

Dr. Manmohan Singh Ji, Hon'ble Prime Minister of India, His Excellency Shri Surjeet Singh Barnala, Governor of Tamil Nadu, Shri Karunanidhi, Hon'ble Chief Minister of Tamil Nadu, Dr Harsh Gupta, General President of the 94th Indian Science Congress, Dr Venkatarangan, Vice Chancellor, Annamalai University, Dr Ramasami, Secretary, Department of Science and Technology, distinguished members of the scientific community, delegates and invitees, ladies and gentlemen,

1. I am delighted to be here at Annamalai Nagar for the inauguration of the 94th Indian Science Congress as the event is unique for at least three reasons. First, all the previous 93 Congresses have been held in major cities and towns. It is for the first time that the Science Congress is being held in this salubrious environment away from the hustle and bustle of cities in the midst of our countryside. Second, is that the theme of this Congress addresses issues relating to 'Planet Earth' as a holistic all encompassing system, whereas in the past, Science Congresses have addressed specific aspects or components of the earth system. We all know that the United Nations has declared year 2008 as the 'International Year of Planet Earth'. Associated activities the world over will occur over the triennium 2007 – 2009. In that sense, the 94th Indian Science Congress is first in addressing issues that will be centre-stage in the International Year of Planet Earth. This again is an unique aspect of this Congress. Third, we have at the national level,

set-up a full fledged Ministry of Earth Sciences to concentrate and deal on the diverse issues and matters concerned with the Earth System as an integrated whole. The Government is thus fully seized of the import of the theme of this Congress. Now to turn to Planet Earth the reason for our very existence.

2. As we address issues confronting Planet Earth I am reminded of the words of Leo Tolstoy who said "The Earth is the general and equal possession of all humanity and therefore cannot be the property of individuals". We are all creatures of nature which is both bountiful and generous. Our existence is predicated on how we interact with nature which both creates and consumes us. "We do not inherit the earth from our ancestors, we borrow it from them for our children" truly reflects the centrality of the planet Planet Earth in the preservation of the human race. Understanding natural phenomenon and its impact on our lives helps us understand ourselves. Mahatma Gandhi rightly said " there is orderliness in the universe, there is an unalterable law governing everything and every being that exists and lives. It is no blind law, for no blind law can govern the conduct of human beings". We continue to be blind to that law at our own peril.
3. Nature's resources are finite. The environment gives to us free of charge basic services, without which our species cannot survive. The

ozone layer screens out ultraviolet rays from the Sun that harm human beings, animals and plants. The unique ecosystems of nature help purify the air we breathe and the water we drink. This ecosystem converts wastes into resources and reduces atmospheric carbon levels, without which global warming would have come upon us much earlier. Nature's bio-diversity provides us a bountiful store of medicines and food products. It maintains genetic variety based on the survival of the fittest and helps reduce vulnerability to pests and diseases. In that sense, nature is the oxygen without which we will perish.

4. But we Homo sapiens degrade and continue to degrade our environment with the over exploitation of nature; we are destroying the ability of the environment to providing its life-sustaining services to us through changes that are irreversible. During the past hundred years or so, the natural environment has borne the stresses imposed by a fourfold increase in human numbers and an eighteen fold growth in world economic output. As a result, the by-products of industrial and agribusiness production poison our soils and waterways; inappropriate farming practices, massive deforestation and uncontrolled urbanization have led to environmental degradation never witnessed so far. The quadrupling of carbon dioxide emissions resulting from burning of fossil fuels is causing global climate change

due to which the Earth's atmosphere is warming up. This has the dangerous potential to melt glaciers and the polar ice caps, raise sea levels and pose threats to hundreds of millions of coastal dwellers while drowning low-lying islands altogether. Portents of this future are already visible. As the warming trend gets accelerated, weather patterns become more volatile and more extreme, while the severity of weather-related disasters keep escalating. Masaru Emoto rightly said, " And we are beginning to hear the groaning from our tortured planet. We are at a point when we must realize that if we want to continue to call this planet our home, we need to change Not the planet but ourselves".

5. Modern technology has made us predators of nature. Take the case of fishing. At the beginning of the 17th century, the Grand Banks off Newfoundland held unbelievable quantities of fish. Fishermen saw cod shoals so thick that they were hardly able to row a boat through them. There were also halibut, haddock, pollock, flounder and plaice. Sturgeon eight to twelve feet long choked New England Rivers, and children collected buckets of ten to twenty pound lobsters to use as pig feed. Cod grew to five to six feet and was incredibly fecund. Today, a typical cod is about 18 inches long. A female used to produce 9 million eggs in a single spawning and spawned ten to fifteen times during her life. These species existed for millions of

years. They adapted to all of nature's changes, but not to the challenges of man's modern fishing technology. By 1988, marine scientist's models showed that the stock of fish in the Grand Banks were on the brink of collapse, with cod being in the worst shape. With super trawlers pulling nylon nets thousands of feet long through the water, 400 tons of fish in single netting has given unfair advantage to man in exploiting the living resources of nature. Recent nylon nets introduced, have mouths of the size of 50 football fields. Since factory trawlers are expensive to operate and fishing risks are high, owners need to keep them busy and ships keep fishing. Major fishes are gone. So trawlers net juvenile fish that have not yet spawned. Technology is used to catch fish lower in the food chain and as lower levels of food chain declines the chances of survival at the top of the food chain are destroyed. Researchers believe that stocks of fish have collapsed in nearly one-third of sea fisheries and the pace of decline is accelerating alarmingly. They are afraid that there will be virtually nothing left to fish from the seas by the middle of the century if trends continue at the current rate. Globally, in the last 50 years or so, we have lost 300,000 species on earth. At least 20% of our oceans need to be marine protection areas, if the fish population has to survive. At present, the figure is 0.01%. Technology globally should be used to preserve nature rather than

destroy it, as is being done. In 1995, according to the World Watch Institute, \$125 billion was spent annually to catch \$70 billion worth of fish and the \$ 54 billion difference is Government subsidies, most of it to foster over- fishing. This must be stopped. We must admire the wisdom of the Mahatma when he said " Earth provides enough to satisfy every man's need, but not every man's greed".

6. We certainly don't know enough for the present to run 'Planet Earth' on a sustainable basis. Yet there is hope. At least today we recognize the dangers of ozone layer depletion and the global community is attempting to address that issue. The 1987 Montreal Protocol on Substances that deplete the ozone layer was a first step. Production of the most damaging ozone-depleting substances has been eliminated, except in a few developing countries. Without the implementation of the Montreal Protocol, the levels of ozone-depleting substances would have been five times higher than what they are today and surface UV-B radiation levels would have been doubled at mid-latitudes in the northern hemisphere. On current estimates, the CFC concentration in the ozone layer is expected to recover to pre-1980 levels by the year 2050.
7. To control carbon emissions, we will have to cut down on burning of fossil fuels, which provides more than 75 per cent of the energy

worldwide. Today the United States generates 23% of the global carbon dioxide emissions. It generates eighteen times as much carbon dioxide per person as India. As the Chinese and Indian economies surge, the levels of such emissions will be alarming. The march from poverty to prosperity in Singapore raised the levels of carbon dioxide emissions from 1 metric ton to 22 metric ton per person in three decades. What will happen to our environment if the Indian and the Chinese economies sustain a double digit growth rate in the next two decades? Until recently 1 billion people of the developed world accounted for most of the carbon dioxide emissions. In future more than 4 billion people of the less developed world will account for these emissions. We must look beyond Kyoto. We need to find solutions now. Alternative cleaner technologies are the answer. Development of solar, fuel cell, wind turbine, photovoltaic and cogeneration technologies must be regarded as natural priorities. In the rural areas, not connected to the energy grid, the rapidly falling costs of solar cells and wind power have the potential to take energy to the poor at reasonable costs, reduce our dependence on fossil fuels and at the same time enhance agricultural productivity and rural India's capacity in generating income.

The international community alive to the problem of unacceptable

levels of carbon dioxide emissions now needs the political will to find solutions. We need a global initiative that will deliver, not multilateral forums for debate. We need solutions at the political and technology levels. Industrialization, urbanization and the unabated growth in vehicles globally, more so in India, have resulted in profound deterioration of air quality. Our four metropolis top the most polluted centres of the world with urban air quality at unacceptable levels. This needs our urgent attention as well.

8. Water is central to all life; it is today, both precious and scarce. Globally, we use about 160 billion tons more water than is replenished by the rain that feeds into water storages. If the water were carried in a convoy of trucks it would be 300,000 miles long everyday and 37 times the diameter of the Earth. This is the extent of overuse of water resources globally. Groundwater supplies about one third of the water required by the world's population. The unsustainable, but largely unnoticed, exploitation of these water resources in India is a particular source of concern. In some cases, water tables are falling by several metres a year. In regions of low rainfall or remotely located from rivers and lakes, optimum utilization of this resource becomes very critical. There is thus an urgent need to find science-based solutions for ground water exploration and management, especially in the drought prone areas of the country.

Our Government has taken several initiatives in watershed development and ground water replenishment. I shall be happy if the scientists through their deliberations on this theme come out with suggestions to increase cultivable land under irrigation without causing damage to the environment or human dislocation.

9. The shortages of freshwater are not the only problem. Fertilizer runoff and chemical pollution threaten both water quality and public health. More than one fifth of freshwater fish stocks are already vulnerable or endangered because of pollution or habitat modification. Our rivers downstream from large cities are little cleaner than open sewers. The health impact of such pollution is devastating. We have endeavoured so far unsuccessfully to clean up the major rivers. We need to find solutions and put in place measures that lead to sustainable condition of river waters.
10. On the food front, increases in farm productivity boosted by high-yield plant varieties and an increase in fertilizer use have greatly enhanced our food security — but often at considerable environmental cost. Also, the rate of agricultural productivity has slowed down in the 1990s. Annually, as we misuse earth's resources we lose 100 million acres of farmland, 24 billion tons of top soil and create 15 million acres of new desert around the world. An inch of

quality top soil takes a thousand years to form but can be destroyed in a few months with mindless deforestation. Land degradation is increasing and there are serious constraints to expanding irrigation. Advances in agricultural biotechnology may help by creating drought, salt- and pest-resistant crop varieties. But the environmental impact of biotechnology is yet to be fully evaluated and many questions, in particular those related to bio-safety, remain to be answered. Thus the threat to our future food security is real. We need to seriously debate on this.

11. Increasing populations and economic growth continue to drive a seemingly insatiable global demand for forest products. Several million hectares of our forest land have been lost since Independence due to over-harvesting of timber, conversion into agricultural land and encroachment. Our reforestation efforts are not yielding the desired results. The need for S&T intervention is thus inevitable.
12. We have not yet properly deciphered the phenomena of the monsoon, getting more complex with the interplay of various factors such as El Nino, climate change, etc. The reliability of the monsoon is key to our future food security. Reducing the margin of error in monsoon prediction would facilitate selection of the appropriate

crops and sowing patterns leading to increased productivity. An increased and effective observational system coupled with modeling based on locale specific conditions is required for refined and reliable predictions. Undoubtedly, this is a challenge for our scientists.

13. Societies, not only in India but the world over are becoming more vulnerable to natural disasters mainly attributable to human activities. We have seen that in the past two years, major natural disasters have unleashed their fury in different parts of the world. The year 2005 witnessed about 650 disaster events leading to a loss of 100,000 lives and property losses worth over Rs.11000 crores; 2004 was equally devastating in its death toll and destruction owing mainly to the Tsunami on 26th of December. Developing countries including India suffered the most, as we were least prepared for such emergency situations. It is imperative for us to put in place technology and systems that respond effectively not only to the adverse impact of natural disasters but enable us to whenever possible predict them. Learning from the Tsunami debacle, we enacted the Disaster Management Act and set up a National Disaster Management Authority, with the Hon'ble Prime Minister as its Chairperson. We are now also helping States to set up State and District level Disaster Management Authorities.

14. As a consequence, the ecological crises we confront have many causes. They include poverty, negligence and greed — and above all, failures of governance. These crises do not admit of easy or uniform solutions. It is also true that technological breakthroughs that are unimaginable today may solve some of the environmental challenges we confront. Perhaps they will, but we should provide for disincentives to decrease the likelihood of their occurring, as it would be foolish to continue business as usual. With a global population of more than 6 billion people pushing our way to an estimated 10 billion in 2050, we need solutions now, not tomorrow. The possibility of nearly 60 percent more people on our planet means that we will need the resources of two 'Earths' to sustain us. We must thus begin planning today on how we will provide for our needs by then. A formidable challenge for all of us.

15. I believe the first major effort in this direction is enhancing the level of public education. Real understanding of the challenges we face is alarmingly low. As more and more of us live in cities insulated from nature, the need for greater awareness grows. Consumers everywhere have to be made aware that their choices often have significant environmental consequences. School children have to be taught of the impending dangers.

16. Second, for too long, we have pushed environmental issues to the sidelines. These must be fundamentally repositioned in the policy-making processes not only at the government level but at the corporate level as well. Environment concerns must become integrated into the mainstream of all our economic policies and activity. The surest way to achieve that goal is to modify the systems of national and corporate accounts so that they begin to reflect the true environmental costs and benefits of development. At this science congress we take a pledge to inform our national policies in terms of what a famous American astrologer once said "Our loyalties are to the species and the planet. We speak for Earth. Our obligation to survive is owed not just to ourselves but also to that Cosmos, ancient and vast, from which we spring".

17. Let me now turn to the state of science. Undoubtedly, our science outputs as reflected by publications and international patents have picked up pace over the last decade. The rate of growth of publications was about 5% in the decade of 1995 to 2005 but doubled to over 10% during the five year period from 2000-2005. Also, our share in international publications has steadily increased over the period. Our PCT patent applications have enhanced tenfold from less than 50 in 1998, the year we took recourse to this route, to around 500 in 2004, confirming the confidence reposed and

investments made in science and technology by the government over the years.

18. The National Development Council met two weeks ago and has approved the approach to the Eleventh Five Year Plan with a GDP growth rate of about 9%. This will entail massive inputs in Science and Technology. We are accordingly seeking an unprecedented four-fold increase in the outlay for science and technology. I am confident that with the unstinted support and patronage that science and technology commands in the corridors of decision making, we will be able to secure this level of funding. It would then be our endeavour and responsibility to position Indian science and technology at the commanding heights of national development.
19. We are proud that today over 300 global companies have set up their R&D and technical centres in India, attesting to the quality and competence of our scientific and engineering human resource base. In this respect, Bangalore has become our show piece. Like the Silicon Valley, it is now a part of the English lexicon. A recent study of US patents granted from Bangalore over the period 1995 to 2005 shows that nearly 500 patents were granted, of which sadly less than 10% were owned by Indian entities, showing that Indian scientific and technical talent in India is creating intellectual property for

foreign companies whereas Indian companies are not taking adequate advantage of this resource. This is an aspect that we now need to focus on, how to create and derive economic value from our scientific outputs.

20. While on the subject, I cannot but quote the words of the 'architect' of Indian Science, Pandit Nehru, who on the occasion of the opening ceremony of the CSIR Headquarters building in New Delhi, where I presently have my offices, said, ***"It is ultimately technology that provides the basis for the advancement of the country Unless there is progress in the technological fields the country will have to depend on technical advice (technology) from foreign countries, which are not always ready or willing to give such advice or which give only superficial advice...."*** How true these words are even today.
21. We thus need to develop a three pronged strategy for science and technology. First, to raise the 'quality and the numbers of our human resources in science; second , to deepen and widen the valorization of our science outputs; and third , to mitigate and improve the quality of our environment by mounting 'mission mode' networked programmes for Process Research Initiatives for Zero Emissions (PRIZE) for a wide spectrum of industries.

22. In regard to raising the quality and quantity of scientific output, we have evolved a vertically integrated programme starting from the level of school children to the University level. A few of the new initiatives are:

- the Innovation for Science Pursuit for Inspired Research (INSPIRE) project which seeks to create innovative learning experience through appropriate awards amongst one million school children and by intermingling of the brightest 50000 school children with the icons of Indian and global science;
- Scheme for Early Attraction of Talent for Science (SEATS) at plus two school level that will assure careers in science for at least 500 talented students per year;
- recognizing and enriching the research base in 20 star colleges in 'life sciences'; and
- step increase in funding of research in 10 selected Universities to bring them on par with global levels.

23. Valorisation of S&T outputs of publicly funded R&D institutions continues to be a weak link in the national innovation chain, especially in the newer and emerging areas of life sciences, pharmaceuticals and nanosciences. We therefore seek to establish -

- a National Technology Management Centre in Biotechnology with around ten regional technology transfer cells;
- a Biotechnology Industry & Development Assessment Council to further facilitate interaction between academia, research and industry;
- an Institute of Translational Research in health that will help to seamlessly dovetail outputs in genomic research to clinical trials stages; and
- jointly with major industry players, specific research-industry clusters, the first being the Agri-Food cluster in Punjab.

24. We are confident that with the all round goodwill and support and the strategic initiatives mounted at the government and institutional levels, Indian science and technology will do the nation proud within this decade.

Thank you and Jai Hind.