government enacted endangered species act in 1973. Greenbelt movement was launched in Kenya in 1977.

In 1977 the United Nations World Conference on Desertification recognized that land degradation/desertification is a major economic, social and environmental problem of concern to many countries in all regions of the world. The Conference therefore adopted a comprehensive Plan of Action to Combat Desertification (United Nations Conference on Desertification, 1977). In 1980 the International Union for Conservation of Nature and Natural Resources (IUCN) came out with the World Conservation Strategy highlighting the inter-dependence between the ecosystem and human existence (IUCN, 1980, p.14). The Strategy particularly highlights the urgent need for maintenance of essential ecological processes and life support systems, preservation of genetic diversity and sustainable utilization of species and ecosystems. The United Nations Convention on the Law of the Sea (UNCLOS) was adopted in 1982 and was opened for signatures in December 1982. Apart from legal acceptance of 12 nautical miles of territorial sea and 200 nautical miles of exclusive economic zone the Convention calls for transfer of technology from developed to developing nations and requires parties to the Convention to adopt regulations and laws to control pollution of the marine environment. The UNCLOS calls for, "the prevention, reduction and control of pollution and hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, with particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging,

excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to human activities" (UNCLOS). Dumping of specified waste, including radioactive waste are prohibited without permission of identified authority under the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matters (1972 Convention on Prevention of Marine Pollution, United Nations – Treaty Series).

7.4 World Charter for Nature:

In 1982 the United Nations General Assembly adopted the World Charter for Nature stating that mankind is a part of nature and life depends on the uninterrupted functioning of natural systems which ensure the supply of energy and nutrients. The Charter specifically states the following (United Nations World Charter for Nature, 1982):

1. Nature shall be respected and its essential processes shall not be impaired.

2. The genetic viability on the Earth shall not be compromised; the population levels of all life forms, wild and domesticated, must be at least sufficient for their survival, and to this end necessary habitats shall be safeguarded.

3. All areas of the Earth, both land and sea shall be subject to these principles of conservation; special protection shall be given to unique areas, to representative samples of all the different types of ecosystems and to the habitats of rare or endangered species.

4. Ecosystems and organisms, as well as the land, marine and atmospheric resources that are utilized by man, shall be managed to achieve and maintain optimum sustainable productivity, but not in such a way as to endanger the integrity of those other ecosystems or species with which they coexist.

7.5 World Commission on Environment and Development (WCED):

Despite growing environmental awareness since early 1970s and many international declarations to contain environmental damage; degradation of environment and over- exploitation of natural resources continued unabated. A new generation of environmental worries - global warming, deforestation, species loss, and toxic wastes - had begun to capture scientific and popular attention. The world's natural resources were being rapidly depleted, often in the name of development, but the poverty this development was supposed to correct, was as widespread as

ever. Thus, in order to contain the fast-growing environmental damage and to unite the nations to raise collective voice against such degradation, the UN General Assembly decided in 1982 to set up the World Commission on Environment and Development (WCED). Former Prime Minister of Norway Gro Harlem Brundtland was chosen as the chair of the commission by the then Secretary General of the United Nations Javier Perez de Cuellar in December 1983. The Commission first met in October 1984 and was officially dissolved in December 1987 after presentation of its report titled "Our Common Future", also known as the Brundtland Report (WCED, 1987). As recorded by the Commission in its report; even during the functioning of the Commission for less than 3 years the following major environmental crises occurred.

- a. A major drought triggered environment-development crisis in Africa putting 35 million people at risk and killing about a million.
- b. A leak from a pesticide factory in Bhopal, India killed more than 2000 (the actual number was estimated to over 5000) people and blinding and permanently incapacitating over 200,000 more.
- c. A liquid gas tank exploded in Mexico City, killing 1000 and leaving thousands more homeless.
- d. The Chernobyl nuclear reactor explosion leading to evacuation of 500,000 people in a radius of 30 kilometers, sent nuclear fallout across Europe increasing the risk of future human cancers.
- e. Agriculture chemicals, solvents and mercury flowed into the Rhine River during a warehouse fire in Switzerland, killing millions of fish and threatening drinking water supply in Germany and the Netherlands.
- f. An estimated 60 million people died of diarrheal diseases related to unsafe drinking water and malnutrition; most of the victims were children.

While the Commission presented a comprehensive report on all aspects of development and environment, a short gist of the main findings of the Commission are as follows.

1. The report officially defined sustainable development for the first time "as development that meets the needs of the present without compromising the ability of the future generations to meet their own needs". And by doing so, it awoke the public to the idea that mankind had to think of the generations to come and the world they would live in.
2. Since the stakes are high and consequences transcend the national boundaries, the report emphasized the need for a globally coordinated political action and responsibility. It called for the return to multilateralism and advocated for setting-up of an international conference to review progress made, and to promote follow up arrangements that will be needed to set environmental benchmarks and to maintain human progress.

3. Despite unprecedented economic growth, scientific innovations and industrialization since 1950; there were more hungry people in the world than ever before and that the numbers were increasing. Similarly, the number of people without supply of safe drinking water and habitable homes was the highest ever in the human history. Moreover, the gap between the rich and the poor was constantly rising.

4. Each year over 6 million hectares of productive land turns into worthless desert. Over three decades this would amount to an area as large as Saudi Arabia. More than 11 million hectares of forests are destroyed annually. In three decades this would roughly equal to the size of India. The Commission also pointed out the increasing acidification of soil and oceans.

5. The per capita consumption of energy in the industrialized countries is over 80 times compared to sub-Saharan Africa and about a quarter of the world's population consumes three-quarters of world's primary energy. Large emission of greenhouse gases coupled with deforestation was causing global warming; already inundating low lying coastal cities and river deltas. 1986 discovery of hole in ozone layer above the Antarctic suggest the possibility faster global warming and rapid depletion of glaciers and ice caps globally. Risks of climate change are indeed real and very high.

6. Species and natural eco-system are vital for human survival and welfare. Habitat alteration and species extinction are serious ecological threats and in long run could threaten the existence of life itself. The human-induced causes have accelerated the extinction rate of species by hundreds of time.

7. The report highlighted the need for distributive justice when it says that sustainable development involves more than growth. It requires a change in the content of growth to

make it less material and energy-intensive and more equitable in its impact. Economic development is unsustainable when it increases vulnerability and crises.

Thus, the Commission highlighted the excessive exploitation of natural resources, increasing poverty and hunger despite unprecedented economic growth since 1950 and growing contamination of air, water and soil, global warming due to excessive release of greenhouse gases, human induced damage to eco-system and the trends of climate change. This was indeed a landmark report on sustainability and development and the first ever comprehensive report on this subject at international level. As a follow-up of this report the United Nations Conference on Environment and Development (also known as the Earth Summit) was held in Rio de Janeiro in 1992 (UNCED, 1992).

7.6 Inter-governmental Panel on Climate Change (IPCC):

In yet another landmark development, the Inter-Governmental Panel of Climate Change was set up in 1988. It was first established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) and later endorsed by the United Nations General Assembly through Resolution 43/53. Membership of the IPCC is open to all members of the WMO and UNEP. The Intergovernmental Panel on Climate Change (IPCC) is the principal international scientific body for the assessment of human induced environmental degradation and to provide the world with a clear scientific view on the current state of knowledge on environmental degradation and climate change and its socio-economic impacts. Around the same time the 1988 Montreal Protocol on Substances that Deplete the Ozone Layer; and the 1989 Basel Convention on Trans-Boundary Movements of Hazardous Wastes were signed.

As mentioned earlier, the IPCC produces reports that support the United Nations Framework Convention on Climate Change (UNFCCC), which is the principal international convention on climate change. The ultimate objective of the UNFCCC is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent further global warming through human induced activities. IPCC has presented five Assessment Reports so far. The 5th Assessment Report of IPCC on Climate Change was submitted in 2014 which provides an alarming picture on emission of greenhouse gases and changes in the Earth's climate. Some of the important findings of this report have been covered in Chapter 5 (IPCC, 2014. Climate Change 2014: Synthesis Report).

7.7 United Nations Conference on Environment and Development (UNCED):

Based on the recommendations of the Brundtland Commission, the United Nations Conference on Environment and Development (UNCED), better known as the Earth Summit, was held at Rio de Janeiro, Brazil (June 3-14, 1992), to reconcile worldwide economic development with protection of the environment. Until then the Earth Summit was the largest gathering of world leaders in history, with 117 heads of state and representatives of 178 nations in all attending the conference. UNCED deliberated and addressed environmental issues, such as the protection of air, land and water; conservation of biological diversity, forests, and natural resources; and sound management of wastes and use of new technologies. It was a unique opportunity for world leaders to curtail the human activities that are threatening our planet and bringing about pollution of land, water bodies and atmosphere, drought, desertification through land degradation, thinning of the ozone layer, global warming and the threat of rising sea levels, and the extinction of plant and animal species (Commonwealth Currents, June/July 1992). Also included were the concerns that have led to serious differences between countries of the North and the South: patterns of development that cause stress to the environment, poverty in developing countries, economic growth, unsustainable patterns of consumption, and demographic pressures and their impact on the international economy. The following major documents were adopted at the conference.

- 1. Agenda 21.
- 2. United Nations Framework Conference on Climate Change (UNFCCC).
- 3. United Nations Convention on Biodiversity.
- 4. United Nations Convention to Combat Desertification.

5. Rio Declaration (a non-binding statement of broad principles for environmental policy).

Agenda 21 was the major overall document coming out of Rio and was devised to deal with some of the fundamental problems of resource degradation and aid to the developing countries. It addresses many issues with respect to global sustainability and includes core chapters related to financing, the implementation of technology transfer and institutional follow-up. The primary goal of Agenda 21 is to ensure that development proceeds in a sustainable manner with "the system of incentives and penalties to reorient and motivate economic behavior towards sustainability." Another goal is to ultimately eliminate poverty throughout the world through better

management of energy and natural resources and improvement of the quality of life by ensuring access to food, shelter and clean water. Agenda 21 also attempts to achieve the sustainable use of global and regional resources such as atmosphere, oceans, seas and fresh water, and marine organisms. The other important goal is for improved management of chemicals and treatment of sewage and solid wastes.

Technology transfer, forest protection and financing were contentious issues. These were resolved superficially by changing the language of the text but without any definitive outcome. The developing countries suspected that the preservation of their forests is advocated only so that these can act as a sink for the carbon dioxide produced in the West. In general, the countries of the South were reluctant to hamper their economic growth with the environmental restrictions urged upon them by the North unless they received increased financial aid, which they claimed would help make environmentally sound growth possible (Encyclopedia Britannica, 1998). Most countries wanted the establishment of a new UN monitoring agency to be called the Commission for Sustainable Development. This was finally agreed to but without any specific details. No minimum amount to fund various activities under Agenda 21 was agreed to. Therefore, although this is a comprehensive document spread over 351 pages with 40 chapters the critical issues were left without any satisfactory solution and financial commitment. The following are some of the important paragraphs defining the core issues (Agenda 21):

- 1. Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can in a global partnership for sustainable development (Preamble, para 1).
- 2. Poverty is a complex multi-dimensional problem with origins in both the national and international domains. No uniform solution can be found for global application. Rather, country-specific programs to tackle poverty and international efforts supporting national efforts, as well as the parallel process of creating a supportive international environment,

are crucial for a solution to this problem. The eradication of poverty and hunger, greater equity in income distribution and human resource development remain major challenges everywhere. The struggle against poverty is the shared responsibility of all countries (Chapter 3, para 1).

- 3. While managing resources sustainably, an environmental policy that focuses mainly on the conservation and protection of resources must take due account of those who depend on the resources for their livelihoods. Otherwise it could have an adverse impact both on poverty and on chances for long-term success in resource and environmental conservation. Equally, a development policy that focuses mainly on increasing the production of goods without addressing the sustainability of the resources on which production is based will sooner or later run into declining productivity, which could also have an adverse impact on poverty. A specific anti-poverty strategy is therefore one of the basic conditions for ensuring sustainable development. An effective strategy for tackling the problems of poverty, development and environment simultaneously; should begin by focusing on resources, production and people and should cover demographic issues, enhanced health care and education, the rights of women, the role of youth and of indigenous people and local communities and a democratic participation process in association with improved governance (Chapter 3, para 2).
- 4. Poverty and environmental degradation are closely interrelated. While poverty results in certain kinds of environmental stress, the major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialized countries, which is a matter of grave concern, aggravating poverty and imbalances (Chapter 4, para 3).
- 5. The growth of world population and production combined with unsustainable consumption patterns places increasingly severe stress on the life-supporting capacities of our planet. These interactive processes affect the use of land, water, air, energy and other resources. Rapidly growing cities, unless well-managed, face major environmental problems. The increase in both the number and size of cities calls for greater attention to issues of local government and municipal management. The human dimensions are key elements to consider in this intricate set of relationships and they should be adequately taken into consideration in comprehensive policies for sustainable development. Such

policies should address the linkages of demographic trends and factors, resource use, appropriate technology dissemination, and development. Population policy should also recognize the role played by human beings in environmental and development concerns. There is a need to increase awareness of this issue among decision makers at all levels and to provide both better information on which to base national and international policies and a framework against which to interpret this information (Chapter 5, para 3).

At UNCED, more than 130 nations signed the United Nations Framework Convention on Climate Change (UNFCCC). The ultimate objective of this convention is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. The main principles of this convention state that the developed world must take the lead in combating climate change and its adverse effects. The Intergovernmental Panel on Climate Change (IPCC) predicts that if present emission trends for greenhouse gases continue, the average global temperature will increase by 1.5-4.5° C during the second half of 21st century (IPCC, 2014, Climate Change: Synthesis Report, 2014 SPM 2.2). The key elements of the convention are: new and additional financial resources to meet convention goals; promotion of transfer of technology to developing countries; and an institutional mechanism to enable the international community to manage the climate change problem over the long-term, working with the Intergovernmental Panel on Climate Change.

The UN Convention on Biodiversity was a global attempt to address extinction of species and deforestation through human induced activities. Conservation of biodiversity is more than an aesthetic or moral issue; it is integral to our health and economy. Species loss threatens the natural resources upon which sustainable development depends. Genetic material from plant and animal species (many still undiscovered) is the foundation for the agricultural, pharmaceutical and other biotechnology-based industries. It is estimated that one-quarter of all the pharmacological products used in North America contain ingredients derived from wild plants. Biodiversity is integral to the maintenance of the environment and supports water purification, soil production, carbon cycling and oxygen production. The UN Convention to Combat Desertification proposes to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability. As mandated at Rio, after further international negotiations the Convention, was adopted in Paris, France on 17 June 1994 and entered into force in December 1996. It has been ratified by 195 countries. Secretariat of the Convention is located in Bonn, Germany. It is the only internationally legally binding framework set up to address the problem of desertification.

Thus, by all accounts the Earth Summit in Rio was a historic event. Apart from the declarations and new institutions, the Summit triggered a new sense of awareness and urgency to all issues concerning economic development and environmental protection. Governments, civil society and NGOs became more active than ever before. Commission on Sustainable Development set up at UN in December 1992, started monitoring the implementation of various agreements and declarations.

7.8 World Summit on Sustainable Development (WSSD):

Ten years later the United Nations World Summit on Sustainable Development (WSSD), also known as Earth Summit II or Rio+10, took place in Johannesburg, South Africa between August 26th and September 4th 2002. The Summit was attended by 187 countries and over 100 heads of governments and a large number of civil society representatives and NGOs. US participation was at a comparatively low level. While reviewing the performance since the Earth Summit in Rio, the Summit leaders noted with great disappointment that the record of moving towards sustainability appeared to have been quite poor and the vast majority of humanity still lacked access to basics such as clean water, adequate sanitation, housing and electricity. On the other hand, the concentration of wealth continues in fewer and fewer hands creating more disparity between the rich and the poor. While relatively modest in its achievements, and with difficulties in achieving consensus in key areas such as energy, trade, finance and globalization, WSSD nevertheless succeeded in placing sustainable development back on the political agenda, giving new impetus, in particular to the environment and development needs of Africa, with a strong

focus on local issues like household energy, water and sanitation. Health was singled out as one of five priority areas, along with water, energy, agriculture and biodiversity, and was devoted a separate chapter in the Plan of Implementation. The major outcomes of WSSD included a negotiated Plan of Implementation, a Political Declaration and a number of sustainable development partnerships and initiatives concluded on bilateral or regional basis. The Political Declaration of the Summit made the following the important points (WSSD, 2002):

- 1. The deep fault line that divides human society between the rich and the poor and the everincreasing gap between the developed and developing worlds pose a major threat to global prosperity, security and stability.
- 2. The global environment continues to suffer. Loss of biodiversity continues, fish stocks continue to be depleted, desertification claims more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating, and developing countries more vulnerable, and air, water and marine pollution continue to rob millions of a decent life.
- 3. Globalization has added a new dimension to these challenges. The rapid integration of markets, mobility of capital and significant increases in investment flows around the world have opened new challenges and opportunities for the pursuit of sustainable development. But the benefits and costs of globalization are unevenly distributed, with developing countries facing special difficulties in meeting this challenge.

Considering the outcome, the WSSD was a moderately successful event. Except for agreement in principle on broad issues, no specific targets or action plans were agreed upon. However, the Summit reaffirmed commitment to eradication of poverty and need for sustainable development and regretted poor achievements thus far.

7.9 Millennium Development Goals (MDGs):

Separately to mark the beginning of new millennium, a Summit meeting of Heads of Governments was held at UN Headquarters in New York in September 2000 where UNGA adopted about 60 new goals including 8 Millennium Development Goals (MDGs). These eight goals were: eradication of extreme poverty and hunger, universal primary education, gender equality and empowerment of women, reduction in child mortality, improved maternal health, combating HIV/AIDS, malaria and other diseases, environmental sustainability, and global

partnership for development. These 8 MDGs became the global agenda for 15 years to tackle the indignity of poverty and hunger until 2015 (Millennium Project, 2002-2006). United Nations Millennium Development Goals Report 2015 claims good progress on some of these goals.

According to this report; extreme poverty was down from 1.75 billion in 1999 to 834 million in 2015, primary school enrolment went up from 83 percent in 2000 to 91 percent on 2015 and dropout rate has fallen to almost half. Many more girls are going to school and are joining work force compared to before and child mortality (under 5 years) has declined to 43 per 1000 in 2015 compared to 90 in 1990. The number of people in the working middle class—living on more than \$4 a day—has almost tripled between 1991 and 2015. This group now makes up half the workforce in the developing regions, up from just 18 per cent in 1991. The global under-five mortality rate has declined by more than half, dropping from 90 to 43 deaths per 1,000 live births between 1990 and 2015. Worldwide, 2.1 billion people have gained access to improved sanitation. The proportion of people practicing open defecation has fallen almost by half since 1990. The proportion of urban population living in slums in the developing regions fell from approximately 39.4 per cent in 2000 to 29.7 per cent in 2014.

The report also claims considerable decline in malaria, HIV/AIDS and other diseases. Country specific data reveal that most of this progress has been possible due to reduction in poverty and illiteracy in China and India during the last two decades. Progress in other regions has been fairly limited. The following chart taken from the Millennium Development Goals.

Image 46.



Number of people living on less than \$1.25 a day

Source: UN Millennium Development Goals Report, 2015.

Report, 2015 provides a comparative study of decline in poverty between 1990 and 2015. However, it must be noted here that the chart given above is based on US\$1.25 as cut off for extreme poverty as against US\$1.90 which is the new cut-off point for extreme poverty decided by the World Bank since 2015. At the new cut-off rate number of extremely poor people will be much higher.

On the negative side, the report admits continued and rapid deterioration of environment as given in the chart below. According to the report "global emissions of carbon dioxide have increased by over 50 per cent since 1990. Addressing the unabated rise in greenhouse gas emissions and the resulting likely impacts of climate change, such as altered ecosystems, weather extremes and risks to society, remains an urgent, critical challenge for the global community. An estimated 5.2 million hectares of forests were lost in 2010, an area about the size of Costa Rica. Overexploitation of marine fish stocks led to declines in the percentage of stocks within safe biological limits, down from 90 per cent in 1974 to 71 per cent in 2011. Species are declining overall in numbers and distribution. This means they are increasingly threatened with extinction. Water scarcity affects 40 per cent of people in the world and is projected to increase. Poor people's livelihoods are more directly tied to natural resources, and as they often live in the most vulnerable areas, they suffer the most from environmental degradation. In 2012, average emissions from the

developed regions were about 10 metric tons of carbon dioxide per person per year, compared to about 3 metric tons in the developing regions" (Millennium Development Goals Report, 2015).

Image 47.



Source: UN Millennium Development Goals Report, 2015.

The above chart presents a very dismal picture as complete disregard for nature continues unabated despite many declarations and treaties putting the future of humanity at risk. In fact, the achievement on poverty reduction could be short-lived if disregard for nature continues as natural disasters can wipe out these gains over night.

7.10 United Nations Conference on Sustainable Development (UNCSD) Rio+20:

20 years after the Earth Summit in Rio, United Nations Conference on Sustainable Development (Rio+20) was held in Rio de Janeiro. The discussion during the conference focused on two main themes; (1) how to build green economy to achieve sustainable development and lift people out of poverty and (2) how to improve international coordination on sustainable development. More than US\$513 billion were pledged to build a sustainable future (UNCSD, 2012).

The conference acknowledged that the continuing problems of hunger, poverty, malnutrition, depleting biodiversity and rising emissions of greenhouse gases even after 20 years of the Earth Summit and adopted a modest set of proposals in a document titled "The Future We Want". The document did little more than to endorse ongoing efforts at the UN system, without new commitments or setting any binding time tables for the existing ones. Paragraph 4 which forms core of the document states, "We recognize that poverty eradication, changing unsustainable and promoting sustainable patterns of consumption and production, and protecting and managing the natural resource base of economic and social development are the overarching objectives of and essential requirements for sustainable development. We also reaffirm the need to achieve sustainable development by: promoting sustained, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living; fostering equitable social development and inclusion; and promoting integrated and sustainable management of natural resources and ecosystems that supports *inter alia* economic, social and human development while facilitating ecosystem conservation, regeneration and restoration and resilience in the face of new and emerging challenges." (The Future We Want, 2012)

The document is clear acknowledgement of failure in every direction despite noble declarations and promising agreements spanning 20 years since the Earth Summit in Rio in 1992 and 40 years since the Stockholm Conference on Human Environment in 1972. By reaffirming the commitment to the previous declarations and objectives, the Conference admitted that the goals of poverty eradication, reduction of inequality and environmental protection remain as elusive as they were in 1972.

7.11 United Nations Sustainable Development Summit (WSDS):

Once again more than 150 world leaders gathered at the United Nations Headquarters in New York to adopt an ambitious new sustainable development agenda at a 3-day summit during 25-27 September 2015. Transforming Our World: 2030 Agenda for Sustainable Development, consisting of a Declaration, 17 Sustainable Development Goals and 169 targets was adopted at the Summit. The 17 goals are (Transforming Our World. The 2030 Agenda for Sustainable Development, 2015):

1. End poverty in all its forms everywhere. 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture. 3. Ensure healthy lives and promote well-being for all at all ages. 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. 5. Achieve gender equality and empower all women and girls. 6. Ensure availability and sustainable management of water and sanitation for all. 7. Ensure access to affordable, reliable, sustainable and modern energy for all. 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. 10. Reduce inequality within and among countries. 11. Make cities and human settlements inclusive, safe, resilient and sustainable. 12. Ensure sustainable consumption and production patterns. 13. Take urgent action to combat climate change and its impacts. 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development. 15. Protect, restore and promote sustainable use of terrestrial use of ecosystem, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss. 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The above list of 17 goals is highly ambitious and appears like a utopia. Given the history of last 45 years since 1972 Stockholm Conference, these goals look unattainable. As of now this is merely a wish list of an ideal world. Nevertheless, there is no harm in aiming high. To make this happen all nations and in particular the developed nations, need to fortify their resolve and take hard decisions. Future alone will tell us the fate of these goals.

7.12 Negotiations under UNFCCC (United Nations Framework Convention on Climate Change):

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty negotiated following the Earth Summit in Rio de Janeiro from 3 to 14 June 1992, and entered into force on 21 March 1994. Presently there are 197 Parties to the Convention. The UNFCCC objective is to "stabilize greenhouse gas concentrations in the

atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, 2014). The framework sets no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. Instead, the framework outlines how specific international treaties (called "protocols" or "Agreements") may be negotiated to set binding limits on greenhouse gases. The parties to the convention have met annually since 1995 as Conferences of the Parties (COP) to assess progress in dealing with climate change.

Soon after the first meeting of the Conference of the Parties (COP) in 1995, to put teeth into UNFCCC, countries launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. There were 192 parties to the Protocol. The Kyoto Protocol legally binds developed country parties to emission reduction targets and set targets to reduce emissions by 5.2 percent below 1990 levels by 2012. To help countries meet targets, Kyoto also offered a range of market mechanisms that could help rich countries offset emissions by investing in low carbon projects in poorer parts of the world (UNFCCC, 2014). However, the Protocol was not ratified for eight years and hence remained ineffective until 2008. Moreover, the US Government refused to ratify the Protocol, weakening it further. The Protocol's first commitment period started in 2008 and ended in 2012. The second commitment period began on 1 January 2013 and will end in 2020. The two biggest emitters of all - the United States and China – churned out more than enough extra greenhouse gas to erase all the reductions made by other countries during the Kyoto period. Nevertheless, the Kyoto Protocol despite all its flaws did start the decarbonization process in many countries (Climate Home, 2016). COP meetings held at Copenhagen (2009), Cancun (2010), Durban (2011), Doha (2012) and Lima (2014) helped in intensifying negotiations leading to the Paris Agreement in 2015.

The 2015 Paris Agreement, adopted in Paris on 12 December 2015 and entered into force on 4th November 2016, marks the latest step in the evolution of the UN climate change regime and builds on the work undertaken under the Convention. The Paris Agreement charts a new course in the global effort to combat climate change. The Agreement seeks to accelerate and intensify the actions and investments needed for a sustainable low carbon future. Its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. The Agreement also aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework is likely to be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The key elements of the Paris Agreement can be summarized as follows:

- A long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels.
- The Agreement even aims to limit the increase to 1.5°C, since this would significantly reduce risks and the impacts of climate change.
- The agreement obliges the developed countries to contribute US\$ 100 billion every year for providing clean technologies to the developing countries.
- Peaking of global emissions as soon as possible, recognizing that this will take longer for developing countries.
- To undertake best efforts through nationally determined contributions and report progress on their implementation.

The Paris Agreement requires all Parties to put forward their best efforts through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. There will also be a global stock taking every 5 years to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual actions by Parties. The first session of the Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA 1) took place in Marrakech, Morocco from 15-18 November 2016 (The Paris Agreement, UNFCCC, 2014). Unfortunately, the United States under the presidency of Donald Trump has already notified its intention to withdraw from the Agreement which is a serious blow to the Agreement in its very infancy. Under these circumstances the outcome of the agreement remains uncertain.

7.13 Conclusions:

Forty-seven years have elapsed since the Stockholm Conference on Human Environment held in 1972. During this period many scientific studies have been conducted and thousands of papers have been presented on all issues concerning sustainable levels of production and consumption, environmental degradation, global warming and climate change. Exhaustive negotiations have taken place under different international and regional fora. Apart from the major international conferences mentioned above, hundreds of specialized conferences have been held on individual issue such as; desertification, river pollution, marine pollution, air pollution, greenhouse gas emissions, bio-diversity, poverty reduction, climate change, health issues and so on. A plethora of documents, declarations and recommendations have emerged out of these conferences. These documents are so large that they cannot be accommodated even in one of the largest libraries in the world. Millions of pages are available on internet alone. Since there is nothing new to add any more; many of these documents have either reiterated what had already been said or played with the words to coin new language. A large number of new institutions have emerged both at national and international levels to deal with the issues concerning sustainable development. Existing institutions have also created new divisions to handle these issues. Thus, there is no dearth of documentation and institutional framework.

While these conferences are taking place in exotic locations in the comfort of five-star comforts, situation on the ground is worsening every passing day. Production is rising year after year with each nation trying to outdo others in attaining higher GDP. Natural resources are fast depleting. Consumption is rising so is contamination. Acidification, desertification and degradation of soil is on the increase. Water bodies are getting increasingly contaminated with availability of fresh water depleting every passing day. Air pollution is reaching new high with increasing health problems. Species are disappearing at an unprecedented rate. Global warming is becoming more intense every passing year. Lakes and rivers are drying up and glaciers and ice caps are melting fast. Oceans are becoming highly polluted for they are the last sink of this growing contamination. IPCC 5th Assessment Report 2014 clearly brings out most of these ground realities which have only worsened since then. It is therefore clear that despite pious aspirations, ground realities are worsening every passing day. It is therefore time to look at other options, particularly at the time-tested wisdom of our ancestors who lived with nature harmoniously for thousands of years.

Chapter 8

Sustainability and Ancient Wisdom

"Only when the last tree has died, the last river been poisoned, and the last fish been caught will we realize we cannot eat money?" - *Cree Proverb*

"When a man does a piece of work which is admired by all we say that it is wonderful; but when we see the changes of day and night, the sun, the moon, and the stars in the sky, and the changing seasons upon the earth, with their ripening fruits, anyone must realize that it is the work of someone more powerful than man." -*Chief Standing Bear*

> "The Lord pervades the entire universe - animate and inanimate. Take only as much as needed in the spirit of detachment. Covet nothing. All belongs to the Lord." - Isha Upanishad

8.1 Perspective:

As wisely defined by the World Commission on Environment and Development a sustainable society is one that "meets the needs of the present without compromising the ability of future generations to meet their own needs" According to Herman Dalya Nobel Laureate, in any sustainable society these three conditions must be met.

- a. The rate of use of renewable resources should not exceed their rate of regeneration.
- b. The rate of use of non-renewable resources should not exceed the rate at which sustainable renewable substitutes are developed.
- c. The rate of pollution emission should not exceed the assimilative capacity of the environment (Daly, 2007).

We have seen in the previous chapters that the stress between environment and development is growing every passing day as we are not able to meet any of the conditions given above. The advent of large-scale industrialisation, intensive commercial agriculture, large-scale deforestation and loss of bio-diversity, increasing use of chemicals, changing food habits, new culture based on increasing and ostentatious consumption and unprecedented quantity of solid and liquid municipal and industrial waste; are all contributing to the deteriorating health of our planet through degradation of soil, increasing water consumption and massive contamination of water

bodies, growing air pollution and declining air quality. The carrying capacity of the Mother Earth has come under pressure never seen before in the history of mankind. Human race is trying to achieve the impossible – to fulfil infinite desires with finite resources. As a result, over the past 100 years humans have changed the ecosystem faster and more extensively than any period in human history. The new equipment and technology of modern era have wounded each and every part of the body of Mother Earth leaving deep scars all over. Moreover, this very equipment and technology is leading to widespread degeneration of humanity in the name of development.

On the positive side, the idea of sustainable development has become a substantial and dynamic force particularly since 1980s. Global awareness of environmental degradation is on the rise. Civil society and non-governmental organizations (NGOs) have become active. New global institutions have emerged. United Nations has taken several initiatives. International dialogue is underway. Therefore, the growing environmental consciousness, new global institutions, ongoing international dialogue, scientific knowhow, technological advances, global connectedness and abundant wealth provide a unique opportunity for a determined march towards sustainability. As stated elsewhere, there has also been some progress in containing extreme poverty, illiteracy, infant mortality and killer diseases under the Millennium Development Goals, 2015.

Nevertheless, transition towards sustainability still remains a distant dream. Journey towards sustainability must commence immediately, if the life support system of the planet needs to be preserved against continuing degradation. Unfortunately, there is no clear blueprint or a road map as of now. Nations need to chart this out without further loss of time. From the brief history of environmental negotiations narrated in the previous chapter, it is apparent that during the last five decades the governments, the NGOs and the so-called environmental experts have successfully converted a simple subject into a most complex matrix with hundreds of variables presented in thousands of tables and graphs running into millions of pages making it impossible for an ordinary folk to understand anything out of it. Intense debates have been going-on, on balance between environment and development, rights of the developing nations to improve quality of life of their citizens, the nature and number of environmental indicators, environmental sustainability index, carbon emissions, technology transfer, financing of new technologies and fixation of voluntary or legally binding targets on carbon emissions. Implementation of Paris Agreement will make it more complicated with new jargons and complexities (Gupta, 2017).

While for intellectuals and experts, such a debate is fascinating and intellectually satisfying, millions of poor people across the globe are suffering due to ravages of nature which are becoming more and more extreme every passing day. According to the World Meteorological Organization (WMO), extreme weather and climate conditions, including Arctic "heatwaves", continued in 2017, after 2016 topped the global temperature charts and saw shrinking ice sheets and surging sea levels. "We are now in truly unchartered territory," said David Carlson, head of the World Climate Research Programme, in a press release from the WMO on March 21st, 2017 (Larson, 2017). Moreover, the economic path we are following today has imposed many life-style and societal changes which are highly detrimental to human well-being and are totally unsustainable. In my opinion durable solution to this problem is simple and straight forward. I believe that ancient wisdom can provide a compass for navigating in sustainable direction. This is a time-tested method successfully practiced for generations by our wise ancestors. This can be successfully integrated with modern technological advances to commence this journey towards safeguarding the future of our children and grandchildren.

8.2 Scientific and Technological Prowess of Man?

Since the inception of the industrial revolution in the 18th century, scientific and technological developments have had a profound impact on humanity as a whole. Developments in transport, communication and production systems; medicine, biological and genetic sciences; new materials; nuclear technology; space research and digital technology have transformed human life beyond recognition. Modes of transport have catapulted human life from simple horse drawn carriages to spacecraft cruising at unprecedented speeds into outer space. Simple wooden boats have been transformed into large luxurious sea cruisers, which are no less than floating cities on the ocean surface. Simple two-way oral communication has travelled a long way to high speed wireless internet and cellular and satellite phones with instant connectivity all around the globe and beyond. Traditional small and cottage industries have been transformed into large scale production units with unprecedented automation, churning out billions of products every day to satisfy ever growing human desires. Genetic and medical sciences have precisely mapped the human genome and body organs; and have invented highly complex systems of diagnosis, medication and surgical intervention. From simple bows and arrows, the weapons industry has evolved to creating long distance to inter-continental ballistic missiles (ICBMs) and nuclear sub-

marines bringing the entire globe within their range. Sophisticated nuclear, biological and chemical weapons and highly advanced systems of their delivery have replaced sword-wielding foot soldiers. New means of production and transmission of energy have intruded into every sphere of our life from cooking to washing to shopping to entertainment to production to transportation and communication. Similar transformations could be seen in many other fields of human life. Internet, cellular and digital connectivity have reduced the world to a global village. Now automation and Artificial Intelligence are becoming key words.

With these unprecedented technological advances during the last three centuries, there is a growing tendency to discard our ancestors and their lifestyle as primitive and unscientific. Quite often their lifestyle is talked about in derogatory terms. Moreover, these advances or "miracles" as they are called by some, has created a distorted image of human power that 'we are beings who possess nature and that our ability to transform and model it, using the power of our omnipotent brain, will help us to deal successfully with the ecological crisis'. Human belief that we are superior to nature and are able to control and transform it according to our desires is a fundamental error. Such an attitude is totally misplaced and is against perennial wisdom because it considers human beings at a particular position outside nature, imposing their decisions and actions upon it (Russell, Dimitrov and Fell, 1998).

The ground reality is that our survival is completely at the mercy of nature. Nature nurtures each one of us every single day. The air we breathe, the water we drink, the food we eat, the habitation we live in, the clothes we wear and whatever else we consume comes directly from the Mother Nature. The day this stops, human existence will come to an end. This is ancient wisdom and a plain and simple truth. No complex statistics, graphs or tables are needed to understand this simple fact. Under these circumstances how can we treat nature as an object of exploitation and a dumping ground for human induced waste? In fact, we are waging a war against our own mother and we are doing so at our own peril.

Not only that we are at the mercy of nature for our very survival, the scientific and technological prowess of man has been highly over evaluated. Human thoughts and technological innovations are based on partial truths and lack holistic vision. Human mind is unable to transcend the limitations of time and space to understand and grasp the impact of innovations on the millions of variables that constitute the balance of nature. Therefore, overtime their negative impact

becomes more pronounced than their positivity. For example, the Green Revolution in India was hailed as a huge success of science and technology. Through promotion of better seeds and use of chemical fertilizers and pesticides Green Revolution did contribute to considerable increase in food production. Fifty or so years on, we're finding that soil has been degraded, water supply has run out and food has chemicals in it. To overcome these problems, we are now returning back to ancient practices under a newly coined name 'organic'. It was the technological prowess of man promoting use of hybrid seeds, chemical fertilizers and pesticides that destroyed the inherent organic character of agricultural practices and gave birth to innumerable health and ecological problems.

Similarly take the case of antibiotics. When they were introduced in 1940s onwards, they were considered a great leap forward in the area of medicine. Developed originally to treat human infectious diseases they have become instrumental in the development of resistant bacteria. Clearly the scientists were unaware of the implications associated with the use of these therapeutic entities and under-estimated the genetic flexibility of the micro-organisms that were targeted. As a result, presently, we face a global public health crisis, as infectious diseases top the list for causes of death world-wide (Barbosa and Levy, 2000). Look at the industrial revolution itself, which was hailed as a spectacular achievement of human mind. Human labor was replaced by machines. Scale of production went up in leaps and bounds while costs came down considerably. The output we used to achieve in months can now be achieved in hours with much less manpower. However, today we are at a cross-road with massive degradation of soil, unprecedented contamination of water bodies and the air we breathe, accumulation of mountains of non-biodegradable waste and rising temperatures with whimsical weather conditions striking at the very root of human existence. Thus, the technological prowess of man is lop-sided giving rise to many new problems over time.

Moreover, systems developed by man are miniscule and are based on disproportionately high use of resources with large-scale contamination. These systems have no comparison to the vast, self-sustaining and cyclical systems of nature taking care of the entire planet and beyond and all species of life. For example, if we need to pump a few thousand liters of water to a township it requires massive effort in terms of laying down of pipelines and machinery and use of energy and other systems. On the other hand, look at nature's hydrological cycle. A vast amount of water is lifted up every second with sun's heat from the oceans, seas and lakes forming clouds. These clouds are then moved by the winds in different directions and then the purified water returns back to the earth in the form of snow and rain as a result of condensation process. The whole earth is provided with fresh and clean water supply without any mechanical infrastructure. Thus, the glaciers, rivers, lakes and ground water table are recharged continuously sustaining life on a continuous basis. This cycle works day in and day out without any outside help or interference. Everything moves in an automated, natural and cyclical manner based on zero-waste principle.

Image 48.



Source: Internet public domain

Similarly look at the oxygen cycle. Humans and animals breathe in oxygen and breathe out carbon dioxide. Plants use carbon dioxide for photo-synthesis and breathe out oxygen sustaining life in all its forms and manifestation. Waste discarded by one species of life becomes food or fertilizer for another in this natural cycle eliminating all waste based on natural inter-dependence of species. Similarly, the carbon and nitrogen cycles operate in completely natural, and self-sustaining manner without any outside interference. The nitrogen cycle is the biogeochemical cycle by which nitrogen is converted into various chemical forms as it circulates among the atmosphere, terrestrial, and marine ecosystems. For example, plants take nitrogen from soil by absorption through their roots as amino acids. Most nitrogen obtained by terrestrial animals can be traced back to the plants at some stage of the food chain. Crop rotation also helps in maintaining the fertility of soil through fixation of nitrogen.

Image 49.



Source: Internet public domain

As such, each and every system in nature is cyclical where waste of one specie become food for another. Therefore, in essence there is no waste so far as the natural systems are concerned. Moreover, think of other systems of nature such as formation of galaxies with billions of stars, rotation of the sun, radiation of sunlight, rotation and revolution of the earth, phases of the moon, occurrence of day and night, change of seasons, regeneration of life in spring, gravitational force and so on. There are billions of such systems which are all self-sustaining without any outside interference. Human mind cannot even fathom the size of the universe leave aside human capacity to understand the infinite number of systems regulating this gigantic body with perfect mathematical precision. Even the structure of a particle remains a mystery till date. Even the best scientific minds of today will candidly acknowledge that they know very little about the functioning of nature, human body and other specie of life. Thus, the scientific and technological prowess of man is indeed miniscule in terms of scale and lop-sided in terms of its sustainability leading to dysfunctions in the form of environmental degradation and other negative consequences. Hence the human efforts to acquire superiority over nature are not only futile but are immensely harmful for the very sustenance of life on Earth. The desire to acquire superiority over nature is propelled merely by ego and greed. Wisdom dictates that we live in harmony with nature.

8.3 Technology, Capitalism and Human Society:

Following the onset of industrial revolution and more particularly after the Second World War, technology and capitalism have profoundly impacted human society transforming the way we think, we behave and we live. Capital and technology have replaced land and labor as the principal factors of production. Mass production in assembly line industrial units is the order of the day. Political economists have always been interested in the differences in the economic and political institutions that have evolved across countries since then. Hall and Soskice in their book 'Varieties of Capitalism' have summarized these developments in the developed countries in four key approaches (Hall and Soskice, 2001). The *modernization approach* that followed the Second World War and still continues is based on modernization of technology to enhance productivity and reduce cost. The second approach is based on neo-corporatism involving durable bargains between trade unions and employers on wages, working conditions and social and economic policies. The third approach is based on the concept of *social systems of production*, involving national innovation systems, flexible system of regimes, and behavioral changes of firms. The fourth approach is based on a *relational view of the firm* involving the quality of relationships with the investors, employees, suppliers, collaborators, trade unions, government and the public at large. Based on these fundamental factors the political economy across countries has evolved in a variety of capitalism. These forms can be primarily divided into liberal market economies and coordinated market economies (Hall and Soskice, 2001). Nevertheless, in my view, despite this multi-relational view with a variety of capitalism and corporate social responsibilities, the entire system of corporate governance still revolves around a fair return to investors on their investments for without inflow of investments in the form of equity and debt no corporate entity can ever survive.

While we are talking of sustainable development, it would be worthwhile to have a brief look of the impact of modern systems of productions on human life itself. Since the inception of Industrial Revolution, production technologies have undergone a radical change. The rapidity of change is taking place at an amazing speed every passing day. In the pursuit of higher production at lower costs, the assembly line techniques of mass production have replaced human ingenuity. These assembly line techniques of production have reduced factory workers to mere machines. Billions of workers engaged in industrial production all over the world are nothing but a computerized version of flesh and bones or robots in human form. I have seen the plight of thousands of such workers during my several visits to large industrial units. They repeat the same movement or action like a robot eight hours a day over a period of several years; sometimes for their whole life. As a result of these repetitive actions for years, their creativity is destroyed, reducing them to a machine in flesh and blood. Millions of jobs generated by these industrial units are therefore leading to large-scale degeneration of humanity.

Moreover, the process of education and training for millions is guided and designed by employment opportunities in such industrial units, thereby killing their ingenuity and creativity forever and making them slaves of machines. Additionally, the rapidly changing technologies are making their training obsolete at a very young age further complicating their livelihood and dampening their human spirit. Therefore, how can we call higher GDP as a symbol of development when millions of workers are being reduced to robotic life? These poor workers can no longer think like normal human beings after having worked for years in these modern industrial units. With mass production, globalised marketing and large retail chains, mechanical operations are fast replacing individual ingenuity in all spheres of economic activities destroying the creative skills of millions of artisans all over the world considerably limiting individual choices as diversity is being repaced by uniformity. The new systems of mass production and marketing have also contributed considerably to the widening disparity of income and wealth as explained in Chapter 3. Despite massive povery and hunger, number of billionares is going up every passing day leading to more and more concentration of means of production, wealth and income.

Large-scale unemployment and considerable loss of human freedom are yet another direct consequences of excessive automation and mechanization of production systems. Human beings are being replaced by machines at a rapidly increasing pace. Today, thousands of hectares of land provide employment only to a few individuals. A large parking lot for over a thousand cars provides no employment at all. A large factory churning out billions of pieces of shoe-wear provides employment only for a very few individuals. Despite growing unemployment, industialists are busy inventing new machinery and systems whereby human deployment could be minimized. Because of these new systems of production driven by technology, capital and technology have become a direct substitute for human-beings. Big capitalists are able to acquire large tracts of land, massive production units and huge shopping and office complexes providing very few jobs. Small and cottage units have no place as they cannot survive in this era of technology and scale driven competition. Hence today's technology-driven world has transformed human-intensive units into capital-intensive systems substantially containing human freedom.

Every passing day more and more capital is needed for every new employment generated. It is an irony that on the one hand all nations are striving to acquire advanced capital intensive technologies and on the other hand these very nations are complaining about large-scale unemployment. Job creation has become completely dependent on the success of these large enterprises which are solely driven by profit motive. Profitability of these organizations depends on the growth of demand. Therefore in order to sustain these small numbers of jobs, the demand must grow and grow constantly. Higher consumption is therefore a natural requirement for sustaining these jobs. We are therefore either willingly or unconsciously contributing to a cycle of ever-increasing consumption. Given the finite natural resources, can we sustain the need for everincreasing consumption? And if so, for how long and at what cost? Moreover, as far as employment is concerned, poorer sections of the society who constitute majority of the work-force have become slaves of the success of these large-scale production units. Closure of a single factory or an office could ruin thousands of families overnight, rendering young and innocent children homeless without any access to food, medicines and education. Under these circumstances we need to think aloud whether the GDP growth, increasing scales of production and excessive automation are leading to development or degradation of human race. Human spirit and dignity are perhaps the worst victims of these new methods of economic growth! The human being has lost his freedom of work and choice to these units. We need to think louder whether this could be called development? This situation is likely to become worse with new technological developments.

In the recent years; automation, robotization and Artificial Intelligence (AI) have acquired new impetus. AI has already made inroads into finance, transportation, defense, energy, education and health. Big data and enhanced computation power have given boost to AI. The Internet of Things (IoT) is facilitated by high-speed networks and remote sensors to connect people and businesses. The large technological companies are moving relentlessly in this direction. Many countries are promoting automation and AI to acquire technological edge over their competitors. Similarly, many societies where labor is in short supply welcome automation instead of inviting migrant labor which has so many social and cultural ramifications. Given the recent origin of AI and IoT, so far there have been no in-depth studies on the implications of these new technological advances. However, one thing is certain that these new technologies have the capacity to disrupt and change the existing social order in a fundamental way.

In his farewell speech to thousands in a packed convention hall in Chicago, President Obama warned; "the next wave of economic dislocations won't come from overseas. It will come from the relentless pace of automation that makes a lot of good middle-class jobs obsolete" (Working Nation, 11 January 2017). For example, driverless vehicles could render millions of drivers jobless. Similarly, robotization of surgeries and investigations could renders millions in medical profession jobless. In a survey undertaken by Pew Research Center in 2014, 48% experts envisioned a future in which robots and digital agents would displace significant numbers of both blue- and white-collar workers—with many expressing concern that this will lead to vast increases in income inequality, leaving masses effectively unemployable and breakdowns in the social order. The remaining 52% anticipated that many jobs currently performed by humans will be substantially taken over by robots or digital agents by 2025 but expressed hope that human ingenuity will create new jobs, industries and ways to make a living, just as it has been doing since the dawn of the industrial revolution (Pew Research Center, 2014). McKinsey Report 2017 on automation found that 30 percent of work activities could be automated by 2030 and up to 400 million workers worldwide could be dislocated by emerging technologies, although the report also expects that the artificial intelligence and robotics will generate significant benefits for users, businesses, and economies, lifting productivity and economic growth (McKinsey Global Institute, 2017). Bruegel research team using European data has predicted that 54% jobs in EU are risk due to automation. The team believes that since the technology will be able to overcome traditional hurdles among non-routine cognitive tasks then we must equip the next generation of workers with skills that benefit from technology rather than being threatened by it (Bruegel, 2014).

Thus, from a variety of sources and studies it is clear that AI, robotozation and automation will lead to massive disruption and relocation of work force. Policy makers, business leaders, governments and individual workers will have very important role to play in smoothing workforce transitions in years ahead. The process will be disruptive and very painful for those who are unable to adapt to new technologies. Of course, there will be demand for human labor, but workers everywhere will need to rethink traditional notions of where they work, how they work, and what talents and capabilities they bring to that job. In this process of transition, the shelf-life of humans will become even shorter due to rapid obsolescence. Disruption of employment, work culture, education and training and other changes will certainly cause new mental and psychological stress in this era of technological transition. Many believe that businesses will not need large numbers

of employees, so individuals would be able to devote most of their waking hours to hobbies, volunteering and community service. Some other believe that humans will be rendered worthless leading to massive social unrest and multiple health problems. Some others hold the view that these super human machines could take over the world and even mistreat humans. "You want to know how super-intelligent cyborgs might treat ordinary flesh-and-blood humans? Better start by investigating how humans treat their less intelligent animal cousins. It's not a perfect analogy, of course, but it is the best archetype we can actually observe rather than just imagine" states Yuval Harari in his bestseller book Homo Deus (Harari, 2016). Therefore, the future scenario is full of uncertainties and challenges.

Urbanization and large-scale migration from rural areas to urban centers is yet another significant development of recent times. This is a direct consequence of mass production and marketing by large-scale enterprises. Family enterprises, micro and small production units are shutting down rapidly as they are unable to compete with large enterprises with vast resources, deep pockets and extensive reach. Similarly, land holdings are gradually becoming more and more concentrated as small and fragmented land holdings are no longer viable. Rural folks are therefore forced to migrate to cities in search of livelihood. Loss of livelihood in rural areas is naturally increasing the number of slum dwellers around megacities of the world. In 1800, only 3% of the world population lived in cities with habitants of one million and above with no slum dwellers at all. Presently the population of city dwellers is estimated to be 55% of the total world population or 3.2 billion people. In 2016, there were 29 megacities with population of 10 million and above with one billion city dwellers estimated to be living in slums with conditions unsuitable for human beings. This number is estimated to double by 2040. A large majority of these slum dwellers have no housing and sanitation and have no access to drinking water, schooling and health services. Naturally, their sub-human existence results in widespread illnesses, poor health, low level of mental development and wide-spread criminality. Their children are born in sub-human conditions, live in sub-human conditions and die in sub-human conditions. In addition, death of small and rural industries and mechanization of agriculture has also taken the human race away from nature to the vast concrete jungles of high-rise buildings leading to disproportionate use of resources, unprecedented levels of pollutions, mountains of waste and a complete disconnect between man and nature. This societal and life-style change has given birth to a large number of

non-biodegradable waste playing havoc with nature. This is the contribution of the modern economic concept of GDP. We need to ask ourselves: is this development?

In recent years, we have also witnessed many economic crises. These include the Mexican economic crisis of 1996, the Asian economic crisis of 1998, the global economic meltdown of 2008 and the ongoing debt crises in many countries. The current world economic order based on the mad race for GDP growth will continue to give rise to such crises year after year. No country can continue to achieve GDP growth forever. Sooner or later the country must reach the peak and then face a climb down. As soon as the climb down starts such crises will happen. During such economic problems the poorest section of the population suffers the most. They are the one who lose their employment and livelihood and face sub-human existence. The existing economic order based on large-scale production and excessive consumption will continue to cause such national crises. In fact they will multiply in the years to follow, as more and more nations will not be able to sustain their present growth rates and the increasing levels of consumption. These crises could also lead to social unrest, break-down of families and increasing criminality due to vast disparity in income and wealth. In some societies it could even result in armed insurgencies.

Diversity is central to human life and conditions. With mass production and global marketing world is gradually turning homogenous while local cultural attributes are being subsumed by the forces of globalization and assimilation. Cultural diversity characterized by different languages, local handicrafts, clothing, gastronomy and festivities is fast disappearing. Today when we go to any shopping place anywhere in the world, we find similar shopping malls with almost identical brands and products from Coca Cola to Nestle to Gucci to Pierre Cardin and so on. Uniformity of the world is becoming a reality. As diversity of human talent makes world rich and multi-faceted. Cultural diversity is indeed the spice of life making it rich and more lively. Increasing uniformity is gradually draining away the the life from our lives. We need to ponder whether it will be desirable to destroy whatever cultural diversity remains in the world with gradually declining human ingenuity and creativity due to fast growing large mechanized production systems?

8.4 Small is Beautiful:

We must therefore undertake a critical examination of gigantic production systems with excessive automation being installed all over the world since the industrial revolution. Turning the clock back to revert to micro and small production units, although not easy, will restore human ingenuity, creativity and dignity. This will halt the massive migration to cities which are becoming concrete jungles and are crumbling under pressure of growing contamination of air and water and accumulation of garbage. This will also help in judicious distribution of wealth and income reducing the glaring inequalities characterizing the economies all over the world. The problem of unemployment is the direct consequence of large-scale production and distribution systems and concentration of means of production in a few hands. Even in those countries where labor is in short supply, rapidly changing technology is the principal cause of employment disruption and human stress. The governments therefore should consider imposing prohibitive environmental tax on large production units to revive micro and small industrial sector. Diversified small units are possible with the help of new technologies. For example, new technologies in the field of renewable energy have given birth to many small and viable solar and wind energy production units reducing dependence on large power grids. Similarly, new cellular and WiFi technologies have transformed and diversified communication systems – telephones, radio, mass media and television. 3D printing technology has the potential to break mass production units into small and diversified units. Such units will contribute to individual self-sufficiency and reduce his financial vulnerability. The Gandhian Model of economics based on self-sufficiency and 'small is beautiful' could help immensely in this direction. In addition, the Bhutanese concept of Gross Human Happiness replacing Gross Domestic Production is also worth looking at. A system built around human beings will restore human dignity and will help in eradication of extreme poverty and hunger through the redistribution of wealth and income and more egalitarian control over means of production. Predominance of rural agro-based small industries is best suited for conservation of environment and the harmonious existence with nature. (Gupta, 2014).

We can therefore surmise that the modern production systems apart from massive contamination has also been responsible for growing unemploment; vast disparity in income and wealth; dehumanization of work-force; considerable decline in human ingenuity, creativity and self-sufficienncy; loss of individual freedom; rapid disappearance of cultural diversity; massive migration to cities; growth of urban slums and periodic economic crises. Can we sustain all this? And if so then for how long? Wisdom lies that we gradually return back to small scale industries based on local resources. Sustainability lies in a judicious mix of global and local. Governments should consider a comprehensive policy to encourage small and micro industries and to discourage

further expansion of large industries to reverse the process. Similarly, the race for higher and higher GDP is futile and destructive. Its a mirage and a curse which is simultaneously poisoning nature and human minds both. Leaders need to think about moderation and contentment. World Economic Forum, G-20 Summit and other economic gatherings of world leaders should consider these measures in order to restore respect for environment and creativity and dignity of human being. Schumacher's Small is Beautiful is indeed very relevant in this era of loss of independence, anonymity and dehumanization. "Wisdom demands a new orientation of science and technology toward the organic, the gentle, the elegant and beautiful. An attitude to life which seeks fulfillment in the single-minded pursuit of wealth - in short, materialism - does not fit into this world, because it contains within itself no limiting principle, while the environment in which it is placed is strictly limited" (Schumacher, 1973).

8.5 Increasing Sicknesses:

State of human health is yet another vital ingredient for sustainable development. In previous chapters we have already discussed the consequences on human health of growing contamination of air, water and soil. Similarly, poverty and deprivation has always been a major cause for sickness and deaths. Urban slums have added a new dimension to this matrix of poverty and deprivation. In the recent years increasing levels of consumption, massive urbanization and new comforts are also playing havoc with human health. Popularly known as life-style diseases, they are contributing to health problems due to fast and unhealthy food; comfortable life-style with no or very little physical activities; addiction to smoking, alcohol and drugs; stress at work places and excessive chemical intake in the form of pesticides, food preservatives and medicines. Although, the life expectancy has risen, general health of people is much poorer than before. Rapid growth of health industry during the last five decades is clear sign of declining human health. Pills have become a norm. Diagnostic techniques have become highly invasive. Moreover, despite increasing number of medical facilities, patients have to wait for weeks just to get an appointment.

According to the World Health Organization (WHO, 2012) the global public expenditure on health in 2010 was estimated to be US\$ 6.5 trillion, US spending being the highest at US\$ 8364 per person/year. According to the World Bank Indicators (World Bank, 2017) total expenditure on health care during 2013 was estimated at 9.9 % of global GDP with 6.4 % for low income countries and 11.9 % for high income countries. In US the expenditure on health care went up from US\$ 356 in 1970 to US\$ 8364 in 2010 (KFF, 2015). Due to new life-style and environmental degradation, cardiovascular and asthmatic diseases are on rapid increase. Today 30 % of total deaths are caused due to cardiovascular diseases and one in every 10 adults is suffering from diabetes (WHO). New diseases like AIDs, heart ailments, Alzheimer, depression, obesity, chronic organ failure and a variety of cancers are becoming common affecting millions across the globe. Autism is becoming a serious problem. Sperm count is decreasing adversely affecting the reproductive capacity and resulting in more and more birth defects. These new and incurable diseases are posing a threat to human health and well-being, never seen before. All this is happening due to the developmental process we have embarked on since the Industrial Revolution.

8.6 Man, and Nature: Deep Connectivity:

Of course, all of us can see the visible dependence of human race on nature for air, water, food, clothing, habitation and so on. Vedic writings of ancient India go a step further and explain the integral unity between man and nature in a deeply scientific manner. According to these writings the physical nature or the Universe surrounding us in its entirety is constituted of five great elements. They are Ether & Space (*Akash*), Air (*Vayu*), Fire or Light (*Agni*), Water (*Jal*) and Earth (*Prithvi*). These are called Five Great Elements (*Panch Mahabhut* in Sanskrit). Given their role in regulating the physical universe they are also revered as deities (*devatas*). Earth is also called as *Vasudha* meaning depository of all wealth. In the Vedic writings there are detailed descriptions of each of these great elements and their role and functions in the natural order.

Nature maintains a delicate balance amongst these great elements and these elements and the living beings. For example, sun is drawing water from the ocean through rays forming clouds, wind moves these clouds far and away in different directions and Earth gets rain from the clouds in the sky recharging rivers and lakes ground aquifers. This process maintains the fertility of the soil and allows growth of plants and vegetation. The plants through photo-synthesis process consume carbon dioxide and produce food and oxygen for the living beings. This inter-relationship and the natural sustaining order is called as *ritam* in the Vedic terminology. Any disturbance in this order or imbalance results in disruption of nature's smooth functioning causing problems for the living entities (estimated at 8.4 million different species) which have been classified in three categories – those moving in the space, those moving on the earth and those moving in the water. Moreover, the bodies of all living beings are made of these five great elements and on death

dissolve back to these five elements. In other words, the all species of life including the humans rise from the nature and dissolve back to the nature. Thus, we are an integral part of nature.

Scientifically, the food we eat becomes our body including blood, flesh, bones, and neurons and so on. All food ultimately comes from plant and herbs. Every plant needs space to grow. The photo-synthesis process that produces our food is based on the combination of air, sunlight, water and soil. Thus, the five great elements form part of our body through the food we eat. Moreover, each of the five senses of perception is directly linked to one of the five great elements constituting the Universe. The sense of hearing is linked to ether & space (Akash), the sense of touch to air, the sense of sight to fire or light, the sense of taste to water and the sense of smell to earth. Thus our senses keep us constantly connected to these five great elements of nature. This relationship becomes apparent when we dig slightly deeper into it in a scientifc way. Space or ether is the medium for transmission of all sounds, when the wind blows we feel the sense of touch, when the light is not enough our eyes are unable to see, water constitutes the base of all tastes and the origin of all smells lies in the Earth. The senses are connected to the nervous system. The nervous system and the brain provide a physical medium for our senses. Hence, the body and the senses along with the nervous system constitute the visible and tangible parts of a human being which are intimately connected to the Mother Nature (Gupta, 2014). This scientific analysis tells us a profound yet simple truth that; it is the nature that possesses us, we do not possess nature. We need nature for our existence and survival; while nature can survive with or without us. Therefore, respect for nature is a survival need and not an act of philanthropy or charity.

8.7 Ancient Cultural Practices:

According to Berkes, precisely for these reasons many ancient societies and indigenous people have relied for millennia on their direct environment for subsistence and autonomy. Over time, they have developed a way in which to manage and use their resources that ensures their conservation into the future. Such traditional societies are interested more in preserving their own social, cultural and environmental stability and integrity than in maximizing production. Consequently, there is no 'exploitation' of nature—which they do not consider as a collection of commodities—in the interaction between humans and natural milieu. On the contrary, their way of life is based on a strong sense of interconnection and interdependence. Relationships are based on reciprocity and obligations. Natural resource management is based on shared meanings and

knowledge. Activities in traditional societies often include a strong symbolic dimension in which every action is highly ritualized, and allow humans to participate in the preservation of the natural order. Of course, these rituals differ between cultures, as each society has its own belief systems, which determine its cultural identity and type of technology (Berkes et al, 2000). Modern science and ancient knowledge constitute different paths to knowledge, but they are rooted in the same reality.

For example, food habits are an integral part of cultural practices. Choice of food - not only what is consumed every day by the household but also what is cultivated - has a direct impact on the health of our local ecosystem and on the planet. The UN Food and Agriculture Organization website states that the livestock industry accounts for 7.1 gigatons of CO₂ equivalent emissions per year, representing 14.5 percent of all anthropogenic greenhouse gas emissions worldwide; almost as much as the transport industry with 1.3 billion vehicles (FAO, 2017). According to the same source cattle are the animal species responsible for the most emissions, representing about 65% of the livestock sector's emissions. Thus, the global meat industry is a disproportionate user of water, energy and one of the largest emitters of greenhouse gases. In this context the tradition of vegetarian diet in India proves to be most ecologically sound and the least violent against other species of life. Obviously, the concept of vegetarianism and non-violence in Indian traditions is based on sound ecological wisdom of harmonious living with nature. In a recent report IPCC has advised people to shift to plant-based diet to reduce CO2 emissions.

Similarly, nature worshipping has been an ancient practice in India. The oldest visual image of the human fascination, love, and reverence for nature in India can be found in the 10,000-yearold cave paintings at Bhimbetka in Central India depicting birds, animals, and human beings living in harmony. The Indus Valley civilization provides evidence of human interest in wildlife, as seen in seals depicting images of rhino, elephant, bull, etc. Historically, conservation of nature and natural resources was an innate aspect of the Indian psyche and faith, reflected in religious practices, folklore, art and culture permeating every aspect of the daily lives of people. Twenty-three centuries ago Emperor Ashoka decreed that it was a king's duty to protect wildlife and the trees of the forests. He got edicts inscribed on rocks and iron pillars throughout his kingdom, prohibiting the destruction of forests and the killing of various species of animals. This historical evidence, surviving to this day, is the first recorded measure on conservation anywhere in the world. In Buddhist mythology, the *Jatakas* or the stories of the Buddha's previous life are replete with several incarnations of the Bodhisattvaas as animals.

In ancient Indian writings the whole physical universe has been described as the body of the Almighty. In Sanskrit, environment is called as '*paryavaran*' meaning which encircles us. Hence practice of worshipping mountains, rivers, lakes, trees and animals form an integral part of Indian cultural heritage. Look at the sacred botany of India, for such trees and plants are considered an integral part of Indian environmental heritage and cultural consciousness. Evidence of tree worship goes back to the Vedic times. *Peepal* (Ficus religiosa) *Neem* (Azadirachta indica), *Tulsi* (Ocimum tenuiflorum), coconut tree (Cocos nucifera) and *Amla* (Phyllanthus emblica) are still worshipped in many parts of India (incidentally these plants and trees have also been found by the modern science endowed with great medical properties). In the Vedas, trees are referred to as '*vansapati'* or lord of the forest and have been invoked as deities, just as rivers, lakes, birds and certain animals. As per Vedic traditions, planting of trees and living in forests are considered as great virtues. The Vedas, the most ancient written scriptures in the world, pay tribute to nature and consider the Earth as mother. Unfortunately, in the modern era many of these traditions have been adversely affected due to greed for wealth and growing appetite for consumerism.

To elucidate this point let me quote Renugadevi who has included some references from the Yajurveda in her article. The Yajurveda (Y.V.) mentions of the great virtues of preserving the plants and animals, the ill effects of cutting of trees and the poisoning of the atmosphere. It also discusses about energy relations of the global eco-system. "No persons should kill animals helpful to all" (Y.V. 13.37). "O King you should never kill animals like bullocks useful in agriculture or like cows which give us milk and all other helpful animals and must punish those who kill or do harm to such animals" (Y.V. 13.49). "The oceans are treasure of wealth protect them" (Y.V. 38.22); "Do not poison (pollute) water and do not harm or cut the trees" (Y.V. 6.33); "Do not disturb the sky and do not poison the atmosphere" (Y.V. 5.43). About the flow of energy in the global ecosystem the Yajurveda says "the whole universe is full of energy in which the sun at its centre is the ultimate source of energy for all living organisms on earth". "The net energy flows from the point of production to the point of consumption through the plants, animals, human beings, the air, water and land, and is completely under the control of the Almighty". While energy flow and balance are maintained in the universe yet some imbalance in this flow causes several
natural disturbances like untimely rain, heavy rain, drought and flood, warm winter and cool summer. "The earth provides surface for vegetation which controls the heat build-up. The herbs and plants having union with sun rays provide congenial atmosphere for the life to survive (A.V. 5.28.5) (Renugadevi, 2011).

The following excerpts from the *Bhumi Sukta* in Atharva Veda explain as to how the Earth was revered as deity (*devata*) by the Vedic seers (Hindu Wisdom, 2006). (Complete text of the 63 verses called *Bhumi Shukta* invoking the Mother Earth as a deity can be found in the Sacred Books of the East Volume 42, 1897).

"Earth, in which lie the sea, the river and other waters, In which food and cornfields have come to be, In which lives all that breathes and that moves, May she confer on us the finest of her yield. Earth, in which the waters, common to all, Moving on all sides, flow unfailingly, day and night, May she pour on us milk in many streams, And endow us with lustre, May those born of thee, O Earth, Be of our welfare, free from sickness and waste, Wakeful through a long life, we shall become bearers of tribute to thee. Earth, my mother, set me securely with bliss in full accord with heaven, O wise one, uphold me in grace and splendour."

The Upanishads go a step further and describe the physical nature as body of the Almighty, elevating nature to even higher status. For example, the Mundak Upanishad (2.1.4) Describes the Almighty (Brahman) in the following words:

"Fire is his head, his eyes are the moon and the sun; The regions of space are his ears, his voice the revealed Veda, The wind is his breadth, his heart is the entire universe, The earth is his footstool, Truly he is the inner soul of all".

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Similarly, the verse 2.17 in Svetasvatara Upanishad states that the Almighty (Brahman) pervades every part of physical nature:

The self-luminous Lord, who is in fire, who is in water, Who has entered into the whole world, Who is in plants, who is in trees To that Lord let there be adoration!

If we just make a general observation of our surroundings, we shall find how deeply we are connected with nature. Space provides the theatre for play of all existence. We cannot imagine any existence whatsoever without space. Movement of air, sounds, energy, water cycle etc. all take place in this theatre provided by space. No breathing is possible without air. Our day begins with sunrise and ends with sunset. Our digestive system is directly linked to the sun; so is the photosynthesis process in plants. This is precisely the reason; we eat three times in the day and avoid eating at night. So-called jetlag is nothing but a temporary disconnect between the sun energy and our digestive system. All the energy that we consume in any form (thermal, hydel, atomic etc.) ultimately come from the sun. Sun is also the cause of rainfall, snow and winds. Moon is directly connected to the productive cycle of women. Ocean tides are one of the most reliable phenomena in the world, and we know that they move in and out around twice a day. Moon's gravitational force is the prime source of tides. Moon also provides nourishment to plants by regulating the water content of the soil, creating more moisture in the soil. This increased moisture encourages the seeds to sprout and grow. Scientists have now developed a lunar gardening calendar to achieve optimum results. Scientists have already accepted that mountains and vegetation attract clouds resulting in more rainfall in mountains regions and forests. Indian astronomy describes as to how the nine types of precious stones called *navaratna* are connected with the nine planets in the solar system and how they can impact on human body. As already mentioned, vegetation is the source of our food which turns into our body parts. And of course, we cannot imagine life without water. Earth provides habitation for all living beings and plants and is the source of all minerals we use in any form. These are merely some general observations to illustrate that the entire nature works in unison as an integrated whole to make life and existence possible.

It is smart to believe in science. But simultaneously we also need a dose of ancient wisdom. Ancient traditions teach that a simple life is best. Ancient sages teach that happiness and virtue are found in restraint and self-control. Desire is a flame that easily burns out of control. Materialism distracts us from eternal happiness. Tranquility and joy are found in peaceful harmony. The Buddhists and the Jains aimed to control desire. The Hindus believed in respect for nature, moderation in consumption, self-control and austerity. The Taoists sought harmony and simplicity. Jesus warned against greed and wealth. The Bible has many verses highlighting the importance of environment. These include; Psalms 104: 25-30, Psalm 96:10-13 and Job 37:14-18. The ancient Greeks praised modesty, moderation and temperance. Similar traditions can be found in many ancient civilizations all across the world including amongst the nomadic tribes of Mongolia, the Mayans of Mexico, the Indians of the United States and the Aborigines of Australia. There was no electricity in ancient times. Sun regulated human life. The nights were darker then. The stars provided entertainment and inspiration. We rarely see those stars today. Boxed in urban apartment complexes, our distance with nature has increased manifold. Today many children believe that milk and bread are produced in factories without any relation to nature.

One interesting suggestion comes from Arnold Schwarzenegger. Schwarzenegger has become a spokesman for meat-free meals as a cure for climate change. Food crops farming emit less greenhouse gases and consume much less water as compared to meat industry. Global meat industry is a disproportionate user of water and land resources as it has been calculated that one kg of beef requires 15 times and one kg of chicken requires 5 times more water as is required in producing one kg of wheat. Locally grown foods also produce fewer emissions. All of our consumption habits have environmental impacts. Coffee is shipped across the globe. Coffee culture creates vast piles of disposable cups. Beer and soda also have an adverse ecological impact. Energy is used to refrigerate and transport them. Modern packaging has become the greatest source of solid waste. Every day each one of us discards one to two kilograms of waste only of the packing material which is poisoning our soil and water bodies. Even if part of this waste is recycled, there are heavy ecological costs in manufacturing, collecting and recycling cans, bottles, cartons, plastic and paper and so on. The focus of human life in the past has always been on sustainability, use and reuse, recycling, and conservation of energy and other natural resources. Our ancestors focused upon building designs suited to local geography and climate; we insist upon uniform building materials and designs across the regions, and lay out energy guzzling and mirrored buildings

throughout the world. Our ancestors considered extending the height of buildings with more thickness of walls so that they are cool in summers and warm in winters; we focus upon use of concrete with reduced height of buildings and use air conditioner, instead. When I was a child in my part of India, we used to preserve vegetables and fruits by drying them in the sun and used to boil them before use. These are just a few examples. There are thousands of such ancient practices all over the world. Therefore, we can only gain from paying attention to our cultural history and richness which is based on sound wisdom observed over millennia.

8.8 Needs versus Desires:

Consumption has become the symbol of development and primary purpose and the principal driver of life. Today, every individual is looking for higher consumption, every organization for higher sales and every nation for higher GDP. Following the industrial revolution, we have created a consumption driven society where everybody is perpetually hungry for more. Mad race by the humanity for higher and higher GDP and per capita income are the root causes of environmental degradation. Obviously in this race for more, more and yet more, we are digging deep into the Earth's surface, the ocean beds and even the ice covered Arctic and Antarctic. Equipment and machinery invented since the industrial revolution has helped exploit nature far more than ever done in the past. As a result, nature has been exploited in an unprecedented manner in the last 100 years. As explained in detail in previous chapters the amount of natural resources extracted for the production of goods and services are steadily increasing. Presently our net extractions stand over 60 billion tons (gross extraction are over 100 billion tons) each year, about 50% more than only 30 years ago. Simultaneously we are denuding our forests and poisoning the air, rivers, lakes, oceans and soil with unprecedented waste in a variety of forms.

Desires are ever elastic and keep growing in geometric progression. In Sanskrit they are called *trishna* which can never be satisfied. The combination of senses and sense objects gives rise to desires. By their very nature, desires keep arising one after another like waves in the ocean. Each such desire hijacks our mind and keeps it engaged till the desire is fulfilled. Once satisfied, it provides pleasure for a while. Once this transient pleasure is over, pain follows with multiple new desires. This is an infinite process where each pleasure sows the seeds of pain and many new desires. Thus, each successive pleasure diminishes in intensity and ultimately it turns into distress and pain. In practice, this process leads to more stress and restlessness which is visible all over, in

modern society. Thus the search for happiness through material possessions and sensegratifications gradually catapults itself into a self-propelling mirage. Since human desires are infinite and interminable, this process is interminable as well. This interminable motor is driven at times by the desire for pleasure and change and at times by greed for power and fame. At times new and more advanced technologies and innovative marketing techniques by large corporations impose this cycle upon us. This process is driven both by the supply side as also by the demand side but quite often by a combination of the two.

In the first case, the industry driven by profit motive develops new varieties of products and creates new demand or temptations through marketing techniques. Wonderful and seductive advertisements are a great source of such temptations. For example a new mobile phone with many new features is developed and then demand is created through marketing techniques. Similarly, a new state of the art airplane with better comforts for the passengers is developed and then air companies are convinced to buy this new plane. The desire for change or for a new look often generates new demand for fashion garments, beauty products, furnishing industry and so on. Similarly, when individuals look for a better variety of cars with more comfort, the car companies through innovations come out with such products to meet customer demands. This ceaseless desire for higher level of physical comforts naturally leads to more innovations. Thus, better technology and billions of new products keep us engaged in our pursuit for happiness.

Let me illustrate this with a real life story. An individual with modest means was living in a small apartment and was quite content. One day one of his friends ignited fire in his mind to improve his life-style. Since then he desired to have a bigger apartment and a small car. He worked diligently and gradually acquired enough money to buy both of them. Then he wanted a big mansion and an expensive sports car. He worked hard and once again he got what he wanted. However, his desires climbed up a few steps further. Now he wants to have houses in different parts of the world, a private jet and a yacht so that he could go on holidays and enjoy. For sure, his desires won't end there. They would stretch further, once these new one's are fulfilled. This point has been aptly covered in the Indian epic Mahabharata with great finess. The following verses are worth quoting:

> On acquiring wealth, men want to acquire a kingdom; having acquired a kingdom, they want to become gods;

and then among gods they want to become the king of the gods.

(Shanti 180/24) Neither all the grain in the world, nor all the gold, nor all the women are sufficient enough even for one man. Man's body decays but not his desires. (Adi 85/13)

By appeasing, the desires cannot be satisfied; with appeasement they only grow, like fire when more fuel is added.

(Adi 75/50)

It is difficult to earn wealth. Painful to part with it, nor is there any pleasure in guarding it. Of course, human beings are never satisfied with any amount of wealth, wanting more and more.

(Shanti 330/18)

In order to contain this ceaseless process of desires, understanding the role of mind and intellect is very significant. In economics, productivity is defined as a ratio between the input and the output. The more output you are able to achieve with a given level of input the more productive you are. Conversely, the less the input for a given level of output, the more productive you are. For example, enterprise A is able to produce X amount of output with Y input, while enterprise B is able to produce the same amount of output with Y-1 input. Thus enterprise B will be considered more effecient. The higher productivity of enterprise B also reflects a higher level of development of production and managerial techniques in this enterprise. Similarly, an individual who is able to achieve a higher level of happiness with a lower level of consumption should naturally be considered more efficient, developed and enlightened. *Hence achieving a higher level of happiness with lower level of consumption and minimum use of natural resources should constitute the core of human development index* (Gupta, 2014).

"We don't live to eat but eat to live" is a dictum often quoted in the West. Unfortunately, we are doing exactly the opposite. We have grown up and are constantly living with the cycle of excessive use of natural resources – higher level of wants -- higher levels of production – higher levels of consumption – still higher level of wants – and still higher levels of production and consumption. This endless cycle of higher production and higher consumption is an elusive and destructive path. Following this path is indicative of a lower level of human development. Perpetual discontentment, frustration, stress, conflicts over resources and environmental disasters are inevitable occurrences on this path. The concept of higher and higher GDP and per capita income provides fuel to this fire of desires for higher consumption and hence leads to a higher level of frustration and stress. Thus, the greed for higher GDP and more and more consumption must come to a halt. Consumption driven approach to life is the single most important aggression against the Self and the Mother Nature. This is also a sign of living in darkness. Moderation, austerity and contentment are ancient dictum. Human needs can be fulfilled but not greed said Mahatma Gandhi. If we fail to address this simple truth all international negotiations and agreements will lead us nowhere. They are doomed to fail. To conclude this section let me quote the following two verses:

> "A man of understanding acts with mind and intelligence; gives up all sense of proprietorship over his possessions and acts only for bare necessities of life; thus working he is not affected by painful reactions"

> > (Bhagvad Gita 4/21)

"The Lord pervades the entire universe - animate and inanimate.

Take only as much as needed in the spirit of detachment. Covet nothing. All belongs to the Lord."

(Isha Upanishad 1)

In this context it's worthwhile to mention the ancient Indian concept of *aparigraha* meaning non-possession and non-attachment. *Aparigraha* spells out how much should be possessed, limiting possessions to essential human needs. Whatever is not needed must not become part of possession. Thus, *aparigraha* connote the moral desirability of limiting possessions and

consumption to the essentials and that too with a sense of detachment. This concept forms an integral part of all Indian philosophies and religious traditions starting from the *Hindu Rishis, Jain Munis, Buddhist Bhikkus* to *Sikhism* and *Sufism*. Under all these traditions, excessive possession and attachment are considered as a hindrance to progress, inner peace and lasting happiness. Other world religious traditions and schools also uphold this principle, although the name, form and degree may differ. In today's era dominated by growing consumerism, this concept has acquired added significance if we need to halt the continuing degradation of environment and to preserve nature's capacity to sustain life on the Planet Earth.

8.9 Conclusions:

From the array of statistics quoted in previous chapters it is clear that the current levels of production, consumption and contamination are totally unsustainable. My research has proved beyond doubt that the problem of sustainable development cannot be tackled simply by controlling the greenhouse emissions. This is merely the tip of the iceberg or a symptom of a much deeper disease of desires overtaking humans. The global leaders will have to think in terms of reducing consumption levels so that the mental stress and pressure on natural resources and consequent contamination of air, water bodies and soil is curtailed. Prudent are those who can manage with less. Excessive consumption is vulgarity. Austerity is wisdom. We must reduce consumption in the present if we want our progeny to survive. Excessive wealth is also the source and cause of large number of criminal activities, financial frauds, drug addiction, alcoholism, domestic violence and life-style diseases. Similarly, large-scale production units must give way to small and rural production centers based on local raw materials to reduce glaring inequality of wealth and means of production, increasing unemployment, misuse of resources and massive contamination. This will also help in addressing the problem of unhealthy and artificial life-style, growing urbanization, urban slums, drug trade and criminal gangs and in restoration of human face to economic activities. The growing disconnect between man and nature must be restored.

Our ancestors lived a simple life for thousands of years during pre-industrial period without playing havoc with nature and inviting nature's fury. They also gave birth to great civilizations in those times. Simple life connected with nature is a virtue and the greatest source of happiness. Mahatma Gandhi was far ahead of his time. In the first half of the 20th century he taught us the

virtues of simple living, beauty of small and rural industries and the concept of trusteeship. The Middle Path of Gautam Buddha is far more relevant today than ever before. This is also the ancient wisdom enshrined in Vedas and many other scriptures around the world including the Bible which says that we do not live to eat but eat to live. Our ancestors were not unwise. It is time to heed them.

Additionally, existing technologies can be used to promote small and viable units and innovation of new technologies can be encouraged to restore human dignity and ingenuity making individual life more self-sufficient. Renewable energies have already diversified power generation and distribution reducing dependence on large systems. Similarly, communication systems – telephones, radio, electronic media and television - have also undergone total transformation following satellite, cellular and Wi-Fi technologies. Social media is further breaking the mass media giants into smaller fragments. 3 D printing could herald a new era in production systems. Smaller, human oriented systems are important to restore human dignity and ingenuity and to mitigate contamination of nature. Mad race for GDP is the outcome of chasing desires. Emphasis on need-based consumption can contain consumerism and contamination and restore harmony with nature.

Chapter 9

Auroville – A Case Study on Sustainable Living

9.1 Perspective:

In order to demonstrate that sustainable living is not a utopia but a livable way of life, I was looking for a human laboratory on sustainable living in an international setting. I found the township of Auroville as the perfect township for this purpose. Auroville, located in South India, is an international township setup under UNESCO Charter promoting the twin objectives of human unity and sustainable living. In order to undertake a proper study of sustainable practices followed in Auroville, I visited Auroville in September 2013 and June 2017 for a total of 10 days. I adopted the following methodology for my study at Auroville.

- 1. Firstly, I visited five industrial and several commercial units, the green belt including the forest area, the solar kitchen, the water recycling facilities, waste reprocessing units and the educational and research facilities to understand the vision and the action on the ground.
- 2. Secondly, I prepared a questionnaire to ascertain the views of Aurovillians on sustainable development, environmental degradation, sustainable practices followed in Auroville and their global vision on these issues. This questionnaire was circulated in advance. A total of 26 persons responded to this questionnaire. A copy of the questionnaire and summary of their responses is enclosed in Appendices II and III.

3. Thirdly, I met over 40 prominent Aurovillians, individually and in groups to understand their ideas, vision and suggestions on sustainable development. Separately, I also met three members of the Working Committee to ascertain their views on the achievements of Auroville as against the vision for the founders. I was also able to meet some volunteers who came to Auroville for a short duration to help for specific projects on sustainability to ascertain their views.

Based on the data and inputs received from all the above-mentioned sources both in writing and orally, **my findings are summarized below**. Sections 9.2 provides the brief background of the township. Sections 9.3 until 9.6 outline the sustainable development practices in place in the township. These include; education rooted in nature and human unity, forestry and green spaces, sustainable farming practices, water and soil conservation, town planning and architecture, industrial and commercial activities, zero waste systems, renewable energy, water treatment and so on. Section 9.7 summarises the responses received from residents to the questionnaire while the section 9.8 outlines the outcome of the group discussion, brain-storming session and individual interviews.

9.2 A Global Township:

The project of Auroville, also known as the City of Dawn; was originally conceived in 1930 by Sri Aurobindo and his spiritual collaborator Mirra Alfassa, known as the Mother; as part of their vision for human unity and sustainable living. Located approximately 12 kms north of Pondicherry in South India; the international township of Auroville was formally inaugurated on 28th February 1968 under the aegis of UNESCO and the Government of India. The inaugural ceremony was attended by over 5000 people representing 124 nationalities. The representatives brought with them, some soil from their homeland, to be mixed in a white marble-clad, lotus-shaped urn; now placed at the focal point of the Amphitheatre called as Matrimandir located in the center of the town. At the same time the Mother gave Auroville the following four-point Charter.

- 1. Auroville belongs to nobody in particular. Auroville belongs to humanity as a whole. But, to live in Auroville, one must be a willing servitor of the divine consciousness.
- 2. Auroville will be the place of an unending education, of constant progress, and a youth that never ages.

- Auroville wants to be the bridge between the past and the future. Taking advantage of all discoveries from without and from within, Auroville will boldly spring towards future realizations.
- 4. Auroville will be a site of material and spiritual researches for a living embodiment of an actual human unity.

Since then Auroville has been striving to become an international-universal township dedicated to realization of the ideal of human unity in diversity; a place where men and women of all countries are able to live in peace and progressive harmony with nature. The project aims at creating a unique community integrating social, spiritual and environmental consciousness in its growth. Today, Auroville is recognized as the first and only internationally endorsed ongoing experiment in human unity and transformation of consciousness engaged in environmental, social and spiritual needs of mankind.

Image 50.



Matrimandir - the Center of Auroville.

Source: Auroville Website

In 1974 there were 320 Aurovillians. With an annual growth rate of 3.5 percent their number went up to 2719 by the end of April 2017 representing 53 nationalities. During my visits;

I personally met Aurovillians from India, Argentina, France, Germany, the Netherlands, Belgium, Italy, Hungary, Bulgaria, Israel, United States, United Kingdom, Canada, South Korea, China, the Philippines and Iran. Most of them are well qualified professionals who decided to leave their homeland and their lucrative professions, in order to contribute to the cause of human unity and sustainable living at Auroville. The composite mix of Aurovillians include; medical doctors, teachers, engineers, architects, town planners, accountants, foresters, soil experts, fashion designers, managers, media experts, painters, writers, cooks and IT personnel. Although a comparatively small township, Auroville boasts of a large number of institutions of repute based on sustainable developmental practices.

9.3 Education and Research for Sustainable Development:

The Auroville Charter makes education a defining characteristic of life. Aurovillians believe that there is within man a spark of the transcendent divine and the aim of human existence as seen by Auroville's founders, is to become conscious of this reality and unite with it. Each human being has his/her unique path to arrive at this union and this can be done while living a normal life. By the use of mind, man has created a complex structure of society using stupendous advances in technology which are gradually getting out of control. Only a move to higher levels of consciousness can save the human race from sliding into bottomless material abyss. Therefore, consciousness and harmony with nature form the core of education. Auroville follows an open and self-growth model of education as inhabitants come from varying nationalities, background and karmic path. "*Living and unending education*" is the motto.

a. Aha and Nandanam Kindergartens: Meant for 2+ to 6 age group, follows a self-directed and free progress philosophy of learning based on conscious inner growth believing that nothing can be taught and that the teacher is not an instructor but only a helper. Freedom to explore the world within and around them and to grow at their own pace and in their own way is the principal guiding factor. Sensorial development, sense of beauty and concentration, languages, understanding of nature and dance and music are some of the ideas pursued. Craft center, drama center, block center, science center, cooking and gardening center, quiet room, reading corner and games corner are available for sensorial and intellectual development. Students are divided in four groups called Prithvi (Earth), Jal (Water), Agni (Energy) and Vayu (Air) to integrate nature in human activities.

- **b. Deepam School:** An English medium school stared in 2000 is meant for the age group of 7 to 14. Laws of nature, bio-degradability, science of energy and sound, human body systems, engineering of simple machines, arts and crafts and physical education are some of the core teachings at the school. Animal life, geography, seasons and arts and theatre form core program for the children in the age group of 9-11. Children in the age group of 12-14 are taught sciences, mathematics, languages, arts, technology and social studies. For each group a schedule is made, by teachers and children together. Progressively, children are encouraged to take up more initiative in making their schedules. Dehashakti program of the school promotes physical education, self-confidence, self-control and respect for others.
- c. Transition School: Transition School started in 1985 is a primary and middle school for the age group from 6-14. These students and the adults that work with them, come from over 19 different countries. This multi-cultural environment exposes teachers and children to humanity's rich cultural heritage and diversity. Children from different cultural and ethnic backgrounds grow together in an atmosphere of protected freedom and harmony, developing an understanding that we are citizens of one world. The school aims to prepare children to live at a higher consciousness to manifest a truer and higher life on earth. The school values practices that heighten observation, concentration, self-awareness and creativity. Themes such as truth, human unity, empathy, freedom, and progress are introduced so that the children can develop a sense of values. The program includes traditional subjects such as reading, writing, math, sciences, computer, environmental and social studies, music, physical education and arts and crafts.
- d. Future School: Children at Future School (age group 14-19) program are inspired towards self-discovery. This platform is based on the philosophy of Sri Aurobindo and the Mother. Students are encouraged to follow a value-oriented approach to life in which they have an opportunity to create a deeper understanding of their responsibility to self, community and the world. Future School offers a high school equivalent education through a wide range of subjects: Languages (English, Tamil, French, German, Italian, Spanish and Russian);

Mathematics; Pure Sciences; Social Sciences (History, Geography, Economics, Psychology) and Extra Curricular Subjects (ICT, Fashion Design, Photography, Film, Arts, Theatre). Forest sanctuary, botanical gardens, sports center, arts center, sustainable palate based on traditional South Indian cuisine and cultural activities also form part of the school program.

- e. Sri Aurobindo International Institute for Educational Research (SAIIER): SAIIER promotes and coordinates most of the educational and cultural programs in Auroville, keeping them focused on Auroville's aims and ideals of human unity and sustainability. It sponsors diverse research units and nurtures new educational initiatives. SAIIER meeting is held twice a year and decisions are taken by a Board comprising of Aurovillians.
- f. The Laboratory of Evolution: The most visible aspect of this laboratory until now has been its specialised library, covering the numerous topics related to the study of evolution, past and future, seen both from a scientific and a spiritual point of view. On an ongoing basis the unit is engaged in the research work relating to Integral Yoga of Sri Aurobindo in the light of new scientific paradigms in physics, biology, medicine and history; how to awaken and develop consciousness in our body cells. Sri Aurobindo foresaw great changes coming upon humanity in the form of an evolutionary process. He had predicted that on the one hand, the development and exercise of the mind would lead to great discoveries in science resulting in several new technologies while on the other hand, the human race would progressively find itself unable to effectively deal with the gigantic structure of civilization and life that would thus get built up.
- **g.** Savitri Bhawan: Savitri Bhavan in Auroville is a center dedicated to fostering Human Unity through spiritual education based on the vision and teachings of Sri Aurobindo and the Mother with the central focus on Sri Aurobindo's poetic epic *Savitri* the supreme revelation of Sri Aurobindo's vision. A regular program of classes, exhibitions, musical events, guest lectures and film shows open to public are organized, in addition to workshops, retreats and orientation sessions.
- **h.** University of Human Unity (UHU): The University of Human Unity is being conceived of as an innovative alternative genre of university, expressive of the exploration of a new consciousness. The University will be a platform for exploration and discovery in all areas of human knowledge and activity where students themselves may conceive and pursue

programs of study in a supportive and contemplative atmosphere with the participation and cooperation of other students and facilitators in their respective fields of interest. Through this University, the students will explore new approaches to knowledge and new ways of self-educational methods and learning modalities which may lead them to a new perspective and expression, a deeper understanding and a truer force of consciousness. This online universe-city will offer personal portals, group collaboration centers for study and research, an interactive speaker/mentor bureau, a comprehensive library of data that includes text, images, audio and video and self-study tutorials.

9.4 Sustainable Practices:

The master plan of Auroville provides for two geographic regions or rings around the central point the Matrimandir. The first region - the city zone; consists of residential houses, community centers and economic and cultural areas. The second region - the green belt surrounding the city zone; consists of botanical garden and the forest areas. The green belt has dual functions of adding greenery and beauty as well as serving as a region for food and raw material production.

a. Solar Technology: Solar technology is the largest renewable source of energy in Auroville. The most common application of solar technology is for cooking, water pumping, water heating, street lighting, and in some cases electricity generation. Some communities and buildings run entirely on electricity produced by photovoltaic (PV) panels. The PV systems used within Auroville are custom designed by Aurovillians, integrating inverter and battery storage systems for cloudy and rainy days. Currently, there are over 400 houses running solely on solar electricity. The largest and the most striking use of solar technology is in the solar kitchen which serves approximately 1000 lunches every day. The kitchen's power system is designed as a hybrid system (solar and diesel) with the diesel system stepping in when the solar energy generation is too low to support the kitchen operations. Auroville claims to be self-sufficient in energy.

AURORE; a renewable energy company based in Auroville has been working since 1992 as an integral service provider for high quality renewable energy applications and solutions. Products of this company include solar water heaters, solar power packs, solar street lights and solar pumping system. AURORE has successfully completed many projects in Auroville and has also executed projects in some of the remotest areas of Gujarat, Ladakh, Orissa, and the Andaman and Nicobar Islands in India. Another energy company - Auroville Energy Products' (AEP) - was founded in 1996 with the focus on high quality and efficient electronic control components for renewable energy systems; such as solar charge controller, inverter, hybrid (wind / hydro / diesel) controller and so on. AEP's aim is to provide a complete solution in collaboration with its local and foreign partners for renewable energy systems based on natural resources like solar, wind and water.

Image 51.

Auroville Solar Kitchen



www.shutterstock.com · 466939322



Source: Auroville Website

b. Wastewater Technology: The Center for Scientific Research (CSR) has applied innovative methods to customize the available wastewater technologies based on simplicity, affordability, and need for minimal energy input. To avoid inefficiency and high cost of municipal wastewater management, the CSR has adopted various techniques of integrated decentralized waste water systems. More than 60 natural wastewater treatment systems are in use in Auroville. These systems consist of underground containment and pre-filtration tanks, overhead oxygenating and polishing ponds and a post-treatment holding facility. For commercial and urban spaces that have very little space for ponds, the institute has designed a cylindrical vortex system which takes advantage of centrifugal and centripetal forces to filter and oxygenate the water. The resulting 'gray' water from the system may then be reinserted into the water table or used for local irrigation purposes. Another technology used for wastewater treatment is effective micro-organisms (EM). EM is an organic liquid composed of microbes, which quicken the decomposition of waste. When effectively added to waste water, it reduces the amount of sludge in the black and grey water. Auroville has several units which are actively implementing waste water treatment systems, including CSR and Aqua Engineers.

- c. Water and Soil Conservation: Integrated water and soil conservation program is an important part of sustainability. In the past, the monsoons would wash over the barren land, carrying topsoil to the ocean and creating deep ravines and gullies. The first step in halting that trend was planting trees to stabilize the soil, retain moisture, provide shade, and replenish soil nutrients. Over two million forest trees, nut and fruit trees, hedges, and shrubs have been planted on the acreage available for development. A second important technique for halting erosion was contour bunding. In bunding, interlocking grids of earth mounds enclose areas of land, preventing runoff and allowing rainwater to percolate down to replenish the water table. Extensive bunding has been carried out over each of the watersheds in Auroville. Additionally, Auroville has adopted pesticide-free organic gardening to complement the protection of scarce soil and water resources.
- **d.** Forestry: Reforestation is another important element of sustainability. Reforestation over the last 30 years has resulted in enhanced water table, increased natural resources in the form of a self-sustaining forest in place of barren wasteland and the sequestration of a considerable amount of carbon by the forest itself. One essential key to reforestation process is the integration of tools and techniques to prevent erosion and to increase soil fertility. The Auroville Nature Camp aspires to be a manifestation of "a living embodiment of an actual Human Unity." This educational activity brings together the children of Auroville and those of its surrounding villages for a collective experience of nature in the forest of Kavunji near Kodaikanal. Each camp offers a range of experiences designed to introduce the children to the flora and fauna of the area, to increase their environmental awareness, to awaken the spirit of adventure through treks and climbs, and to deepen their relation to and appreciation of nature. In the simple rustic camp setting children learn to live together in a group and to care for each other and the environment.
- e. Botanical Garden: The Auroville Botanical Garden was started in August 2000 on 50 acres of old cashew land rescued from the threat of real estate development. Since then the site has been transformed into a luxuriant landscape that serves as an area for research into environmentally sustainable approaches to land management, as well as a location for environmental education. More than 250 tree species have been planted in the 25-acre arboretum, 5,500 specimens have been planted in the 10-acre conservation forest, and a

plant nursery has been created, capable of producing 50,000 seedlings per year to promote the re-introduction of the indigenous flora of the region. Conservation and preservation of the Tropical Dry Evergreen Forest (TDEF) is the Botanical Garden's special mission. Botanical Services, is the commercial unit of the Auroville Botanical Garden dedicated to bringing ecologically sustainable solutions to the commercial, private and government sectors, drawing on the cumulative experiences of the Auroville Township, as well as the experience of creating the Auroville Botanical Garden, in how to create beauty in an ecologically vulnerable area.

- f. Farming: Auroville has over two dozen farms, which vary greatly in size and character. Those primarily engaged in growing Auroville's food are united under the Auroville Farm Group, each working with some combination of orchards, crop fields, vegetable gardens or dairy. The farmers study the relationship between traditional farming and modern agriculture and make use of eco-friendly technologies such as wind and solar energy for irrigation, micro-sprinklers and methane gas collectors. The farms use a wide variety of ecologically oriented farming philosophies, such as traditional organic, permaculture, biodynamic, natural farming, etc. In addition to farming some of the farms have other activities like food processing (cheese, jam, pickles and other value-added items that help to support the farms financially), education and training, research and a range of other farm-related pursuits, such as building up seed banks and procuring animal feed for the farm community. Out of over 320 acres of farm land in Auroville, about two thirds is currently under active cultivation, with the rest being used for timber-growing or left fallow. About half of the land is irrigated, with the other half being used for rain-fed crops.
- **g. Biogas Plant:** Biogas designs were developed in India as early as 1950. However, the Centre for Scientific Research at Auroville developed an innovative combination of a renewable energy system with an appropriate building technology. The outcome was a modular prefabricated ferro-cement biogas system suitable for small scale farm operations and producing biogas in the range of 2 to 4 m3 a day. Advantages of prefabricated biogas plant are the corrosive resistant digester and gasholder and a very short installation period of one day. Bio-waste and cow dung available in Auroville are used of the biogas plant to produce energy. Auroville Building Centre is also selling these biogas plants to outside users.

- **h.** WasteLess: WasteLess is a non-profit social enterprise dedicated to changing the harmful habits that affect the way we make, dispose of and think about waste. Waste is a serious and growing global problem. The way we use and discard it, is quickly destroying the Earth and water bodies and damaging our health faster than most people realize. Presently, when we think of waste, we follow a linear model. A product is created, we purchase it and, when we've used it, we throw away whatever's left. However, this approach generates an amazing amount of 'unseen' waste long before consumers touch it. Conservative experts claim that each kilo of garbage we dispose of in our bins produces 40 kilos of waste upstream from extraction to production to distribution. WasteLess has developed an innovative, activity-based curriculum called 'Garbology 101'. It is an educational tool kit that includes a 101 multi intelligence activities aimed to educated children (6-12 years of age) about waste, consumerism and the environment. It integrates easily into school program and stimulates analysis, critical thinking and hands on learning for a Clean Planet. Since separation at source remains one of the major challenges for waste management today, WateLess has developed an innovative card game called 'Pick it Up'. It aims to spread awareness on waste separation in a fun and interactive way.
- i. Daily Green Practices: Some of these practices at Auroville include:
 - 1. Separation of garbage based on its bio-degradable nature that allows the garbage to be reused for compost (fertilizers for gardens and lawns), or recycled.
 - 2. Auroville's EcoService manages solid waste for the international township of Auroville. An EcoService team collects waste from households, communities, guest houses, and restaurants and another team does the processing and sorting at a shed in Kottakarai. Waste is then either sold to recycling dealers, or land filled at the Auroville landfill. Approximately 60 percent solid waste is recycled while the remaining 40 percent is land filled.
 - Lavatory and eco-sanitation refer to the segregation and use of excreta for agriculture fertilizers. Fertilizers produced from these materials are cheap and good for garden and orchard applications. Communities such as Sadhana forest currently use this practice.

- 4. Community recycling and reuse project is yet another innovative practice. Instead of dumping old and unwanted items in the garbage, community members are encouraged to exchange or donate these items to a designated shop where they can be picked up by other community member who may find them useful. WELLpaper project reuses old newspapers and other unwanted items to create crafts and jewelry that are sold for profits.
- 5. Common communal facilities and schedules reduce energy consumption of the community. For example, offices within Auroville have similar tea time schedules. Since the tea preparation is done in bulk, less electricity is used in the preparation of tea. Replacing plastic bags with paper bags, and encouraging the use of recycled shopping bags reduces the litter accumulation within the area while also saving money in the community.
- 6. In order to minimize CO_2 emissions most Aurovillians use either bicycles or two wheelers. Of late about 5 percent Aurovillians have started using cars. Since there are no regulations governing use of vehicles presently the issue is under debate. A large majority of Aurovillians are of the view that cars should not be allowed in the township to preserve its sustainable character.

9.5 Town Planning and Architecture:

Auroville's Town Planning and Development Research Organization, is located at the Town Hall and includes sections for dealing with urban design, planning, architecture, topography, mapping, model making, infrastructure and data bank. Under its umbrella falls everything concerning the conceptual planning, design, architecture and execution of the physical township and its surroundings in terms of the galaxy concept and Master Plan of Auroville. It encompasses environmental matters, integration of services and infrastructure, non-polluting traffic, water harvesting and conservation, cultural heritage conservation, interaction with organic farming and forestation projects, as well as integration of villages and regional development needs.

a. Town Planning: One of the most remarkable concepts of Auroville is its master plan, laid out in form of a galaxy - a galaxy in which several 'arms' or lines of force seem to unwind

from a central region with four important zones; industrial, residential, international and cultural. Surrounding the city area is a Green Belt consisting of forested areas, farms and sanctuaries with scattered settlements for those involved in green work. Thus, in terms of physical development, Auroville aims at becoming a model of the 'city of the future' or 'the city the earth needs'. It wants to show the world that future realizations in all fields of work will allow us to build beautiful cities where people sincerely looking towards a more harmonious future will want to live. Through its Master Plan, Auroville hopes to demonstrate how 'urban' and 'rural' areas can complementarily develop in an integral and holistic way for their mutual benefit and well-being. It is common in many parts of the world that the expanding urban areas encroach not only on valuable agricultural land, but also tend to surround village settlements in such a way that they become islands of poverty with scarce infrastructure. Auroville's concept is to build a city that will economize on land needs by introducing development approaches with an optimum mix of densities and appealing urban forms and amenities, while the surrounding Green Belt will be a fertile zone for applied research in the sectors of food production, forestry, soil conservation, water management, waste management, and other areas which assist sustainable development.

b. The Auroville Earth Institute (AVEI): The Auroville Earth Institute is considered as one of the world's top centers for excellence in earthen architecture, working in 35 countries to promote and transfer knowledge in earth architecture. Compressed Stabilized Earth Blocks (CSEBs) are made in a manual press designed and manufactured in Auroville, using a mixture of earth with 5% cement. Some of the advantages of using CSEBs for construction are that they can be made on site and their manufacture needs much less energy and reduces pollution (a CSEB uses 10.7 times less energy to make than a country fired brick). The Visitors Centre, Solar Kitchen, Vikas Community, Realization Community and Pitanga are good examples of their diverse applicability in Auroville. Since 1996, the Auroville Earth Institute, which is now representative for Asia of the UNESCO Chair on "Earthen Architecture", has been developing an earthquake-resistant technology with hollow, interlocking CSEBs. This technology was used extensively in Gujarat after the 2001 earthquake and has received approval from the Gujarat and Tamil Nadu state governments as well as from the Government of Iran. The Earth Institute also offers regular training

courses that have been attended by thousands of students from 76 different countries since 1989.

c. Auroville Building Centre (AVBC): The Auroville Building Centre is the unit under Centre for Scientific Research which carries out the activities connected with appropriate building technologies and architecture. Over the years the center has acquired a unique reputation of its own particularly in the area of ferrocement technologies. In 1992 AVBC received the Hassan Fathy Award for Architecture for the Poor from the Society for the Revival of Planning and Architectural Heritage, Cairo, Egypt, for the construction of the Auroville Visitors' Centre, where cost-effective earth and ferrocement technologies have been applied in a public building. The center is a recognized training center for Craterre University of Grenoble, France, for Housing and Urban Development Corporation (HUDCO), India for its building center project managers and engineers and for the Council of Architects. AVBC is also a reference center for the International Ferrocement Information Centre (IFIC) at AIT, Bangkok.

9.6 Industrial and Commercial Activities:

The Mother envisioned industry and commerce to be an integral part of life in Auroville and a means of financially sustaining the economy of the Auroville community. She designated one of Auroville's four zones as the 'Industrial Zone', and called it 'Auroshilpam'. As this Sanskrit name connotes, industries in Auroville are mainly small-scale and pollution-free using local raw materials and talent. Many of them deal with handicrafts. These units cater to the basic needs of the residents and also generate some income for the general maintenance of the township. They also provide direct employment to some 4000 residents in the neighboring villages. The Auroville Board of Commerce (ABC) comprises executives of all Auroville commercial units, who appoint a core group to take care of the day-to-day activities. The core group of the Board meets regularly to approve the opening of new units, handle applications for business credits, co-ordinate yearly auditing of accounts, and advise units regarding accounts, finance, marketing, management, etc. The greatest challenge that Auroville commercial units face is to be efficient and productive in a way which conforms to normal business standards without compromising the spirit and ethics of Auroville. There are over 70 industrial and commercial units in Auroville. Almost all of them are based on sustainable eco-friendly practices and are inspired by individual creativity and innovation. Most of these units are innovative and competitive contributing to the economy of the township. These units cover a vast range of products such as organic food, milk, renewable energy, natural dyes, handmade paper, printing press, apparel and garments from organic materials, organic beauty products, toiletries, gems and jewelry, leather bags and shoes, art and craft, herbal supplements, toys, books, green architecture and so on. An estimated 3500 products are made by these units. www.auroville.com is engaged in e-commerce and is exporting over 26000 items every year to over 100 countries. Some of the important industrial and commercial units in Auroville are as follows.

- **a.** La Ferme Cheese: Started in 1988 this unit produces over 100 kgs of handmade cheese in 10 different varieties every day. Milk is procured locally either within Auroville or from the neighboring villages, pasteurization is done with biogas, water is pumped by wind energy and waste water is recycled.
- **b.** Auroville Bakery: This unit produces a large variety of bread, pastries and biscuits from organic farm inputs.
- **c.** Eco Femme: Eco Femme is women's empowerment initiative to promote and revitalize menstrual practices that are healthy, dignified, affordable and eco positive. In addition to the educational program the unit produces and promotes cloth washable pads, an alternative menstrual product, which lasts for approx. 75 washes and can prevent on an average 600 disposable pads or tampons. These washable pads also decrease the risk of rashes and yeast infections by using pure cotton cloth, which is soft and hypoallergenic. These pads are also exported outside India.
- **d. Wellpaper:** This is another initiative for empowerment of rural women and to promote waste-less economy. All Wellpaper products are hand-made and eco-friendly, transforming local raw materials and recycled newspaper into art and accessories. Product range include from baskets, bowls and coasters to jewelry, X'mas ornaments and colorful Paper Mache figures.
- e. AUREKA: AUREKA is an ISO 9001 certified engineering company focused on the design and production of equipment for sustainable construction and living. Specializing in earth

block presses and mixers, the company also produces windmills, shredders & chippers and accessories & spare parts. With more than 20 years of experience the company provides solutions for customers worldwide.

- f. Upasana Design Studio: Upasana designs and produces a variety of women apparel and accessories using organic cotton and sustainable ecofriendly practices. This unit has tie ups with several units outside Auroville for promoting sustainable practices and natural dyes.
- g. Auromode: This unit produces a range of fashion garments and accessories made of silk, the finest cotton, linen, and natural viscose based on green practices. The unit produces 2500 pieces a month and employs 130 people.
- h. Aurorachana: Aurorachana is engaged in the antique restoration business for over 25 years selling mostly in the wholesale market to dealers and wholesalers in Europe and other parts of the world. For the past 10 years it has been specializing in wooden handicrafts, contemporary designs, antique furniture and colonial reproductions catering to hotels, interior designers and private customers.
- i. Auroville Press: Set up in 1982, this unit comprises Auroville Paper and Auroville Press and Publishing. Auroville Paper manufactures handmade paper using local raw material and natural dyes. Auroville Publishing publishes books only on the theme of value education, human unity and evolution keeping in view the philosophy of Sri Aurobindo. Range of services of Auroville Press covers graphic designing, copy editing, typesetting, high quality scanning and image manipulation, sheet fed offset printing, silkscreen printing, binding, packing and shipping.
- **j. Bijou:** Bijou was born in 1985 as a creative endeavor to infuse imagination, originality and beauty into hand beaded products and to create employment for the local women of the local villages surrounding Auroville. The unit produces jewelry, tapestries and beaded wear using local material and talent.
- **k.** Maroma: Started as hand rolled line of incense with 12 fragrances, Moroma has evolved into a multi-product unit with moth deterrents, candles, soaps, shampoos, massage oils and other body care products. Based on local natural resources, Maroma products are completely non-toxic. Known for their quality they are exported all over the world.

- The Colors of Nature: This unit specializes in natural Indigo Fermentation Process and the Turkish Red Process to produce all variety of natural dyes. The unit not only produces dyes and dye yarns, fabrics and garments, but also weave and knit and can provide a whole range of ecofriendly textiles.
- **m.** UnLtd Tamil Nadu: UnLtd Tamil Nadu supports exceptional individuals to promote social entrepreneurship. Social entrepreneurs identify gaps in the society and address the problems of social exclusion, extreme poverty and environmental protection. This is done through a yearlong incubation program where the unit incubates 10-20 start-ups per year in diverse sectors. Workshops and thematic trainings on business planning, prototyping and market testing, fundraising, financial planning, communication, team building, management, legal issues, environmental sustainability and governance are the important methods and tools used. Projects incubated by this unit include WasteLess, Eco Femme, Amirtha Herbal and Sankalpa.
- **n.** In addition to the above there are many more industrial and commercial units, restaurants and boutiques. All these units based on sustainability, forms an integral part of the economy of this international township.

9.7 Survey on Sustainability:

As second part of the methodology, I undertook a survey in the form of a questionnaire circulated to the Auroville residents to ascertain their views on global sustainability issues. 26 residents responded providing their assessment. Respondents include; Dutch, French, British, Indians, Germans and Swiss with 9 females and 17 males in the age group between 32 and 80. Stay of the respondents at Auroville ranges between 1 and 41 years with an average of 20 years. The questionnaire and a summary of their responses are enclosed in Appendix II and III respectively. The following is the brief analysis of these responses.

 Understanding of Sustainable Development (Q-6): All the 26 respondents stated that moderation in consumption and exploitation of natural resources, reduction in municipal, chemical and industrial waste and preservation of bio-diversity were essential ingredients of sustainability. Two residents added that enriching health and dignity of mankind while simultaneously contributing to planet's biological productive capacity also form an integral part of sustainability.

- 2. Economic Development, Consumerism and Contamination (Q-7, 9 and 17): Every respondent except one either substantially or completely agreed that increasing industrialization, growing consumption and large-scale urbanization have resulted in massive contamination of water bodies, soil and air; resulting in global warming and climate change and could endanger life on Earth in the foreseeable future. 88% respondents agreed that economic growth and sustainability could co-exist with moderation in consumption and harmonious living with nature and that humanity cannot be at war with nature. 12% respondents felt that economic growth and sustainability were incompatible.
- 3. Success of Global Negotiations (Q-8): Over 80% respondents were of the view that the global negotiations on reduction in greenhouse gases have either failed or have achieve very little. Two respondents felt that these negotiations have been substantially or totally successful, while one of them had no idea about these negotiations.
- 4. Sustainability Achievable or Utopia (Q-10): All the respondents agreed that sustainability and respect for nature was an ancient and time-tested concept and with proper education and effective leadership could be realized to a great extent.
- 5. Gross Domestic Product and Human Happiness (Q-11): None of the respondents found direct correlation between GDP growth and happiness. Over 75% of respondents felt that fulfillment of basic needs, contentment and self-realization are important for happiness. Three of them supported the new UNDP concept based on health, education and per capita income while one of them supported the Bhutanese concept of Human Happiness Index.
- 6. Large Industrial Units and Mass Production (Q-12 and 14): 66% respondents believed that small-scale industries and self-sustaining communities was a better option compared to large scale units with mass production. Three respondents were of the view that both large and small units were needed while one person felt that large scale units with mass production was a better option. One individual termed 'consciousness' as the solution. However, 92% respondents agreed that large-scale units were contributing to the growing

disparity of income and wealth. One respondent expressed his ignorance while one felt that 'consciousness' was the solution.

- 7. Migration to Cities (Q-15 and 16): All the respondents were unanimous, although with varying degree, that destruction of rural industries, loss of jobs and lack of poor infrastructure in rural areas were responsible for migration to cities. One person also cited deforestation and thirst for material wealth as additional reasons for migration. There was also near unanimity that massive migration to cities was responsible for loss of human touch and growing distance between humans and nature. They felt that cities were becoming unmanageable while slums and criminality were growing.
- 8. Role of Technology and Innovation (Q-13): 82% respondents believed that no technology and innovation could be better than the functioning of natural systems based on recycling of air, water and soil. However, they also believed that renewable energy, energy conservation and treatment of waste could help in mitigating contamination. Three respondents were of the view that technology was a double-edged sword and has done more harm by promoting massive exploitation of nature.
- 9. Ancient Wisdom and Environmental Degradation (Q-18): 92% respondents were of the view that ancient wisdom was of great relevance in mitigating environmental degradation. One person was of the view that culture was a dynamic concept and another one felt that humanity could not go back in time to life of austerity and hardship.
- 10. Auroville an Example of Sustainability (Q-19): Except one all respondents felt that Auroville is a living example of sustainable development although much more needed to be done. Example of sustainability included; basic life-style based on inner and outer harmony, holistic education for higher consciousness and human unity, organic farming, water harvesting, sustainable earth-based architecture, renewable energy, water reprocessing, waste minimization and reprocessing, use of bicycles and two wheelers, forestation and tree plantation, use of credits instead of currency and so on. One respondent felt that Auroville is not an example of sustainable development except in the area of forestation. The former Secretary of the Auroville Foundation held the view that although it's not an ideal example it is one of the better experiments anywhere in the world and felt

that the pioneer spirit of the early days has somewhat faded and many people may not be walking the talk.

9.8 Group Discussion and Interviews:

The third part of my study on Auroville was to have a free-flow of ideas in open discussion individually and in groups based on the founding principles of Auroville and sustainable living. Under this methodology I tried to cover many senior citizens who were reluctant to answer the written questionnaire. Apart from free-flow of ideas, another purpose of such meetings was also to corroborate the contents of written questionnaire. Over a period of 4 days, I met over 35 prominent residents in separate groups of 4 to 6 and 5 residents individually. The following is the gist of these group and individual discussions.

1. **Paradigm Shift:** The following fundamental vision behind Auroville was to bring about paradigm shift in the way of thinking and living by raising the level of consciousness and integrating harmonious simplicity at every level and to achieve human unity.

"There should be somewhere on Earth a place which no nation could claim as its own, where all human beings of goodwill who have a sincere aspiration could live freely as citizens of the world and obey one single authority, that of the supreme Truth; a place of peace, concord and harmony where all the fighting instincts of man would be used exclusively to conquer the causes of his sufferings and miseries, to surmount his weaknesses and ignorance, to triumph over his limitations and incapacities; a place where the needs of the spirit and the concern for progress would take precedence over the satisfaction of desires and passions, the search for pleasure and material enjoyment" (Auroville, A Dream).

Most interlocutors opined that although the township is far from achieving this vision, the experiment is a work in progress with some visible achievements.

2. A Laboratory of Human Evolution: Many interlocutors termed Auroville a laboratory of human evolution that allows experiments on material and spiritual planes. This is the only township anywhere in the world that represents global cultural and religious amalgam and a life-style based on consciousness without observing national boundaries, societal and administrative hierarchy and cultural stereotypes. Thus, Auroville provides right

conditions for evolution of new global borderless consciousness-based society, free from religions, creeds, caste and ethnicity solely based on human values and human unity. All the interlocutors were unanimous in stating that experiments like Auroville have acquired more significance given growing religious and ethnic conflicts, widening distance between man and nature, increasing environmental degradation and the looming threat of climate change.

- 3. **Consciousness based Education:** Vision of Auroville provides that money would no longer be the sovereign lord; individual worth would have a far greater importance than that of material wealth and social standing. Therefore, in Auroville children are allowed to grow and develop integrally without losing contact with their souls. Education is given not for passing examinations or obtaining certificates and posts but to enrich human values and to bring out human potential. The primary objective of Auroville remains to replace titles and positions by opportunities to serve and organise the society in such a way that the bodily needs of everyone are provided for, and intellectual, moral and spiritual superiority is expressed not by an increase in the pleasures and powers of life but by enhanced duties and responsibilities. Beauty in all its artistic forms; painting, sculpture, music, literature, should be equally accessible to all; and must not be based on social or financial position.
- 4. Green Practices: In terms of green practices, Auroville can boast of many achievements. A barren piece of land has been converted into a productive and self-sustaining township in less than 50 years. Auroville's afforestation campaign began in the early 1970's. The first tree nurseries were started in Success and Kottakarai and, with the help of grants from the Point Foundation, the Tamil Fund and friends abroad, large-scale tree planting began. In the next ten years, as part of a massive soil and water conservation program, over a million trees timbers, ornamentals, fencing, fruit and fodder trees, nut trees etc.- were planted. As the trees grew, and micro-climates formed, many species of bird-life and animals returned, further accelerating the dissemination of seeds and enriching the environment. Aranya, Sadhana and Pitchandikulam forests and bio reserve centers are good example of afforestation. Water bodies, specially created to conserve rainwater and raise the water table, have attracted migratory waterfowl, fish, amphibians and aquatic arthropods. Today there are over 50 variety of birds including some rare species and over 600 plant species

including several medicinal plants. The Auroville Botanical Garden was started in August 2000 on 50 acres of old cashew land rescued from the threat of real estate development consists of 250 tree species and plant nursery capable of producing 50,000 seedlings per year.

- 5. Organic Farming: Although started with mostly barren land, today Auroville has over two dozen organic farms, which vary greatly in size and character; each working with some combination of orchards, crop fields, vegetable gardens and/or dairy. The farms use a wide variety of ecologically oriented farming philosophies, such as traditional organic, permaculture, biodynamic and natural farming. The farmers study the relationship between traditional farming and modern agriculture, and make use of eco-friendly technologies such as windmills (for water), solar energy, micro-sprinklers and methane gas collectors. Each farmer can work in his own field of interest, taking into account the quality of the soil, the availability of water, and other factors that determine the potential of each place.
- 6. Other Sustainable Practices: Many interlocutors high-lighted the sustainable practices in place in Auroville such as; renewable energy, water harvesting and treatment facilities, waste reprocessing, zero waste practices, use of natural colors and dyes, use of bicycles and two wheelers for transportation, sharing of transport, environmental friendly earth based architecture to minimize use of energy, small industries based on local skills, education based on consciousness and human unity and of course green practices and biodiversity.
- 7. Decision Making: Auroville Foundation Act of 1988 passed by the Parliament of India remains the fundamental law governing Auroville. Decision-making process is based on self-governance. All decisions are taken by Residents' Assembly (comprising of all residents) with a minimum of 50% of votes in favor of the proposal. Given total self-governance based on universal franchise, the decision-making process in Auroville is very slow. Moreover, it gets further compounded due to wide diversity of inhabitants coming from 53 countries with different ethnic, cultural and religious backgrounds. Most interlocutors felt that this is one of the main reasons for slow progress in attaining the vision of Auroville.

9.9 Conclusions:

Given the facts documented above it is clear that the township of Auroville is a human laboratory clearly based on the principles of human unity and sustainable living with zeroemission, zero-waste and green practices. Despite its comparatively modest size, Auroville is a unique experiment in raising human consciousness to achieve human unity and harmonious living with nature. To my knowledge, this is the only global township transcending national boundaries, race, religions and ethnicities (with 53 nationalities) dedicated to sustainable living practices. This is a fairly successful experiment based on the principles of ancient wisdom – consciousness-based living, austerity and moderation in consumption, respect for nature and contentment with less. In this era of environmental degradation and growing consumerism, this life-style presents an example worth emulating. If we can multiply such townships all over the world, sustainability can take practical shape on the ground and humans will be able to restore harmonious relationship with nature.

Chapter 10

Krishna Valley: A Case Study in Sustainable Living

10.1 Perspective:

In addition to Auroville, I was looking for another example of sustainable living particularly in the developped world, preferably in Europe to corroborate my research hypothesis. For this purpose, I chose Krishna Valley Somogyvámos, Hungary located in the heart of Europe. Dedicated to a life-style based on consciousness, moderation in consumption and complete harmony with nature, I found this township absolutely in tune with my research on sustainable development and relevance of ancient wisdom. Although, located in the developed world dominated by material wealth, Krishna Valley presents another successful human experiment on sustainable living based on ancient wisdom. In order to undertake a detailed study of sustainable practices on the ground in Krishana Valley, I paid three visits to the Valley - the last being in January 2018. Mr. Madhupati Das, an active member of the International Society for Krishna Consciousness extended his fullest help to me in organizing these visits. He also extended his services to me as an interpreter and translator whenever needed. His support was indeed valuable in completion of this research work.

In order to arrive at comparable results, here too, I adopted the same three stage methodology as I did for Auroville. A detailed study of the sustainable practices prevailing on the ground, a survey based on responses from the residents to a questionnaire identical to that used for Auroville and detailed interviews with residents and the members of the management team. Since most residents are Hungarian, the questionnaire was translated into Hungarian to elicit proper responses. A total of 26 members responded to the questionnaire. Mr. Madhupati Das helped me immensely in the English-Hungarian-English translation process. Separately, I was able to meet and talk to over 25 residents during the visits.

My findings based on the research and the inputs received in writing are summarized below. Section 10.2 provides basic information on Krishna Valley, its inception and and vision. Section 10.3 summarises the sustainable living practices in Krishna Valley. These include; consciousness-based education, sustainable farming and dairy practices, renewable energy, water and soil conservation, zero waste, small and cottage industries and so on. Section 10.4 summarises the responses received from the residents to the questionnaire circulated and section 10.5 outlines the outcome of group discussion and individual meetings with residents and management.

10.2 Consciousness Based Township

The Krishna Valley project was started in 1993 on a plot of land that gradually grew and presently measures 280-hectares and is located at 8699, Somogyvamos, Hungary. When the land was acquired for the project, it was in an advanced stage of degradation due to over grazing by animals for years. "There was nothing on the farm," said Radha Krishna Director Krishna Valley, "no buildings, no trees, no gardens; just one dilapidated barn on an old sheep run." It was primarily a degraded piece of land. Since 1993, over the last 25 years, the land has been transformed into a fertile valley with thriving agriculture, fruit trees, vegetable gardens and forest with a host of sustainable practices in place. Over the last three decades, Krishna Valley has emerged as the largest organic farmland at a single location and one of the largest ecological townships in Eastern Europe.

The township is based on the vision of "God Consciousness and Simple Living". One must not exploit nature but use it only to the extent needed, is the fundamental principle guiding living practices in the Valley. Only those who are devoted to these ideals are allowed to live and work at the Valley. Excessive desires and the culture of consumerism are incompatible with the life-style at the township. Before admitting anyone as resident in the Valley, applicants are tested for simple and sustainable living practices. As of 2017, the total number of people living inside the Valley were in the vicinity of 150 consisting of 70-80 families. Considering the housing constraints inside the Valley and the need to allow flexible life-style for those who cannot follow strict austerity, a number of them are allowed to live in the neighbouring villages. There are about 100 such residents. Unlike Auroville where are 53 nationalities, most residents in Krishna Valley are Hungarians. Only three families - two British and one Russian family constitute non-Hungarian families in the Valley. Apart from the spiritual aspects, the daily lifestyle involves work at the agricultural and dairy farms, looking after the nurseries and pavements, making processed products using locally produced inputs (fruits, vegetables, milk, honey and other agri-products), teaching at the school and cooking at the common kitchen.

Image 52.



Entrance to Krishna Valley

From an administrative point of view, the activities at Krishna Valley are divided into 9 divisions – Temple/Spiritual, Education, Agriculture and Food Processing, Green Areas, Tourism, Construction, Books and Charity, Kitchen, Catering & Supplies and General Administration. While Auroville is an international township and a foundation with a Residents' Assembly and a Governing Board created under an act of Indian Parliament and supported by UNESCO, Krishna Valley is an ecological township registered with the Government of Hungary. Therefore, their administrative systems are quite different. It is not my purpose or intention to go into their administratives differences. My purpose is confined to study the sustainable living practices in these townships located in two different parts of the world. The ecological life-style of Krishna Valley attracts over 30,000 tourists mostly from
Hungary and other European countries each year. The impressive entrance to the valley provides an idea of its development since 1993.

10.3 Sustainable Practices at Krishna Valley

a. Agriculture and Forestry: The available land at the Valley has been divided as follows:

Pasture Grazing Grounds	90 hectares
Forests	75 hectares
Agriculture	35 hectares
Orchards	3 hectares
Vegetable Gardens	3 hectares

The remaining 74 hectares of the land is used for habitations, common areas, schools, nurseries, a botanical garden and a Gaushala (cow habitation). Agriculture is 100 percent organic with cow dung serving as manure. No pesticides, herbicides or fertilizers are used in any form. Bulls are used for ploughing the fields. Use of modern agricultural machinery is almost negligible. Main agricultural produce includes wheat, barley, oats, chickpeas, amaranth, honey, fruits and vegetables. The township meets almost 100 percent of its food requirement from the local produce except during November - February when some vegetables and fruits are required to be bought from the local market. This is done against the sale of excess wheat, pumpkins and hay produced at the Valley.

All houses (including the temple, the office and school building) use wood for heating which is obtained from the forest land. Massive plantation has been undertaken in the forest land since 1993 to meet wood requirements during the winter season. I was told that over 400,000 trees have been planted so far. Nearly 60 percent of the fruit and vegetable requirements are met from the orchards and the vegetable gardens. Fruits grown at the Valley include; peach, apricot, cherry, sour cherry, apple, plum and pears. Excess fruits and vegetables in summer months are preserved in brackish water without any preservatives for use in the winter season. The Valley also maintains is own seed-bank for all the agricultural

products. Similarly, large well-equipped nurseries are maintained to meet the requirements of a variety of plants needed at the township. The following pictures provide an idea of the kind of agricultural practices followed at Krishna Valley.

Images 53 and 54.



Agricultural practices at Krishna Valley



b. Gaushala or Cow Habitation: The gaushala at Krishna Valley was opened in 1995. In January 2018 there were a total of 46 cows and bulls at gaushala. There is a proposal to increase the number of cows to 70 in the next 4-5 years. Antardhi Das, the manager, has been working for gaushala since its very inception. He feels proud and energetic taking care of these fantastic animals. He even wants to move one or two at his home so that his children could learn to live with them on a daily basis. Because of these cows, the township is self-sufficient in milk, milk products (cheese, yogurt, cottage cheese, butter etc.) and manure. These cows survive only on natural grazing and hay produced at the Valley; hence the milk is completely organic and healthy. I found the milk and milk products at Krishna Valley exceptionally tasty. The following pictures provide a glimpse of the cow habitation.

Images 55 and 56.



Gaushala at Krishna Valley



c. Energy: Krishna Valley is largely self-sufficient in meeting its energy needs except for a small quantity of cooking gas for the kitchen. Since the habitants do not have TV and other electric gadgets and generally follow the sun-cycle in their daily life, their energy needs are limited. The township is not even connected to the local electricity grid. Solar panels are used for lighting of houses. A combination of solar and wind energy is used for lighting of all common areas. There is a proposal to install another windmill to increase renewable energy production. Solar tubes are used for heating of water. Heating requirements in winter months is met from wood grown in its own forest land. Thus, almost all of its energy needs are met from renewable energy except for a small amount of cooking-gas.

Images 57 and 58.

Solar Energy at Krishna Valley



d. Water Supply and Sewage: The township is self-sufficient for water supply and sewage. Krishna Valley is not connected to the state water supply system. Ground water and water from an internal stream in the Valley are used to meet township requirements. There is no central water supply system except in the reception area and the main kitchen where solar energy is used for pumping the water. For individual houses, water is drawn from the wells with the help of solar pumps. Located close to Lake Balaton, Krishna Valley is a water-sensitive area as no untreated water is allowed to be discharged. The entire sewage is treated meticulously by using biological method based on Reed root Purification process. Since the use of plastic items are discouraged, the township generates no non-biodegradable waste. All the biodegradable waste is processed biologically into compost and used as fertilizer. Therefore, the township is self-sufficient for water and sewage and runs on zero waste principle.

- e. Bio-diversity: Due to the restoration of land through massive plantation and organic agriculture, bio-diversity at the valley has recorded a healthy growth. Additionally, a botanical garden has also been developed. As a result, species of birds have increased to 180 instead of 27 before. Similarly, there are over 500 varieties of plants now compared to less than 50 before. The management has now started the process for plantation of original indigenous fruit trees with the help of other eco-villages and private seed banks. This will further contribute to the bio-diversity of the township.
- f. Elementary Education (Gurukul): The township started a kindergarten in 2003 which was upgraded to Elementary School (Gurukul) in 2011. Presently there are 21 students in the age group of 6-10 and one student in the age group of 11- 14 with four full time and two part time teachers. The basic education at the school is based on the state compulsory curriculum. In addition, Sanskrit, English, Vedic literature, importance of nature in human life and devotional music are taught to all the students to raise their level of consciousness. Students are also taken for field visits to the botanic garden, horticulture farms and cow habitation to enable them to develop harmony with nature. Head mistress Sushila who is working at the school since 2003, briefed me on the school curriculum and teaching practices.

Image 59.





She told me, "I am here to teach them ancient culture in the midst of modern consumerism and bring them closer to nature." Sushila was a teacher at a government school but left that job to teach at the Gurukul. Sushila who has been to India was of the view, "people who look at Indian villages as primitive and under-developed are ignorant of the real meaning and value of life". The main purpose of Gurukul is to sow the seed of God-Consciousness among children.

- **g. Bhaktivedanta College:** While Krishna Valley does not have a High School, they are associated with Bhaktivedanta College located in Budapest which is meant for the age group of 18-26. Education at this college is based on the Bologna System of Education with three years of college and two years of masters. The Bhaktivedanta College teaches Vaishnava theology, Sanskrit, Vedic sciences and Vedic mathematics as well as yoga to impart education in ancient wisdom. It is the first state accredited institute of higher education in Europe which awards diploma in yoga.
- h. Seminars/Conferences: In addition to the formal education, special seminars and conferences are held from time to time on selected topics. Lilasuka Das is in charge of such events. These events are meant both for the residents of the Valley as also for the outsiders and are designed to address day-to-day issues of modern life. Topics for these events include; Body-Mind and Soul, Stress Management, Ayurveda, Ecology, Motivational Training, Imbalance in Life, Consumerism and Environmental Degradation and so on. Core message of such conferences is also uploaded on social media platforms like Facebook and YouTube. Many universities and organizations invite speakers from Krishna Valley on these subjects. Written material and books are also distributed on these topics.
- i. Local Produce: Residents of Krishna Valley are also engaged in eco-production in the form of cottage industry based on local raw materials. There are about 100 different products produced locally by the residents. These include; milk products, bread, sweets and cakes, honey, fruit jams, syrups, cereals, processed vegetables, fruits juices, herbal tonics and food supplements, toiletry and cosmetic items. Mr. Radha Krishna, Director told me that in order to regulate the quality of these products they intend to reduce the current

number of products to about 20-25 under a new brand named 'Balarama' which is likely to implemented by March, 2018. These products are available at the utility store located in the Valley.

Images 60 and 61.







(J) Common Kitchen: Krishna Valley residents have the option to take their meals in the common kitchen or at their homes. Those who prefer to prepare their meals at home get an additional allowance for food. Normally those living with children prefer to cook at home. Approximately about 50 percent residents take their meals at the kitchen. Collective cooking is not only cheaper but provides residents a unique opprtunity to meet and interact in an informal surrounding on a daily basis leading to better inter-personal relations and higher productivity. Of course food at the kitchen is made from organic ingredients and is healthy as well as tasty.

Image 62.

Common Kitchen at Krishna Valley



10.4 Survey on Sustainability:

As the second part of the methodology, I undertook a survey in the form of a written questionnaire circulated to the Krishna Valley residents to ascertain their views on global sustainability issues. 26 residents – 15 males and 11 females - responded providing their assessment. 25 respondents are Hungarian citizens and one from UK. Stay of the respondents at Krishna Valley ranges between 1 and 24 years with an average of about 10 years. A summary of their responses is enclosed in Appendix III. The following is the brief analysis of these responses.

- 1. Understanding of Sustainable Development (Q-6): All the 26 (100%) respondents stated that moderation in consumption and exploitation of natural resources, reduction in municipal, chemical and industrial waste and preservation of bio-diversity and harmony with nature were essential ingredients of sustainability. While 19 respondents emphasized on all the ingredients, 7 of them highlighted moderation in consumption and preservation of bio-diversity and harmony with nature.
- Economic Development, Consumerism and Contamination (Q-7 and 17): All respondents (92%) except two either substantially or completely supported the view that increasing industrialization, growing consumption and large-scale urbanization have resulted in

massive contamination of water bodies, soil and air; resulting in global warming and climate change and could endanger life on Earth in the foreseeable future. Remaining two agreed as well, but to a limited extent. 21 (81%) respondents were of the view that growing exploitation of natural resources, increasing consumption and large-scale contamination pose a certain or imminent danger to existence of life on the Earth in the foreseeable future while 4 of them felt that the danger to existence of life was limited.

- 3. Success of Negotiations (Q-8): 19 respondents (73%) were of the view that global negotiations on sustainable development have either completely failed or have been only marginally successful in containing greenhouse gases and large-scale contamination. One each was of the view that these negotiations have been considerably successful. 6 respondents did not have any idea on this issue.
- 4. Economic Growth versus Sustainability (Q-9): 12 (46%) respondents were of the view that economic growth and sustainability cannot co-exist while 13 (50%) respondents felt that with moderation in consumption and harmonious living with nature the two could co-exist. However, all of them felt that humanity cannot be at war with nature.
- 5. Sustainability-Achievable or a Utopia (Q-10): All the respondents (100%) held the view that sustainability is an achievable target. They felt that respect for nature is a time-tested concept and with proper education and cultural values sustainability can be realized to a great extent. One respondent also felt that most people remain engaged in their day-to-day activities and do not fully understand sustainability. For them sustainability is a utopia.
- 6. Gross Domestic Product and Happiness (Q-11): None of the respondents found direct correlation between GDP and human happiness. All (100%) of them were of the view that human happiness is the result of contentment and self-realization, once the basic needs are fulfilled.
- 7. Large-scale Industrial Units and Mass Production (Q-12 and 14): 25 respondents (96%) were in favor of small-scale industries and self-sustaining communities based on human creativity, and direct employment. One respondent felt that in modern era of technology, small-scale units are unviable. 19 (73%) respondents were of the view that large-scale production and distribution units are contributing to enormous or substantial disparity of income and wealth. One respondent denied this contention and five of them did not have any idea on the issue of disparity of income and wealth.

- 8. Role of Technology and Innovation (Q-13): 15 respondents (58%) were of the view that no technology or innovation could be better than the systems of nature which are based on inter-dependence and zero waste cycles. 9 respondents (35%) were of the view that the technology is a double-edged sword and has promoted more exploitation of natural resources through large-scale production units. 5 respondents (19%) felt that with the use of renewable energy and treatment of waste, contamination can be mitigated.
- 9. Migration to Cities (Q-15 and 16): 24 respondents (92%) felt that destruction of cottage and rural industries, loss of jobs in rural areas and comparatively poor education and health facilities are the principal causes of migration to cities. All the respondents agreed that massive growth of cities have created enormous distance between humans and nature, people are becoming more and more indifferent losing human touch and that there has been enormous growth of slums and criminality.
- 10. Ancient Wisdom and Environmental Degradation (Q-18): On this is there was complete unanimity that ancient values of moderation and austerity in consumption and respect for nature are the only way forward to sustain life on the Planet Earth.
- 11. Krishna Valley as an Example of Sustainability (Q-19): 22 respondents (85%) answered this question stating that Krishna Valley is indeed an example of sustainable living. They quoted examples of traditional organic agriculture, cow protection, spiritual values, self-sufficiency in water and food, vegetarian life-style, austerity in consumption, renewable energy, harmony with nature, zero waste systems and respect for others. 4 respondents did not answer this question.

10.5 Personal Interviews:

The third part of my study on Krishna Valley was to have a free-flow of ideas in open discussions individually. Under this methodology I tried to cover many senior citizens and the members responsible for overall management of Krishna Valley. Another purpose of such meetings was also to corroborate the contents of written questionnaire. Over a period of 4 days spread over two different visits, I met over 25 prominent residents individually. The following is the gist of these discussions.

1. God - Consciousness: I was told by many residents that living with God-consciousness was the cardinal principle governing life in Krishna Valley. Only those who are found God-

conscious are accepted as residents. There are daily prayer meetings and periodic discourses to promote God-consciousness. Yoga and meditation are also taught to those who are interested. Residents believe that without higher consciousness it is not possible to avoid the temptations of wealth, recognition, comforts and pleasure available in plenty in modern society. Education both at the Gurukul and the Bhakti Vedanta College are also consciousness driven.

- 2. Moderation and Austerity: Simple living based on basic human needs is the second core principle at Krishna Valley. The life-style is based on Vedic teachings. Drawing from the nature only as much as necessary for basic needs and violence against none are other important factors and therefore vegetarian food and harmony with nature are considered essential ingredients. Sun-cycle governs the daily routine. Basic needs of housing, education, food and medicine are available to all. No one has either time, money or desire to indulge in excesses and consumerism. Another objective of austere life-style is to raise the children in an environment away from desire driven consumerism so that the ancient values could be inculcated in the next generation.
- 3. Green Practices: Green practices or living with nature is the third core value at Krishna Valley. Rearing animals particularly cows, organic agriculture, self-sufficiency in food and water, zero contamination, renewable energy, common kitchen, consciousness-based education, handicrafts and cottage industry based on local raw materials and respect for all are other important guiding factors of life at Krishna Valley.
- 4. Paradigm Shift: I queried many interlocutors whether such a paradigm shift towards austerity and consciousness was possible in face of vast temptations of modern life-style. Most of them told me that it was a slow process and may take 30 to 40 years or even more. However, they felt that it was their duty to promote this shift in the interest of humanity as a whole. According to them Krishna Consciousness movement is already spreading fast covering over 100 countries as people are feeling happy and contented away from the mad race of consumerism, greed and stress.

10.6 Conclusions:

From the research outcome summarized above it is clear that Krishna Valley is also a human laboratory in sustainable living. The life-style at the Valley is characterized by consciousness-based living, moderation and austerity in consumption and respect for nature. This experiment proves that even in an environment primarily dominated by consumerism and located in the developed part of the world; sustainable life-style with austerity and moderation, zero waste and zero emission is possible. The residents in the Valley hold the view that ever-growing culture of consumerism is unsustainable and is detrimental to the very existence of humanity. Modern technology is a double-edged sword that can be used both for massive exploitation of nature to promote consumerism and to mitigate contamination through use of renewable energy and recycling of waste. Unbridled growth of cities is leading to massive slums and criminality and increasing distance between humans and nature which is unsustainable. Results of this empirical study are comparable with those from Auroville despite their different locations, composition and administrative systems.

Chapter 11

Research Questions and Conclusions

I started my research work based on four research questions stated in the beginning of this dissertation. It is now time to examine each one of them based on the research results detailed in preceding chapters.

Question One:

What is sustainability? Is there a paradox between sustainability and economic development? Could they co-exist?

As discussed in detail in chapter one, sustainability is the practice of maintaining processes of productivity indefinitely—natural or human made—by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems. In this sense sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs as stated by the World Commission on Environment and Development. Therefore, economic development and sustainability could coexist provided, the rate of use of renewable resources do not exceed their rate of regeneration, the rate of use of non-renewable resources do not exceed the rate at which sustainable renewable substitutes are developed and the rate of pollution emission does not exceed the assimilative capacity of the environment.

However, as discussed in chapter one, some economists hold the view that there is a clear paradox between economic growth and sustainability because of the following:

- a. If human consumption growth continues, the planetary life support system will be disabled and the very existence of humanity will be endangered.
- b. If the consumption growth is stopped, the viability of the global economic and financial system will be threatened endangering the stability of governments, social systems and individuals.

Even if we take this scenario, by simple logic we must choose the option with lesser evil. The first option is an option which endangers the human existence itself and hence second option is the only option available, although it may cause temporary disruption of financial and social systems.

Moreover, as explained in chapter three, the Gross World Product rose from US\$ 5.31 trillion in 1950 to US\$ 134.9 trillion in 2018 (on PPP basis) recording 25-fold increase just in 68 years. Ironically, despite such a massive increase in the Gross World Product; poverty, hunger and malnutrition are on the rise. Over 860 million people do not have enough to eat and 1.4 billion people survive with less than two dollars a day. 3.1 million children die annually due to lack of nutrition. Large-scale production systems of modern era, have destroyed the small and cottage industries in the rural areas leading to mass migration to cities. As a result, slum dwellers in cities have increased to nearly one billion and unemployment rate is on the rise. Thus, the large-scale production, marketing and distribution systems are resulting in more and more concentration of wealth and means of production with number of billionaires and millionaires increasing rapidly. Only 1% global population controls over 40% of global wealth and resources. Richest 20% in the world consume 76.6% of total global consumption while the poorest 20% consume only 1.5%. Blatantly unjust imbalance of this nature is completely unsustainable and could lead to social unrest in addition to environmental degradation as discussed in chapters 4-6. Moreover, this new

economic paradigm is resulting in millions of deaths every year due to malnutrition resulting from poverty and deprivation and millions of others facing life-style diseases due to plenty and prosperity.

Consumption cannot be the only goal of human life. It is often said that we do not live to eat but eat to live. How can we turn enemy of the very nature that supports life on the planet Earth? Consumption based on human needs and not greed is the key to sustainability. Needs are finite while desires are infinite and keep growing in geometric progression as explained in chapter 7. A fulfilled desire gives rise to many more and hence desires can never be fully satisfied. They only lead to mad race for higher GDP at national level and higher per capita income at individual level. This cycle at global level is leading to unsustainable level of production and consumption resulting in massive environmental degradation as explained in chapters 4-6. Education based on nature-consciousness and moderation in consumption are the only way to move forward on the path of sustainable development. This ancient wisdom contained in the Upanishads and advocated by Gautam Buddha, Lao Tzu and Mahatma Gandhi has been fully supported by literature review as well as during my research at Auroville and Krishna Valley where basic needs of all are fulfilled with no excessive consumption and zero contamination. This is the only way economic development and sustainability could co-exist.

Question Two:

What is the connection between rapid economic and technological transformations and environmental degradation?

Technology is a double-edged sword. On the one hand, it has contributed enormously to degradation of environment; on the other it can also be used to mitigate environmental degradation. The environmental cost of rapid economic and technological transformations has been fully documented in chapters 4 to 6 of this dissertation. The combination of technology and economic growth has been deadly. Net extraction of minerals was around 60-65 billion tones in 2008 which is like to go up to 100 billion tones by 2030. All in all, we move over 100 billion tons of material each year including unused extracted material or overburden. Each person on the planet uses on average over 8 tons of natural resources per year or 22 kg per day. If we include the unused extraction of materials (overburden), each inhabitant of the planet uses almost 40 kg per day. There is already a global power play for control over resources.

With increasing use of chemicals and pesticides, intensive agriculture and continuing deforestation, over 35 percent of world's top soil has been degraded. Approximately 24 billion tons of topsoil is lost annually, which is equivalent to about 9.6 million hectares of land. Soil loss rate exceeds soil formation rate at least by tenfold. This coupled with increasing population will naturally lead to food scarcity in the coming decades. Fresh water consumption has gone up 9 times during the last century due to increasing industrial, agricultural and municipal use. Per capita availability of fresh water on the global basis fell from 17,000 m³ in 1950 to 7,300 m³ in 1995, and is currently estimated in the range of 5000 m³. Many countries including some developed countries are already in water-stressed condition. Ground water aquifers are depleting fast. Many lakes and rivers have dried up completely, while many others are facing substantially decreased flow.

In addition to the increasing water consumption, massive contamination of water bodies due to industrial and municipal effluent is another serious problem. In addition to the huge quantity of industrial effluent, globally 330KM³ of municipal sewage and about 1.7 billion tons of solid municipal waste is generated every year. According to UNEP 6.4 million tons of litter consisting of 8 million items is dumped directly into the oceans and seas every year. There are 13,000 pieces of plastic every KM² of ocean surface. As a result of growing marine pollution, marine life and coral reefs have been seriously affected. Marine bio-diversity has declined considerably. Large-scale commercial fishing and global shipping industry are also adversely affecting the marine life. According to WHO/UNICEF Joint Monitoring Programme 2.5 billion people lack safe drinking water. Water borne diseases are increasing killing 3.4 million people every year. Experts foresee a massive water crisis looming large in the coming decades which can even lead to water wars. Already in many developing countries ladies spend hours just for a few buckets of drinking water.

Due to growing air contamination, quality of air has deteriorated in all the major cities around the world. According to WHO, in many cities air quality is rated as 'unhealthy to hazardous'. This is already causing serious health problems all over the world. According to WHO, globally over 7 million people die every year due to air pollution. Anthropogenic greenhouse gas emissions have increased substantially giving rise to global warming. Due to substantial emission of greenhouse gases - carbon dioxide, methane, nitrous oxide and ozone - global temperatures are rising. Emissions from industrial and manufacturing processes, transportation, commercial agriculture and deforestation are the major contributors of greenhouse gases with maximum contribution coming from the industrial processes. According to the Intergovernmental Panel on Climate Change between 1880 to 2012 global mean temperatures have risen by about 1.1 degree centigrade. Over the period 1992 to 2011, the Greenland and Antarctic ice sheets have been losing mass, and at a much larger rate over 2002 to 2011. The annual mean Arctic sea-ice extent decreased over the period 1979 to 2012, with a rate that was very likely in the range 3.5 to 4.1% per decade. Each succeeding decade has been warmer compared to the previous one, with the last 16 years of this century being the warmest ever. Over the period 1901 to 2010, global mean sea level rose by 0.19 [0.17 to 0.21] m. Weather patterns are becoming increasingly erratic resulting in manifold natural disasters all over the world. The IPCC 5th Assessment Report, the NASA Global Observatory, the European Environmental Agency and many more scientific observatories fully support these conclusions.

In the recent decades, technology has also helped in mitigating environemtal degradation in a limited way through renewable energy, waste reprocessing, water and soil conservation, development of small self-sustaining industrial units, environmentally friendly architecture and pollution control. Unfortunately, these have been as fragmented solutions and have been able to mitigate only a small segment of the problem. Technology has failed to provide one-stop comprehensive solution for restoration of environmental health.

Empirical research in the two townships of Auroville and Krishna Valley have clearly demonstrated that excessive consumption and contamination can be easily avoided with consciousness-based sustainable living. These townships have been able to achieve contentment in the life of citizens with moderation in consumption, absence of hunger and poverty, zero waste and complete harmony with nature. Therefore, if the humanity wishes to contain environmental degradation and natural disasters, consciousness-based sustainable living is the way forward. It provides a comprehensive one-stop solution. Mad race for higher and higher consumption and more and more Gross Domestic Product will continue to further aggravate the ecological disasters in the coming decades which may even render the Earth inhabitable for the coming generations.

Question Three:

What is the current status of international negotiations on issues of sustainability?

International negotiations on sustainability have been on the international agenda since the Stockholm Conference on Human Environment, 1972. Since then several impressive reports,

protocols and declarations have been produced by World Commission on Environment and Development 1987, the Earth Summit in Rio in 1992, UN Millennium Summit 2000, the World Summit on Sustainable Development in Johannesburg in 2002, the Rio+20 Summit in Rio in 2012, the United Nations Sustainable Development Summit in New York in 2015, and a host of conferences held under the United Nations Framework Convention on Climate Change. Preservation of environment and reduction in poverty and economic inequality have been the main thrust areas of these declarations and agreements. As part of 2030 Agenda for sustainable development, a set of 17 sustainable development goals and 169 targets were adopted by the United Nations in 2015.

As discussed in chapter one, although the Millennium Development Goals did help in poverty reduction to a limited extent, unfortunately none of these declarations, documents and agreements have led to any visible improvement on environment protection and climate change mitigation. On the contrary, during the 15 years from 2000-2015, environmental degradation worsened with 50% increase in emission of greenhouse gases, growing desertification, increasing contamination of oceans and unmitigated deforestation. Degradation of environment and inequality of income and wealth continue unabated since then as outlined in chapters 3 to 6. According to IPCC 5th Assessment Report 2014, total anthropogenic greenhouse gas emissions have continued to increase over 1970 to 2010 with larger absolute increases between 2000 and 2010, despite a growing number of climate change mitigation policies. The UN report on MDGs, 2015 as quoted in chapter 7 admits that "global emissions of carbon dioxide have increased by over 50 per cent since 1990. Greenhouse gas emissions are continuing unabated since then.

Moreover, the international community is primarily focusing on CO_2 emissions fearing the challenges of climate change. No serious attention has been given to contain soil degradation, water contamination, air pollution, deforestation and declining bio-diversity which are equally important aspects of environmental degradation. Without addressing these issues in totality achieving the goal of sustainable development will remain a distant dream. Even in the area of CO_2 emissions the Kyoto Protocol was a total failure. While CO_2 emissions are continuing to rise threatening climate change, the Paris Agreement signed in 2015 providing for voluntary reductions in CO_2 emissions is already running into serious difficulties with US threatening to withdraw.

Under these circumstances it is crystal clear that the international declaration, agreements and protocols have led to no visible improvement in environmental degradation ever since the Stockholm Conference on Human Environment 1972. Given the dismal outcome of international negotiations spanning over 47 years it is unlikely that the international declarations and agreements will be able to produce any concrete results in the foreseeable future. The IPCC 5th Assessment Report, 2014 as also the scientific reports of NASA and European Environment Agency support these conclusions. This fact was also confirmed during my research both at Auroville and at Krishna Valley.

Question Four:

Since our ancestors lived in harmony with nature for thousands of years, could their wisdom be relevant to contain environmental degradation?

Nature nurtures each one of us every single day. The air we breathe, the water we drink, the food we eat, the habitation we live in, the clothes we wear and whatever else we consume comes directly from the Mother Nature. The day this stops, human existence will come to an end. This is ancient wisdom and a plain and simple truth. No complex statistics, graphs or tables are needed to understand this simple fact. Under these circumstances how can we treat nature as an object of exploitation and a dumping ground for human induced waste? If we continue to do so, we are waging a war against our own existence.

The core issue therefore is, that the humanity cannot sustain the ever-growing exploitation of nature, rapidly rising consumption, rising economic inequalities, increasing emission of CO_2 gases resulting in global warming and unprecedented contamination of soil, water and air. According to a large number of scientific studies examined in this dissertation if the growth in production and consumption continues unabated, contamination levels will continue to rise endangering the very survival of life on Earth. As discussed in chapters 4 and 5, by 2050, the world is likely to experience serious water scarcity and challenges of food security. Death tolls form the collective impact of air pollution, water scarcity, water contamination and food shortages would rise tremendously. Climate change due to increasing CO_2 emissions will play havoc in terms of erratic and extreme weather patterns as discussed in chapter 6.

As outlined in chapters 9 and 10, my research clearly demonstrates that ancient wisdom based on austerity and moderation in consumption and consciousness-based living are the answers to address these problems. These conclusions have been validated both at Auroville and Krishna Valley. Therefore, moderation in consumption and respect for nature must replace greed for consumption and more and more exploitation of natural resources. Excessive and ostentatious consumption must be spurned. This is also the path towards inner peace and happiness. The Earth which sustains all forms of life cannot be reduced to a garbage bin nor can it be the object of exploitation. We cannot afford to be at war with the very source of our sustenance. This is plain truth and ancient wisdom for sustainable development and happiness of human race.

Research Conclusions:

The principal conclusions of my research can be summarised as follows:

- Nature is the source of our existence and sustenance. Human life and nature are closely inter-twined. Everything we consume in any form; comes from nature. We cannot be at war with the very source of our sustenance. Thus, harmonious relationship with nature is a survival need.
- 2. Over-exploitation of nature and excessive consumption are the primary reasons for environmental degradation as also for human distress. We should draw from the nature only as much as is needed. People should be encouraged to minimize consumption to their basic needs and not to engage in ostentatious consumption. Enlightened are those who can manage with less. Moderation in consumption is a one stop comprehensive answer to environmental degradation. The mad race for consumerism cannot be sustained without further degradation of environment.
- 3. Education based on consciousness is key to sustainable development. Sensitivity and respect for nature and austerity and moderation in consumption should form the foundation of this new education. Needs are limited while the desires are infinite and they grow in geometric progression. Chasing these desires is the primary cause of human distress and environmental degradation.
- 4. Large-scale assembly-line production units controlled by MNCs are the principal cause of environemtal degradation, increasing concentration of wealth and means of production; destruction of small and cottage industries; massive unemployment in rural areas and

large-scale migration to urban centers putting more pressure on urban centers and use of natural resource. These units have also reduced humans to a robotic life.

- 5. Turning the clock back to revert to micro and small production units is not easy. Heavy environmental and unemployment tax should be imposed on large production units. New technologies should be developped to decentralize production systems to revive rural economies and to restore human ingenuity, creativity and dignity. This will also ease mounting pressure on urban centers which are gradually turning into concrete jungles with crumbling infrastructure and massive pollution and heavy traffic.
- 6. In the recent decades technology has successfully decentralized many sectors of the economy. Decentralized and scattered production of solar and wind energy has reduced dependence on central power supply systems. Communication systems telephones, radio and electronic media have undergone a sea change, rendering the centralized telephone, radio and TV networks irrelevant. Social media networks are further diversifying electronic media. Similarly, 3D printing has the potential to replace large-scale production units into thousands of smaller units scattered all over. Governments and scientific communities are required to promote such innovative technologies to return back to diversified small and cottage industrial systems to restore human ingenuity, creativity and dignity and to make people self-sufficient and reduce their vulnerability. Such technologies will also help in reducing excessive concentration of wealth and income and reduction in extreme inequality.
- 7. Technology and innovations can supplement efforts towards mitigation of environmental degradation though clean and renewable energy, waste reprocessing, soil and water conservation, pollution control and environmentally friendly architecture.
- 8. Exploitation of nature must be replaced with respect for nature. Mad race for higher GDP and consumerism should be replaced with fulfilment of essential needs. These are the guiding principles for a sustainable and happy human society. This is also the wisdom of our ancestors who lived in harmony with nature for thousands of years.
- The life-style based on the wisdom of our ancestors is not a utopia. The human laboratories in two different settings – Auroville and Krishna Valley have clearly demonstrated that these are achievable goals. Of course, this requires a paradigm shift in our thinking process.

Inclusion of these values in the educational curriculum at all levels is the first essential requirement. NGOs and civil society could launch special campaigns to inculcate these ideas in day-to-day individual and societal behaviour. National leaders and social avant-gardes should present examples of simple living and high thinking so that ordinary citizens can emulate their foot-steps. Leaders should stop the mantra of higher GDP; instead they should talk of moderation in consumption. Global human happiness should be at the center and not the GDP. Global media as well as social media channels could help in supporting such campaigns at national and global levels. New townships based on sustainable development on the models of Auroville and Krishna Valley should be promoted to reverse the current trend of consumerism. This will be a right step toward genuine sustainable development. Such steps are already underway in a limited way, in some Nordic countries. Some countries have started promoting **Minimalist Approach** towards consumption which effective means the ancient wisdom of moderation and austerity with new terminology. We need to accelerate this process to mitigate environmental degradation and save humanity from the brink of disaster.

Possible Areas for New Research:

Environmental degradation is a complex issue with many dimensions – social, national, economic, technological, educational, cultural and historical. Several problems are inter-twined in a complex matrix. Many experts therefore, believe that in order to address this problem we need to work in multiple directions at multiple layers simultaneously. Therfore, the outcome this research could be further supplemented in a variety of ways with additional research the following areas:

1. Study on historical and cultural dimensions of environmental protection; such as tribal cultures, pastoral practices and so on.

2. Environmental education in different countries and at different levels.

3. Environmental awareness among citizens and the role of NGOs.

4. Environmental awareness in business community.

5. Possible areas for new technological research to reduce environmental degradation.

6. Successful experiments for protection of environment at national and global levels.

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New research in these areas will certainly enrich our knowledge in this vital field opening new options for mitigating environmental degradation.

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Chapter 9 (Auroville – A Case Study on Sustainable Living)

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Appendices

Appendix I

A. Details of published articles and books by Gauri Shankar Gupta directly related to the research on Sustainable Development and Relevance of Ancient Wisdom

Articles:

- The Paradox of Sustainable Development Periodica Polytechnica Social and Management Sciences 25(1), pp. 1-7, 2017 DOI: 10.3311/PPso.8919 May 2016, Budapest University of Technology and Economics.
- (Un) sustainable Use and Management of Water in the 21st Century Corvinus Journal of Sociology and Social Policy Issue 2018/1, pp. 81-100. (Jointly with Dr. Annamaria Orban).
- Land Degradation and Challenges of Food Security Review of European Studies, Vol 11 number 1, 2019, pp. 63-72.
- Environmental Degradation and Ancient Wisdom Delhi Business Review (Volume 20, Number 1, January-June 2019).

Books:

• "Limits of Consumption – Environmental Degradation and Ancient Wisdom" published by Hansib Publications, United Kingdom in October 2018.



• "Science and Spirituality" Published in December 2017 by LAP Lambert Academic Publishing, Germany (a member of OmniScriptum Publishing Group, Beau Bassin, Mauritius).



B. Details of other published articles and books by Gauri Shankar Gupta. Articles:

- Game Theory Chartered Secretary, Journal of the Institute of Company Secretaries of India, 1978.
- India's Foreign Policy Mongolian Journal of International Affairs, No 12, 2005.
- India's Foreign Policy Mongolian Journal of Strategic Studies, Volume 31, No. 3 (Fall 2005).
- India and Mongolia 50 years of Diplomatic Relations between India and Mongolia published by the Embassy of India Ulaan Baatar 2005.
- International Terrorism Mongolian Journal of International Affairs, No 14, 2006.
- Legends Never Die A publication on Elisabeth Sass Brunner by Nagykanizsa City Museum, 2010.
- India-Hungary: Widening Cooperation, Embassy of India, Budapest 2010.
- Tagore A Symbol of Indo-Hungarian Ties, Diplomacy and Trade, November, 2012.
- Overview of Indo-Hungarian Relations Indo-Hungarian Ties A Journey in Time, Published by Embassy of India, Budapest in 2013.
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- Science and spirituality -- Interreligious Insight, Volume 12, Number 1, June 2014 (pages 40-54), a Journal published by the World Congress of Faiths from US and UK.
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- Indian Diaspora in the Caribbean, India in the Caribbean (Socio-cultural Moorings of the Diaspora) – A publication brought out by the High Commission of India, Port of Spain in August 2015.
- Religions and Spirituality Studii de știință și cultură, Volumul XIII, Nr. 2, iunie 2017
- Religions and Spirituality Interreligious Insight, Volume 15, Number 1, June 2017 (pages 48-54), a Journal published by the World Congress of Faiths from US and UK.

Books:

• **"Mongolia: The Land of Blue Skies"**- Published by Roli and Janssen BV, the Netherlands in 2007 (Available at Amazon.com).



• "Unraveling Mysteries of Life-Modern Science and Ancient Wisdom" Published by Vaszistha Kft., Budapest in 2012 (Available at Amazon.com). This book has been translated and published in Hungarian, Romanian, Czech, Spanish, Hindi and Bhasha Indonesia.



• In addition, I have also published three poetry books; one in Hindi poetry and two in English poetry titled "Chand Lamhe", "Droplets" and "Sublime"



Appendix II

Research on Sustainable Development and Ancient Wisdom By Ambassador (Retd.) Gauri Shankar Gupta Case Study of Auroville/Krishna Valley Questionnaire^A

I am an external research scholar at the Szechenyi Istvan University, Gyor. This questionnaire is part of my PhD thesis on 'Sustainable Development and Relevance of Ancient Wisdom'. Target group of this study are the inhabitants of Auroville and Krishna Valley. Your help in completing this questionnaire will be greatly appreciated. You are free to tick one or more options in response to any question as long as they are not contradictory. I will request you to read the entire questionnaire before you start answering. All answers will be treated anonymously and dealt with strict confidence. The research is not for any commercial purpose. Results of this study can be provided on request.

- 1. Male/Female:
- 2. Age:
- 3. Nationality:
- 4. Duration of stay in Auroville/Krishna Valley:
- 5. What is your mission/purpose in Auroville/Krishna Valley?
- 6. What do you understand by sustainable development?
 - a. Moderation in exploitation of natural resources and consumption.
 - b. Reduction in municipal, industrial, chemical waste/contamination.
 - c. Preservation of bio-diversity and harmony with nature.
 - d. All the above.
 - e. I have no idea on this subject.
 - f. Any other views/comments:

- 7. Do you agree that massive industrialization, growing consumption and urbanization during the last few decades are responsible for large-scale contamination of water bodies, soil and air as also for climate change?
 - a. No, I do not agree.
 - b. I agree little bit.
 - c. I agree substantially.
 - d. I agree completely.
 - e. I have no idea.
 - f. Any other views:
- 8. Do you think that the global negotiations on sustainable development and Green House Gases have been successful in reducing contamination?
 - a. No, not at all.
 - b. Very little.
 - c. Substantially.
 - d. Yes of course.
 - e. I have no idea.
 - f. Any other views:
- 9. Could economic growth and sustainability co-exist?
 - a. No, because economic growth means more production, more consumption and therefore more contamination.
 - b. Yes, moderation in consumption and harmonious living with nature is important for steady and sustainable growth. Humanity can't be at war with nature.
 - c. Since the world is dynamic it's impossible to be static. Growth is inevitable in our civilizational march. Nature will take care of itself. We don't have to be excessively worried about sustainability.
 - d. Sustainability is an idea floated by the rich nations to contain the economic development by the poor nations. Poorer nations have to continue with economic growth.
 - e. Any other views:
- 10. Is sustainability an achievable target or merely a utopia?

- a. People in general do not understand sustainability. They are concerned about their day-to-day life and hence sustainability is merely a utopia.
- b. Human efforts are guided by comforts and desires. A life of comforts and plenty is therefore a natural path. Hence sustainability is a mere wishful thinking.
- c. Sustainability and respect for nature is an ancient and time-tested concept rooted in human history and culture. Nature is the source of our very survival. Everything we need starting with air, water, food and clothing comes from nature. Therefore, in our own interest we must learn to respect and live with nature.
- d. Ancient cultural values and traditions can help in sustainable development and respect for nature.
- e. With proper education and effective leadership sustainability can be realized to a great extent.
- f. Any other views:
- 11. In your view has the economic growth and higher Gross Domestic Product (GDP) added to human happiness and well-being?
 - a. Human happiness is the result of contentment and self-realization and not that of consumption or GDP.
 - b. Fulfillment of basic human needs is important but contentment and moderation are far more important for happiness.
 - c. Happiness is a broader concept based on good health, education and fulfillment of needs as outlined by UNDP in human development index. Contentment and self-realization play only a marginal role, if at all.
 - d. Without economic growth, higher GDP and fulfillment of desires; happiness is not possible. Contentment is merely a figment of imagination with no tangible value. Human beings have to fulfill their needs and want to be happy.
 - e. Any other views:
- 12. Do you consider mass production by large industrial corporations as a better option compared to small scale industries and self-sustaining communities?
 - a. I consider mass production, a better option since it is based on large-scale mechanization/automation, uniform quality and lower cost of production.
 - b. Small scale units are unviable in modern era of technology and mechanization. Survival of the fittest is inevitable.

- c. I consider small scale industries and self-sustaining communities as a better option as they are based on creativity, direct employment and human touch.
- d. Since the large-scale production units are over-exploiting resources and emitting/discharging dangerous pollutants, I consider small scale units a far better option.
- e. In large assembly-line units' human have been reduced to robots in flesh and blood due to repetitive action day after day and year after year where human thought and intellect has no place. Hence small units are far superior.
- f. Any other views:
- **13**. How do you see the role of technology and innovation in mitigating contamination and waste and promoting sustainable development?
 - a. With renewable energy, conservation of energy and treatment of industrial and municipal waste; contamination of air, water and soil can be mitigated.
 - b. Technology has in fact promoted large scale production units through mechanization/automation leading to over exploitation of natural resources, enhanced production and massive contamination. Technology has promoted massive non-biodegradable waste and hazardous emissions of chemicals.
 - c. Technology is a double-edged sword. However, it has done more harm through promoting massive exploitation of nature and mass production and contamination. Renewable energy, conservation of energy and reprocessing of waste are merely a sugar coating of the bitter pill of massive contamination.
 - d. No technology or innovation could be better than the functioning of nature with its systems of recycling of air, water and soil. Humanity must help nature in recycling of waste by eliminating non-biodegradable waste and hazardous emissions.
 - e. Any other views:
- 14. Do you agree that the large-scale production and distribution units are contributing to the enormous disparity of income and wealth through concentration of wealth and means of production?
 - a. Yes, I fully agree.
 - b. Yes, to a great extent.
 - c. May be in a limited way.

- d. No, not at all.
- e. I do not know.
- f. Any other views:
- 15. In the recent decades there has been heavy migration to cities from rural areas. In your view what are the principal causes of such demographic change.
 - a. Destruction of cottage and rural industries due to large scale production units.
 - b. Loss of jobs in rural areas due to destruction of cottage and rural industries and more comfortable job opportunities in cities.
 - c. Lack of basic infrastructure like electricity, water supply, heating and so on.
 - d. Poor educational, health and cultural amenities.
 - e. All of the above.
 - f. Any other views:
- 16. What are your views on destruction of rural habitat and unbridled growth of urban areas?
 - a. This has created an enormous distance between humans and nature. Children born and brought up in apartments in cities do not fully understand the interdependence between human life and nature.
 - b. Cities have become unmanageable with gradual deterioration in basic infrastructure.
 - c. People are becoming more and more indifferent losing human touch and values. Economics has become the core value.
 - d. There has been an enormous growth of slums with sub-human living conditions and increasing criminality.
 - e. All of the above.
 - f. Any other views:

17. In your view will the growing exploitation of natural resources for increasing consumption, large-scale migration to cities and increasing contamination of air, water-bodies and soil will endanger existence of life on the Earth in the foreseeable future.

- a. Yes definitely.
- b. Yes, it could lead to an imminent danger.
- c. May be in a limited way.
- d. Some attention should be given to avoid major disasters. Nevertheless, resources are meant for human use and we have every right to exploit them.
- e. I do not believe in the prophesy of doom. Let us live a comfortable life without worrying unnecessarily about the future.
- f. Any other views:
- 18. In this new era of mass production, rising consumption, growing contamination of nature and migration to cities, do you see any relevance of ancient values of moderation, austerity and respect for nature.
 - a. Yes of course, these values are the only way forward to sustain life on the Planet Earth and to bequeath this planet to our progeny.
 - b. Yes, these values are very important to avoid natural disasters but are not so critical.
 - c. May be, I am not sure.
 - d. Civilizational march and human advances cannot be reversed back to primitive life of austerity and hardship. Ancient values have very little relevance in this era of economic growth and human comforts.
 - e. Any other views:
- **19**. Do you see Auroville/Krishna Valley an example of sustainable development? If so how? Give examples of some distinctive features.
- 20. Any other views, observations and suggestions.

Kindly email your response to *guptags57@gmail.com*

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The questions included in the above questionnaire are based on the research work done for the chapters contained in the Dissertation as follows:

a) Questions 1 to 5 are preliminary questions to identify the respondents.

- b) Questions 6 and 9 are based on the contents of chapter 1.
- c) Questions 7 is based on the contents of chapter 2.
- d) Question 8 is based on the contents of chapter 7.
- e) Question 10 is based on the contents of chapters 1, 9 and 10.
- f) Questions 11, 14 and 15 are based on the contents of chapter 3.
- g) Question 12 is based on the contents of chapter 8.
- h) Question 13 is based on the contents of chapters 9 and 10.
- i) Question 16 is based on the contents of chapters 1 and 3.
- j) Question 17 is based on the contents of chapters 4, 5 and 6.
- k) Question 18 is based on the contents of chapter 8.
- 1) Question 19 is based on the contents of chapters 9 and 10.

Appendix III

Results of Questionnaire Based Research

(1) Auroville



Questionnaire Research Summary - ,

(2) Krishna Valley



Questionnaire Research Summary - I