IMPACT OF ICT ON ENVIRONMENTAL SUSTAINABILITY

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ABSTRACT

In recent years, the role of Information and Communication Technologies (ICTs) in the protection of the environment and combating climate change has received significant attention in different types of international forums. At present, the Environment management is the most important but most neglected discipline. It is very closely linked with the national development and economic growth. The developed countries have achieved high level of development and decent standard of living but at the cost of environment damage and depletion of natural resources. On the other hand, the developing countries are still struggling to attain a minimum standard of living though they are also contributing to the environmental damage. Thus both the developed and developing countries are damaging, depleting and polluting the environment; former out of greed and luxury, and the later out of need. It's the responsibility of each and every individual to protect the environment from damage and to avoid the depletion of natural resources so that we have a rich nation from social and economic point of view. The nature has been providing resources and protection to the living creatures including human from long time but now nature needs protection from the human being. Our objective is to minimize the resource depletion and protection of the environment from damage, which as a result leads to national development and economic growth. The impact of human activities on the environment – and on climate change in particular – are issues of growing concern confronting life on Earth. At the same time, Information and Communication Technologies are being rapidly deployed around the world. Although ICTs require energy resources, they also offer a number of opportunities to advance global environmental research, planning and action. This paper reviews key ICTs trends and provides an overview of the impact that ICTs have on the environment and climate change as well as their role in helping mankind to mitigate and adapt to these changes. The purpose of this paper is to discuss the role of Information and Communication Technologies for promoting environmental sustainability in a changing society.

Keywords **-** Environment, ICT, Management, Natural Resources, Sustainability

I. INTRODUCTION

Environment means the surroundings in which any business organization or living system operates. It includes natural physical entities such as water, soil, land, air, human beings, plants (flora), animals (fauna) etc. and their interrelationship. Its well-known fact that the environment provides resources to produce goods. Some of these resources are not renewable and those, which are renewable, do not get renewed at the same speed as they are consumed. Secondly, the process of production of goods does not produce goods only but also the waste. There is a great need to tackle these problems along with other environmental problems such as:

- Global Warming
- Ozone Depletion
- Hazardous waste
- Air Pollution
- Water Pollution
- Noise Pollution
- Soil Pollution

e-Environment is simply defined as the use of Information and Communication Technology (ICT) as an instrument for environment management and sustainable use of resources. It includes implementation of ICT based system to store, access, manage and disseminate the environmental data and information. We can also say that e-Environment is:-

- The use and promotion of ICTs as an instrument for environmental protection and the sustainable use of natural resources;
- The initiation of actions and implementation of projects and programmes for sustainable production and consumption and the environmentally safe disposal and recycling of discarded hardware and components used in ICTs, and;

- The establishment of monitoring systems, using ICTs, to forecast and monitor the impact of natural and man-made disasters, particularly in developing countries, LDCs and small economies.

1.1 Global Warming

Global warming means gradual increase in world temperature caused by green house gases. The greenhouse gases are Carbon Dioxide (CO_2), Methane (CH_4), Chlorofluorocarbons (CFC_4), and Nitrous Oxide (NO_2) etc., out of which CO_2 is the primary one. These gases come from various sources. Scientists have also indicated that there has been 25% increase in carbon dioxide during the last 100 years and it is expected that it will double in next 50 years, the major source being burning of fossil fuels, especially coal. Of course, deforestation would have its own share in the increase of green house gases. These gases have the property of trapping the infrared sun radiations in the atmosphere. As the concentration of green house gases is increasing continuously, the heat trapping is also increasing, thus causing the temperature to rise. This is called global warming. The main problems caused by global warming:

- Extreme weather changes. Hurricanes may be the result of such a change.
- Rise in sea level in coastal areas because of melting of mountain glaciers and expansion of oceans, which leads to flood.
- More electricity consumption, Lack in agriculture production and Change in ecological balance

1.2 Ozone Depletion

Ozone depletion is another global environmental problem. The sun emits radiations of different wavelength such as ultra violet (UV) radiations, infrared radiations and visible radiations. The UV-B radiations are very harmful for the living creatures. The ozone (O_3) layer in the stratosphere forms a shield, for living creatures on earth, against harmful ultraviolet solar radiations. The increase in concentration of various Ozone Depleting Substances (ODS) such as chlorofluorocarbons (CFCs), Hydro chlorofluorocarbon (HCFC), Halons (A compound consisting of bromine, fluorine and carbon) etc. are causing significant decline in the amount of ozone in the stratosphere and thus making it more and more thinner. This thinness in ozone layer is referred as ozone hole. If there are ozone holes, the UV-B rays will reach the earth and causing the harmful effects to the living creatures. The infrared radiations (longer wavelength radiations) are mainly causing the problem of global warming while UV-B radiations (short wavelength radiations) are primarily causing the problem of ozone depletion. The harmful effects of ozone depletion on the living creatures and plants are:

- Rise in temperature as much as 5.5^0C, which ultimately give rise to global warming
- Skin cancers, Health problems to human beings such as nose and throat irritation, extreme fatigue etc., Damage to eyes
- Reduction in the growth rate of tomato, bean, pine, tobacco and most other plants
- Disturbance in the process of photosynthesis and hence ecological balance

1.3 Hazardous waste

Environment as well as human beings is adversely affected with the increase in the production of hazardous wastes, which are toxic in nature. The primary sources that generate these wastes are given below:

- Waste from industries such as pesticides, polish, paints, fluorescent lights etc.
- Radioactive waste from nuclear installations
- Mining and quarrying industries
- Heavy metal industries such as lead, mercury, cadmium etc.

The hazardous wastes pose the following threats:

- Health risk to human such as cancer, eyes blindness etc.
- Environmental damage such as damage to soil, water and air

1.4 Air Pollution

Air pollution is, the presence of air pollutants in the atmosphere. Air pollutant means any solid, liquid or gaseous substance present in the atmosphere in such concentration that may be injurious to living creatures. The major air pollutants are originated from

- Industrial plants due to combustion of petroleum, coal, wood etc.
- Natural sources such as volcanoes
- Domestic sources
- Vehicles

- Thermal power plants
- Agricultural burning and much more

Air pollution influence the environment adversely that causes

- Asthma, Lung, Lever, and Kidney disease
- Volcanic eruptions
- Eye irritation, Cancer, Headache and much more
- Disturbance in photosynthesis process, Global warming

1.5 Water Pollution

The principal causes of water pollution are:

- Domestic waste and sewage
- Surface run off
- Discharge of industrial effluents
- Oil
- Nuclear & Thermal pollution and much more.

The water pollution has lot of adverse effects as mentioned below:

- Asthma, Lung, Lever, and Kidney disease due to Industries effluents
- Headache and teeth problems
- Depletion of Oxygen and it leads to suffocation.
- Water unfit for recreation process, Water unfit for human, animal and industrial use
- Killing of organic life, if oil polluted water in sea catches the fire
- Blood cancer due to nuclear pollution
- Killing of animal and plant life due to thermal pollution etc.
- Adverse effects on photosynthesis process
- Adverse effects on agriculture production and much more.

1.6 Noise Pollution

The release of unwanted sound into the atmosphere is called noise pollution. Noise is generated by various sources such as Industry, Road traffic, Trains, Aircraft, Loud speakers, Construction work and much more. Noise pollution affects the health of human being, both physiologically and psychologically in different ways as mentioned below:

- Exposure to noise for long duration leads to buzzing in ears or damage of the internal ear and subsequent deafness
- It disturbs rest and sleep
- It induces the development of short temper
- It produces vasoconstriction which reduces the flow of blood
- Excessive noise increases irritability, tension and feeling of fatigue, hence reducing efficiency at work
- Increase in blood pressure of patients suffering from heart diseases and much more

1.7 Soil Pollution

The immediate surface of the earth that serves, as a natural medium for the growth of plants constitute soil. It contains minerals, organic matter, air and water that support plant life by protecting it from wind and water erosion. The important soil pollutants are:

- Pesticides and Weedicides
- Industrial wastes, Ash from coal based industries
- Settling of air pollutants on the soil, Mine dust
- Chemical fertilizers and much more

Soil pollution can cause serious problems to the life of plants as well as of living creatures. These are:

- Hypertension, Cancer, Malformation of sex hormones
- Adverse effect on central nervous system, Food chain is disturbed
- Asthma, Lung, Lever, and Kidney diseases
- Skin diseases and teeth problems, Adverse effects on photosynthesis process and much more

The effects of global environmental issues are shown in Figure 1.

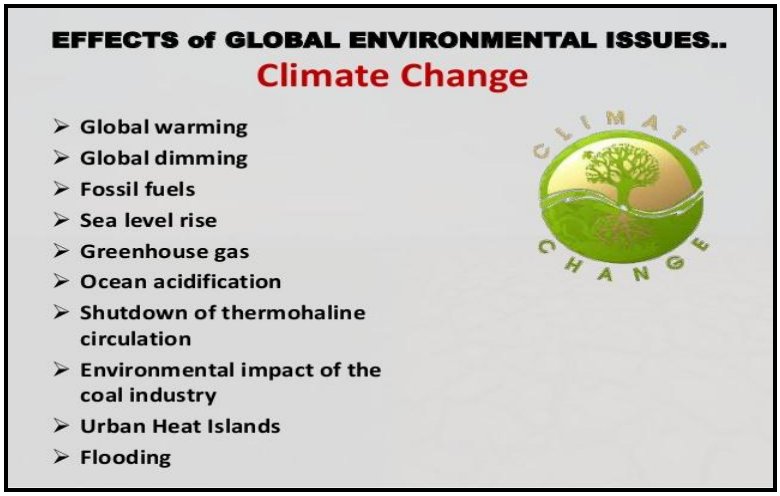

Fig. 1: Effects of Global Environmental Issues

II. NEED OF ENVIRONMENT MANAGEMENT

In the present scenario, environment management is the most important discipline that must be taken into the consideration, both for national development and economic growth. Both developed and developing countries have the rights to focus towards their development but it should not be at the cost of damage to the environment. Actually, there is a trade-off between the development and environmental management. So what we need at present is sustainable development. The sustainable development aims at minimizing the resource depletion, and the environmental damage. It follows the theory that the rate of consumption of natural resources should approximate the rate at which these resources can be substituted or replaced. Some of the efforts that can be put by the nation as well as each and every individual of nation for the successful implementation of sustainable development are:

- States should facilitate and encourage public awareness and participation in sustainable development.
- The 'Limit to Growth' principle should be followed while making development. We have to set a level of sufficiency i.e. this much of development and not beyond it, so that environment is protected from damage.
- Population factor alone has significant contribution towards degradation of environment and resource depletion. In India, We are adding more that one Australia in terms of population each year. So population growth needs to be controlled.
- The states should exchange new innovative technologies for sustainable development.
- Energy is derived from non-renewable resources (Oil, Coal and Natural gas) and renewable resources (Solar energy, Wind energy, Water energy, Biomass energy, Hydropower energy) and the former are in the process of depletion. So use of renewable energy resources should be increased to large extent, especially for the environmental reasons and sustainable development.
- Afforestation helps in sustainable development. The basic requirement for this is that the people with specialized managerial skills should do the forest management.
- The use of resources, on which one state has rights, should not damage the environment of other states.
- Decline in the biological diversity of our nation is a threat to our environment. The conservation of biological diversity is necessary for the sustainable development. Therefore, appropriate steps should be taken to control its continuous decline.
- Management of mountains, seas, islands and coastal areas is necessary for the sustainable development.
- States should reduce and eliminate unsustainable patterns of production and consumption.

- All states and all people should cooperate in eradicating poverty.
- States should enact effective environmental legislations for sustainable development. Punishment should be given to those who do not obey these legislations.
- States should develop national laws regarding liability and compensation for the victims of pollution and other environmental damage.
- The relocation and transfer of hazardous wastes among different states should be prevented.
- Polluter pay principle should be implemented.
- States should immediately notify to other states, if any natural disaster or other emergencies are likely to produce sudden harmful effects on the environment of those states.

It is clear from above aspects that the environment management is needed both, for the national development & economic growth and these needs can be achieved only through sustainable development. There is a great need to execute a systematic and well-planned procedure for the resources conservation and the protection of environment from all the sources harmful to it. This procedure for the overall management is called as Environment Management System (EMS). In other words, we can say that Environment Management System is adopted as a strategy by the enterprise for the overall management and it helps in meeting the expectations of the society as well as in sustainable growth. Having Environment management system would:

1. Lead to maintaining and improving the quality of environment.
2. Lead to resource conservation.
3. Protect both human health and environment.
4. Meet environment related expectations, of the customer.
5. Lessen interference from regulatory authorities.
6. Lead to good public relations.
7. Provide confidence to shareholders.
8. Lead to enhance image and market share.
9. Provide incentive for technology development and its transfer.

III. ROLE OF ICT IN ENVIRONMENT SUSTAINABILITY

ICTs can help to significantly reduce greenhouse gas (GHG) emissions while increasing energy efficiency and reducing the use of natural resources. This is achieved through the use of ICTs for travel replacement, dematerialization and reduced energy consumption. ICTs are essential to our understanding of the environment and to our ability to deal with environmental change. Newly developed high speed processors using energy efficient CPU designs along with the rapid diffusion of advanced broadband networks and deployment of web-based services are transforming the way environmental research, learning and decision-making are taking place. Faster processors using ever larger, accurate and detailed data sets are increasingly linked together through GRID networks and this is permitting more accurate, predictive and complete modeling of environmental processes. This in turn is facilitating decision-making thanks to new technologies such as geographic information system (GIS) and a new generation of web-based services such as virtual globe browsers which may gradually replace stand-alone software platforms. Today, a broadband Internet connection is probably the most important tool to support environmental research, learning and decision-making. There is a clear need for a more comprehensive and integrated approach to global environmental action through access to ICTs and the use of information technologies and management practices to eliminate duplication of efforts.

IV. IMPACT OF ICT ON ENVIRONMENT

It is important to understand the net impact of ICT on environment. However, the empirical evidence on how ICT contributes to environmental sustainability particularly at macroeconomic and global level is scarce. They find that ICT has significant positive impact on both economic growth and CO_2 emissions. The positive and negative environmental impacts of information and communication technologies (ICTs) are widely debated. In theory, ICT is among the sources contributing to the increasing levels of CO_2 emissions in terms of production of ICT machinery and devices, energy consumption, and recycling of electronic waste. However, ICT is also expected to reduce CO_2 emissions on a global scale by developing smarter cities, transportation systems, electrical grids, industrial processes, and energy saving gains. These two effects work in opposite direction, creating an inverted-U relationship between ICT and CO_2 emissions. The aim of this study is to investigate this non-linear relationship between ICT and CO_2 emissions on a global scale. Given that global warming is a global issue, it is necessary to look at this relationship in countries at all levels of development. To this end, we use a panel data set consisting of 142 economies, split into 116 developing and 26 developed countries, over the period 1995–2010. The results of our empirical study confirm that the relationship between ICT and CO_2 emissions is an inverted

U-shaped relationship. Moreover, while for the sample of developing countries, the ICT turning point is well above the mean value, the opposite is true for the sample of developed countries. This implies that many developed countries have already attained the level of ICT development, at which CO_2 emissions decreases as the level of ICT development improves further.

V. SUGGESTIONS

a) *Environment Management in Business Schools*

Till yet, very little attention is paid to the study of environment management in the Indian business schools. Most of the Business schools in India are not teaching the subjects of environment management while Schools of Engineering, Public Administration, Law schools are teaching this. This thing is of big concern because every student in business schools should be familiar to environmental issues. The mangers deal with industry directly or indirectly. They must have the thorough knowledge of

- Latest techniques for protection of environment from any damage
- Rules and Policies for setting up of a new industry
- Handling of waste products such as chemicals
- The process of production of goods in the organization
- Packaging of goods
- And above all environmental protection equipments. Environmental protection equipments are providing solution to major environmental problems especially by air cleaning, waste products utilization etc. and much more.

The students of the business schools are the new breeds of managers and they must know about all the environmental issues, problems and the way to handle these issues/problems.

b) Spreading Awareness among Society using ICT Tools/Applications

As we all know that natural environment is getting damaged every passing day. It is our priority to save the environment judiciously. Number of ICT tools/applications can be used to spread awareness among the society for environmental conservation and sustainability. For example:-

a) Whatsapp

b) Facebook

c) Twitter

d) Instagram

The society at large must be guided about the pros and cons of various environmental factors. One such photo seen in media about water conservation is worth sharing here.

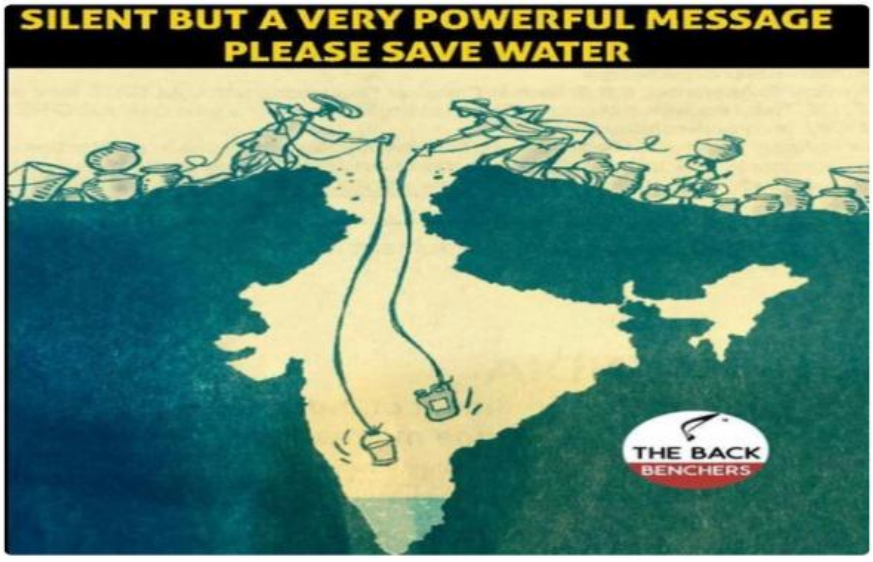

Fig. 2: Save Water Save India

Grandfather saw it in Rivers

Father saw it in Wells

We saw it in Taps

Our children see it in Bottles

Where will our grandchildren see it?

In Capsules?????

If we still neglect, It will be seen in Tears.

Please note that Packed Drinking Water (PDW) is not the solution. Every litre of PDW requires three litres of water and three more litres of water is required to manufacture plastic bottle. That means we are wasting 5 litres of water for every litre of PDW and additionally non degradable plastic waste. So let us avoid it unless it is essential. We all must Save Water. Every drop of water is precious, so conserve, preserve, recycle, reuse and reuse. Like saving water, we all have to think collectively to how to combat with air pollution, soil pollution, noise pollution, global warming, ozone depletion etc.

CONCLUSION

The relationship between Information and Communication Technologies & environmental sustainability is complex and still little understood. Will ICT help us move toward a more efficient and sustainable society, or will it increase resource consumption and emissions? The objective to "minimize the resource depletion and protection of the environment from damage" can be achieved to greater extent through sustainable development of nation, which as a result leads to national development and economic growth. Environmental planning: at the international, regional, national and local level, planning starts with a study and assessment phase that is based on the output information available from environmental observation and analysis. This is then used to develop policies and strategies. Environmental planning and decision-making uses many of the applications mentioned under environmental analysis. Decision support systems for environmental decision-makers are useful to assist the planning process and to help implement the activities stipulated under the plan of action. ICT applications have played major role in environmental planning, management and protection. As an example, Environmental Control Systems are emerging as tools that can allow remote management of human dwellings and facilities including buildings and construction sites. Intelligent building systems (IBS) integrate ICTs in their design and operation in order to manage comfort, security and costs. Using ICTs in the form of broadband cabling and wireless systems as well as networked devices and intelligent algorithms is the technological foundation for a "smart building". This consists of a combination of networked devices such as intelligent thermostats, presence sensors, lighting sensors and controls, heating ventilating and air conditioning systems (HVAC), security, fire, vibration, strain and moisture sensors, elevator and escalator control systems, and other building systems communicating over a "single broadband infrastructure". ICTs have been used both for managing the natural environment as well as human created environment. There is also greater use of ICT in policy formulation and for enforcement as well. The potential mitigating benefits of ICT use arise primarily in transportation (both in management and reduction), energy management (in the case of server management, smart buildings, etc.), production chain efficiencies by decreasing warehousing costs, inventories, etc., and in waste reduction through dematerialization.

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