

**Science and Technology: A New Development Paradigm  
by**

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I feel honoured to be invited to deliver this second Rajiv Gandhi Memorial Lecture, and am thankful to the organizers for having given me this opportunity to honour a youthful leader in India, who had a unique vision for the scientific and technological development of his country.

My topic today is on the need for a new paradigm for global development in the wake of multiple crises facing us at present. The signs had been there for decades, but the spirit of greed underlying the concept of accelerated economic growth based on maximization of profits, and ignoring the fundamental animal instinct in human beings have withheld a change in the direction of this development. I will dwell on this aspect later.

Our main agenda these days is the desire to embark on a sustainable development so that we improve the standard and quality of life of the peoples, while ensuring that we do not destroy the environment and pass on worthy livelihood for the future generations.

**The Nexus of Population, Development and Environment**

Three main parameters dictate our future orientation as a species on this planet. These are the issues of growing population, the type of development we envisage, and the type of environment we want to live in and leave as legacy to future generations.

The population of this planet, presently over six billion, is growing to seven to eight billion in the next thirty years, that is within the life time of most of us here. Out of this, we have nearly eighty percent living in developing and underdeveloped countries that will on their own, experience over two to three billion growth in this period. Already we have a situation in which 1.6 billion people have no access to electricity, and 1.2 billion live below the poverty line with less than \$ 2. a day, unable to meet their basic need.<sup>1</sup>

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<sup>1</sup> World Development Report 2003, Overview, Sustainable Development in a Dynamic World, World bank.

Out of this population, more than 60 % will live in cities and mega cities, with the pressure on infrastructure and basic amenities that this will bring about. The global resources are limited, but the desire of people to improve their living conditions, and simply to have a basic better livelihood is natural.

That is why it is imperative for the present generation to reflect on the type of development it wants to have, and the type of environment it wants to leave for future generations. Future generations should not blame us for what we have done as selfish human beings.

### **Role of Science and Technology**

Our development has been marked by our mastery of science and technology that has been the primary tools for changing our lives and ensuring basic needs. As tools, S&T is neutral. It is up to us to decide on what type of tools we develop, and what use we make of them.

Science and Technology on their own are ineffective. It is the economic, social and political visions that dictate their development and use. Unless we have sound economic, social and political orientations, we are likely to fall in a trap of inappropriate development, and soon destroy ourselves, and our planet. We need changes in our economic and social policies and a new vision for political development at global level.

### **Benefits of S&T led development**

There is no doubt that science and technology have changed our lives, with the multiple benefits that have accrued over the ages. First and foremost, our life expectancy has increased with better education, health care facilities, adequate food through better agricultural output, and overall higher standard of living. Most of all, science and technology have helped to reduce the drudgery of hard physical labour, and machines have changed our lives. Life has become easier on the whole.

Developments in the communications sector have brought human beings closer together with faster travel, better telecommunications, and the world has shrunk as a global village. The advent of satellite communication, mobile phones, internet, video and teleconferences has been a boon to mankind. Like any other technology it is up to us to make rational use of

them for the preservation of human civilization. This has strengthened and enlarged man's horizons, and we are now envisaging, through space travel, migrations to other planets where new developments are possible. We have acquired greater mastery over the forces of nature, and are able to meet the needs of an ever-growing population.

### **Negative aspects of Science and Technology**

While enhancing man's capacity to enjoy and live higher life styles, Science and Technology have also contributed to making lives more difficult by the wrong and inappropriate choices made by the users. When man started conquering new countries and peoples, developments of new forms of communication and warfare were crucial. Innovations, research and development, have led to new weapons of destruction, at times mass destruction through nuclear weapons. Day by day more and more **sophisticated weapons** are being developed and used in warfare, and billions of dollars are being spent to satisfy man's **greed for power** and control over the destinies of others. If only a small fraction of the amount spent on the development of new weapons and the pursuit of numerous wars was spent on the alleviation of poverty and the provision of basic needs globally, the world would be a better place. Asia and Africa are witnessing continued war, and the spill over is felt in the other continents. Daily thousands of lives are being decimated. The recent bombings in Mumbai are only the result of such asymmetrical development.

With the advent of the Industrial Revolution two and a half centuries ago, a new culture of **consumerism** has developed, with ruthless exploitation of the limited resources of the world. Respect for nature has diminished, with the belief that all that exists on this globe is for human consumption! **Existentialism** as a philosophy has become rampant in the developed world. People believe in one life that has to be lived to the full, irrespective of what happens to others and other forms of life. There is little if any, respect for other forms of life on the planet.

People are not content with simple life styles, and the spirit of **greed** has caught up. Accumulation of material properties and enjoyment of the same is the order of the day. Forget about plain living and high thinking!

Besides wars, global physical and natural **environment** are being destroyed. The environment appears to be the main victim of the type of science and

technology we have pursued. With the unbridled consumption patterns being promoted, **global warming** has resulted and unheard of catastrophes are becoming more and more common. The melting of the North pole ice cap has led to a **rise in sea water levels** globally. It is estimated that by 2050, fifteen major cities across the globe will be under water. London, New York, Bangkok, Shanghai and many others will not be spared. Can we imagine the havoc this will create, the lives that will be lost, and the trillions of dollars that will have to be spent to displace tens of millions of people to higher places and provide them with basic amenities?

Thousands of islands will be lost for ever in different parts of the world! People living in those islands will either disappear or have to be moved to safer places. Fifteen to twenty percent of Bangladesh now lies within one metre of sea level, and will be under water. 13 to 30 million people will be affected. Pacific islands like Tuvalu are already being evacuated. Maldives, 1,200 islands will disappear from the map! In Indonesia 17,500 islands are presently threatened.

Large rain forests in Brazil and other places can turn into savannas. Rising temperature and shifting rainfall patterns can affect major staple crops like maize and sorghum. **Biodiversity**, both on land and in the sea, is being fast decimated. Over the last ten years over 30% of this biodiversity has disappeared. Future generations will never see and admire certain plants, animals, butterflies, birds, fish, tortoise, and so many other species.

We are releasing millions of tons of **toxic gasses** in the atmosphere, gasses like CO<sub>2</sub>, SO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, ozone depleting chlorofluorocarbons, and these, besides polluting the environment, are adding to the greenhouse effect and accelerating the global warming. Here the major culprit is the consumption of fossil fuels, and an ever-growing need for them. Bigger cars, bigger airplanes, bigger factories, bigger houses, and the craze for material gains have become part of our symbol of civilization. The lifestyles we are emulating will be the poison that will destroy us.

Albert Gore who shared the Nobel Peace Prize for 2007 with the Intergovernmental Panel on Climate Change, while addressing the Nobel function, said: ‘ Today, we dumped another 70 million tons of global-warming pollution into the thin shell of atmosphere surrounding our planet, as if it were an open sewer. And tomorrow, we will dump a slightly larger

amount, with the cumulative concentrations now trapping more and more heat from the sun. As a result, the earth has a fever. And the fever is rising.’<sup>2</sup>

Globally cyclones, hurricanes, floods, landslides, droughts, desertification are increasing in intensity. More and more lives are being lost, but we still wish to mimic the same consumerist development path. This is leading to heavy discontent in some parts of the world struggling to survive, and violence in its multiple forms is increasing. Human conflict and growing disharmony are prevalent, leading to the rise of guerilla warfare, terrorist groups, and open warfare. Just to preserve our acquired privileges, we engage in the production of more and more terrible weapons of mass destruction!

This global warming has also led to the birth of new strains of **diseases**, bacteria and viruses. More money is going into research and development to find new cures for these diseases, and our health budgets are always strained. The rich have ailments different from the poor. Obesity and diabetes with cancer in one region strike at the face of starvation caused anemia and death in other parts of the world.

And the culprit is global warming due to man’s consumerism and greed! If we continue along the beaten track, we will need **five more planets** like our blue-green earth to enable us to survive, and this is nigh impossible now and within the next few generations.

### **What solutions? The Way Ahead.**

The grim picture of the world as described above can be changed. Man’s capacity to adapt to new situations is enormous! And there is no room for despair! There is need for a new global development paradigm based on the wisdom of seers through the ages, supported with government and private sector policies and strategies that can enable us to take a new turn on the road to sustainable development.

One thing is certain now. Old **economic theories** based on Adam Smith’s credo of the rule of the market dictated by demand and supply has failed miserably! The world is witnessing not only global climate spurred devastating catastrophes and ever-increasing social strife, but also a financial

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<sup>2</sup> Jagadish Shukla and Daniel Shaffer, ‘A new climate for change’, TWAS Newsletter, No.1, 2008, Trieste.

crisis, unforeseen by most, that has led to a global recession with increase in suffering of the billions in poor countries. While the rich will have to straiten their belts, others will simply disappear from the scene.

### **Visionaries of a new type of development**

After the industrial revolution with its stress on production based on economies of scale and profit maximization, a new breed of economists spurred by humanism came up. John Galbraith in the 1950s and Ernst Frederic Schumacher<sup>3</sup> in the 1970's were both influenced by Gandhian<sup>4</sup> concept of new patterns of decentralized production with possibilities of increased job creation and minimal energy consumption.

Galbraith realized that human nature is such that greed is inherent when maximization of profits becomes the objective. The vision of a trickle down effect has failed. The hope that individuals and companies will share the profits for the benefit of the poor in the developing world is remote, for over the years some have enriched themselves beyond measure at the detriment of the needy. In order to maintain their supremacy, they are able to influence policy makers and ensure that power stays in the hands of the chosen few.

The concept of profit maximization has to be reviewed. Just we have limits to economic growth within a context of sustainability, there is need to develop a new concept of **limits to profits. Through legislations**, profits should be allowed only up to certain levels to be decided by mutual consultation, and any excess generated should be shared with the less fortunate ones in other countries or in the same countries. The spirit of **Corporate Social Responsibility (CSR)** has to be promoted within enterprises. It has been observed in some countries that where the firms take this seriously, there is much more commitment by workers who feel that their employers are considerate to the family and social needs. Harmony prevails and the company's output increases. It is necessary to undertake studies on the CSR practice of companies, and to publish the results so that improvements can occur. Otherwise only lip-service will be the norm.

**Workers** should be empowered to become **shareholders** of companies so that they feel as part of a big family enterprise. This is the case at the BMW

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<sup>3</sup> E.F.Schumacher, 'Small is Beautiful: Economics as if People mattered.' 1973

<sup>4</sup> Mahatma Gandhi, Pictorial Bibliography by Dr. John Mott, Gram Udyog Patrika, 1937

factory in Germany where workers are prepared to work overtime at no extra pay in order to meet company supply commitments and time schedules. When other companies have been forced to lay off workers because of financial crisis, these workers accepted to take home a reduced pay-package and maintain their jobs, as they feel, as shareholders, a part of the company. It is revolting to note that during this period of global financial crisis, car-companies in USA have been laying off workers by the hundreds of thousands. At the same time the top executives of these companies have been enjoying fat salaries, and have been asking the government to bail their company out by providing billions of dollars. Very recently, in order to influence senators in US Congress adopt a bail package for them, many of them traveled by their private jet airplanes to reach Washington! Is there any sign of sustainable development in such context? Or the spirit of corporate social responsibility?

Schumacher, on the other hand, realized the harm that economies of scale were inflicting over the environment, and was in fact, one of the earliest to draw the attention of the world towards the need for sustainable development. Besides polluting the environment, carbon, natural gasses, and mineral oils are limited in quantity, and not renewable.

In his book, 'Small is Beautiful; Economics as if People Mattered.', he questioned prevalent economic theories, and wrote:

'Can such a system conceivably deal with the problems we are now having to face? The answer is self-evident: greed and envy demand continuous and limitless economic growth of a material kind, without proper regard for conservation, and this type of growth cannot possibly fit into a finite environment. We must therefore study the essential nature of the private enterprise system and the possibilities of evolving an alternative system which might fit the new situation....

Ever bigger machines, entailing ever bigger concentrations of economic power and exerting ever greater violence against the environment, do not represent progress; they are a denial of wisdom. Wisdom demands a new orientation of science and technology towards the organic, the gentle, the non-violent, the elegant and beautiful.'

The Pope Benedict XVI, addressing a congregation of thinkers in 1985, while reflecting on the supremacy of the market as proclaimed by Adam Smith who said that the rule of supply and demand is primordial, said: 'The

market is incompatible with ethics because voluntary ‘moral’ actions contradict market rules and drive the moralizing entrepreneur out of the game.’<sup>5</sup>

## **Gross Domestic Welfare**

National development has been measured in terms of Gross Domestic Product per Capita, and the standard of living based on that. It has been noted that this is not a fair measure of development, since the quality of life is not the same as the standard of life. A new concept of Gross Domestic Welfare (GDW), taking into consideration other factors like environment and peace, family spirit and solidarity, is a more appropriate one, and economists are fast developing this new global index. USA and Europe are the continents with the highest standard of living, and they are the ones that are contributing most to environmental degradation and lowering of the quality of life. Their consumption patterns are unsustainable, and if China and India join the band-wagon, following similar growth patterns based on heavy consumption of non-renewable fuels, the end of the world will not be so far!

## **The Problem of Energy: New and Renewable Sources of Energy (NRSE) V/S Fossil Fuels.**

The most important factor affecting human development is the amount of energy we consume per capita, and its origin. We need to reduce this amount, and start with improving energy efficiency in all systems. In parallel, we need to move fast to the development and use of new and renewable sources of energy, while eliminating as fast as possible, the use of fossil fuels.

Eighty percent of global energy consumed depends on coal, mineral oil, and natural gas. And these are non-renewable and fast depleting. On the other hand there are plenty of renewable sources of energy like solar, hydro, wind, wave, biomass and geothermal. Globally this accounts for only four percent, except for Mauritius where, because of use of sugar cane ‘bagasse’, this amounts to nearly twenty percent.

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<sup>5</sup> Pope Benedict XVI, The Acton Institute, Occasional Papers, “Market Economy and Ethics”, 1985.

The normal energy consumed per person for a healthy life is in the range of 2000-3000 kilocalories per day<sup>6</sup>. In the United States this is 230,000 kilocalories per day, or a hundred times as much. In other words a US citizen is gobbling the energy of hundred normal persons. In Europe it is fifty times as much. And this consumption pattern cannot be sustained! In the last thirty years the energy consumed worldwide has doubled, and the trend will continue unless we change lifestyles.

The world is waking up to the realization that the development and use of new and renewable sources of energy is essential for survival. But it is not easy to change things overnight. Many countries are paying lip service to the development of NRSE, especially those that have appreciable reserves of fossil fuels. And the sad story is that many countries are moving to the use of nuclear energy, building new nuclear plants to ensure sustained energy supply, not realizing that even nuclear fuel (Uranium, plutonium..) is non-renewable, and that there is so far no viable solution to take care of the radioactive waste products of nuclear plants. Some are also building many more coal-fired plants, knowing very well that coal is heavily polluting, and technologies available to contain the flux gasses are still inefficient. They produce twice the amount of CO<sub>2</sub> per unit of energy obtained. And still China is building one coal-fired plant every seven to ten days!

Developing countries are at an advantage by tapping on more efficient energy systems. The application of **passive heating and cooling for buildings** offers the possibility of having zero-net consumption! Buildings with less energy for lighting, heating in winter and cooling in summer, are possible, and architectural designs, enforced by legislation, should aim at this. Fluorescent bulbs, wind power, solar, photovoltaic, geothermal, wave and biomass are the options for the future.

Governments should urgently adopt policies to enable the development and use of NRSE, giving suitable incentives to the producers and users.

### **Appropriate Technologies**

A host of appropriate technologies are available and need to be enforced through legislations globally. Rather than rely of heavy industries gobbling massive amounts of energy, smaller units using appropriate technologies are

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<sup>6</sup> José Goldemberg, 'Lighting the way to a better future', TWAS Newsletter, No. 2 2008, Trieste, Italy

preferable. These technologies are environment-friendly, easy to maintain, and most often less costly. We can actually leapfrog in terms of this development path towards sustainability, using more efficient systems.

In the area of manufacturing, stress can be laid on the adoption of the concept of **3 R's**, Reuse, Reduce and Recycle in order to have **zero waste**. This concept can in fact be extended to all production and consumption activities, anywhere. It has to start from the home where everybody is educated to understand sustainability, and to make optimal use of energy.

We have to reduce the **environmental footprint** in all activities by educating the public, starting with the schools and colleges. It is essential to understand that the future can only be ensured through rational and optimal use of available resources. Recycling of wastes should start at home. In developed countries, as soon as some minor fault appears in any gadget, the tendency is to throw it in the bin and get a new one! Even when something is still usable, in order to save on labor, or taking the trouble to have it transported, it is simply thrown outside. Those who have been to student dormitories in the west, especially in USA and Canada, are shocked to see so many usable equipment, furniture, gadgets, just thrown on the pavements or near the dustbins. These include cars, refrigerators, washing machines, complete drawing room furniture, beds, kitchen utensils....! This is the spirit of consumerism!

Governments should aim **at reducing the emission of CO<sub>2</sub> by 2% every year**, through legislation, incentives to manufacturers and consumers.

Traffic congestion causes significant waste of energy. People have to be encouraged to use the car less, and to use public transport systems. There should be separate lanes for bicycles and motorbikes, and the government should encourage the public to utilize such less **polluting vehicles**. There should be fewer high cylinder capacity cars on the road, and battery operated electric cars, bikes, charged by solar and wind energy should be promoted.

**Airplane travels** should be discouraged for attending meetings and conferences. Video-conferencing and teleconferences should be encouraged. Developments in these areas are such that investments in the provision of such facilities are soon recovered, and a healthier climate is promoted. Travels abroad should be allowed only exceptionally. It is likely that the

tourism industry will suffer, but alternative ways of spending holidays can be developed to meet the needs of the people.

To achieve the above, a change in mindset is necessary. It has to start with people at the top giving the right example to others.

## **Conclusion**

In the face of this present global financial crisis coupled with the man-engendered global warming causing untold havocs to nations over the globe, it is opportune to press for a new mind set. Humanity's future depends on the speed and the extent to which a radical change can be effected in our conventional development paradigms. A new path for science and technology, along with economic and social policies and practices is necessary. We live on this sick planet, having a fever that is growing. We need to save it in order to save ourselves and generations to come.

Our needs are to be limited through elimination of greed, with stress on meeting the basic needs of populations. After all, what are our basic needs? For a country as Mauritius, the following quotation can be quite appropriate:

‘What do we need to live as a happy nation in an island blessed with matchless beauty, warm sunshine and multi-coloured rainbows, emerald green sea and wonderful casuarinas decked white beaches? Do we need concrete jungles with multi-storeyed structures barring our horizons, hiding the beautiful mountain profiles in the background, mountains that remind us of our cultural identity? Do we need five-lane divided motorways where the eternal signs of speed limit keep forcing us to have our foot on the brakes of powerful limousines? Do we need traffic jams and increased blood pressure in our veins, with the eternal fear of being sacked by our employers hungry for productivity gains? Do we need a world record in the magnitude of non-communicable diseases like diabetes and blood pressure, as is the case at present? Or do we need a more relaxed lifestyle with lesser earnings but with conscientious devotion to our duties, with **job security** and above all, more family love and social harmony? It is up to all of us to decide, and especially up to our policy makers and rulers!’<sup>7</sup>

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<sup>7</sup> Soodursun Jugessur: ‘Science –Based Development: Policy Issues’, Our Basic Needs, Ch XVIII. ELP Publications, Mauritius, 2008