Fourteenth T. A. Pai Memorial Lecture

Decade of Determination to Achieve Sustainable Development

BY

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Decade of Determination to Achieve Sustainable Development

1. Introduction

I deem it a great honour to deliver this memorial lecture named after Shri T. A. Pai, whom I had known since my student days. Coming from an illustrious family of business men, and with his abiding interest in education and development, T. A. Pai became a house hold name in Udupi. He and his uncle Shri Madhava Pai created the excellent educational complex at Manipal on the outskirts of this temple city, which stands as a living monument to their credit. It was only but natural that the services of such a talented person were requisitioned to serve the entire nation, which he did with great distinction as a Cabinet Minister in the Central Cabinet. The unique characteristic of T. A. Pai was his unwavering commitment to the development of the society.

While India can take justifiable pride in developing a healthy, democratic system of Government and has no doubt made considerable all round progress during the last five decades since independence, the explosive growth in population combined with limited natural resources has severely eroded the quality of life in the country. India, covering just 4.2% of the global land area but carrying over 16% of world population, continues to suffer from serious shortage of capital, large scale illiteracy, low agricultural productivity, industrial backwardness, inadequate infrastructure, severe environmental degradation and a rapidly growing population. In spite of the phenomenal developments, the promise of gains from science and technology still eludes a majority of the people in the country whose aspirations for a better and richer life remain unfulfilled. Unless we firmly resolve to make the next decade, a decade of determination to achieve integrated sustainable development, our nation will undoubtedly witness a major catastrophe – that of the spectre of millions dying of naked starvation. As beautifully summarised at the 1992 Intergovernmental World Summit held at Rio de Janeiro:

> *"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, illiteracy and*

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the continuing deterioration of the eco-systems on which we depend for our well being. However, integration of environment and development concerns and greater attention to them all will lead to the fulfilment of basic needs, improved living standard for all, better protected and managed eco-systems and a safe, more prosperous future."

2. State of Post Independent India

In the last 50 years since independence, our country has no doubt achieved considerable growth, thanks to the truly visionary policy of Pandit Jawaharlal Nehru who recognised that *"It is an inherent obligation of a great country like India, with its tradition of scholarship and original thinking and its great cultural heritage, to participate fully in the march of science, which is probably mankind's greatest enterprise today".* The gross national product which was just around 9000 Crores in 1950 has gone up by a factor of 5 in real terms. The annual output of food grains has increased from a mere 55 million tons to over 190 million tons. The total irrigated area has increased from 20 m. ha. to 50 m. ha. during this period. A country, which was facing the spectre of hunger and starvation in the 60's, has today not only attained self-sufficiency in food production, but also has become a marginal net exporter of food grains. In the industrial sector, during the same period, the coal output has increased from 30 to 250 million tons, petroleum from 0.5 to over 30 million tons, steel from 1.7 to 15 million tons, and commercial energy production from barely 2 GW to 85 GW. Average life expectation in India has gone up from 30 to 60 years during the corresponding period.

While these figures are impressive and embellish statistic profiles, the real per capita income and quality of life of an individual has not improved significantly. Almost 40% of our countrymen still live below the poverty line, unemployment of even the educated is on the increase, industrial growth has not been able to initiate a revolution and the educational system has remained stagnant, unable to produce innovative scientists and technologists who can strike new pathways. The percentage of illiterates in the country still remains a staggering 47% of our total population, with over 66% of female population unable to read and write. The average intake of food continues to be as low as 2400 calories/day. Mortality rate of children under five, which is the generally accepted criteria for representing the true index of health and living conditions, is about 130 per thousand as against less than 15 in the industrialised nations. In spite of the phenomenal advances

in medical sciences and health care, pollution of poverty, widespread illiteracy and environmental degradation in both urban and rural areas have resulted in over 3 million children dying every year from rampant respiratory and communicative diseases. The real annual per capita GDP is a low $1000 as against over $17000 in industrial countries, placing India in the bracket of the countries having very low human development. Over 25% of our people do not have access to even safe drinking water. The per capita energy consumption is hardly 250 kg. oil equivalent, one thirtieth of that in USA. In terms of human development index, which is based on the quality of life evaluated using four major factors namely food sufficiency, economic security, ecological integrity and social equity, India ranks a low 135 among 175 nations of the world. The outlay on scientific research, which alone can create necessary technical manpower who can effectively contribute to the wealth of the nation, continues at a meagre level of less than 1% of our GDP, which is hardly conducive to the creation of the technological society of the future. The expenditure on urban water supply, sanitation and other health improvement measures is a meagre 3% of our total plan allocation, which has left most of our urban cities and rural population with poor sanitation and health care.

The explosive growth of population in India, as in all the developing countries, is undoubtedly a major factor which has been responsible for the perpetuation of poverty. In spite of the population control measures which have been adopted in the last two decades, the crude birth rate has only reduced to 29 per thousand which is still far away from the desirable target of 21 per thousand which is the replacement fertility rate. The population in India which was barely 350 million in 1950 has now already crossed 900 million and is expected to only stabilise at 1.8 billion by 2100. The consequent reduction in the availability of land to just 0.15 ha. per capita which is unable to sustain large rural population, has led to the inevitable migration of people to urban areas in search of gainful employment. The phenomena of large scale urbanisation in India and other developing countries is exactly similar to that witnessed by developed nations 50 years ago. The urban population in India, which was barely 30 million in 1900 has already increased to over 260 million and is expected to cross 400 million by 2000, growing at the rate of 4% per year. Even more important, while only 26% of the total urban population in 1900 lived in cities with over 100,000 population, the share of the larger cities has dramatically increased to 65% which is a reflection of the growing industrialisation and better employment opportunities available in

mega cities. Consequently all our mega cities, which are already suffering from a serious social deficit, have further degraded and have become sources of concentrated environmental hazard instead of engines of growth. The escalating brown environmental degradation, inadequate infrastructure and poor sanitation have created mega slums in all our major cities like Calcutta, Hyderabad, Mumbai, Chennai, Delhi and Bangalore, where the annual solid waste generated is almost a million ton, 50% of which is not even collected let alone recycled, making them fertile breeding grounds for a large number of communicable vector diseases like cholera, plague, typhoid and malaria.

The negative repercussions of the very green revolution have resulted in rendering vast tracts of once fertile land into saline and alkaline deserts due to extensive water logging, indiscriminate use of chemical fertilizers and inadequate drainage. Extensive deforestation has reduced our forest cover to less than 20% of the total land area, only half of which is closed forest having over 40% canopy, making our national policy statement of having 33% of land area under forest cover yet another ludicrous pious statement of pontification. Increased run off of rain precipitation, severe soil erosion, sedimentation of water bodies and land degradation resulting from deforestation, together with the pathetic management of agricultural land and water resources have resulted in the severe degradation of over 100 million ha. of the available 160 million ha. of arable land. In spite of the green revolution the agricultural productivity in the country is just 1.6 ton/ha. as against the world's average of 2.6 ton/ha. and over 5 ton/ha. achieved in the developed nations.

Indiscriminate discharge of sewage, dumping of solid waste, improper aquaculture and release of harmful effluents from poorly managed industrial establishments have resulted in polluting river water and surface water bodies severely contaminating the air we breathe, water we drink and the food we eat. The coastal zone environment, which provides habitat to over 50% of our population, has become the final dumping ground of particulate, chemical and biological pollutants picked up enroute by the multitude of rivers flowing back into the oceans. Superimposed on these is the irreversible long term effect due to the perturbation of the green house equilibrium resulting from uncontrolled anthropogenic activities. Frequent occurrence of extreme natural disasters like floods, cyclones, earthquakes and droughts have further added to the misery of the vulnerable population of our country.

In industrial productivity India ranks a low 39 among 48 industrial nations, which is a true reflection of totally inadequate communication and transport infrastructure, escalating energy deficit, degree of illiteracy among our industrial work force and the poor economic policies adopted by our socio-political system. In spite of the considerable horizontal expansion in the number of educational institutions, more than 60% of our female population are still unable to read or write. Consequently only one third of the industrial work force in the country consists of literate people, less than a fifth of which are matriculates, which is the primary cause of poor industrial productivity and competitiveness. Experience all over the world clearly indicates that improvement in literacy, particularly female literacy and access to information have invariably resulted in the decline of female fertility, improved health care, reduction in infantile mortality rate, enhanced agricultural productivity, increased industrial output and vast improvement in the quality of life. The only way we can reverse the prevailing situation is by appealing to the bounties and the unlimited capabilities of science and technology to initiate sustainable fast growth rate through implementation of rational socio-economic policies.

3. **Application of Science and Technology for a big leap forward**

Exploitation of the full irrigation potential of about 80 million ha. and utilisation of the available 20 m. ha. of wasteland with appropriate agricultural practices can at best increase the annual food grain output to 220 m.t. The challenge of providing adequate food security to the growing population, which requires an annual production of over 350 m.t., can only be met through the initiation of a new green revolution involving sustainable integrated development. Significant advances in biotechnology have resulted in a variety of new genetic seeds, early maturing dwarf varieties of crops, pest resistant hybrid cultivars and suitable cultivation strategies even for dry land agriculture. Combined with integrated pest management strategy, use of bio-pesticides and conservation of top soil and water resources, these biotechnological advances can substantially increase the genetic potential and initiate a total agricultural revolution. The remarkable developments in space remote sensing which can provide synoptic and repetitive high resolution imageries over large areas have now become a powerful tool for mapping spatial and temporal changes in soil characteristics, soil moisture and land use pattern at micro level to identify forestry, plantation, pasture land, single and double cropped areas, cultivable

wasteland and fallow residual lands. Space imageries are not only able to provide reliable forecast on agricultural crop yields but also able to identify underground water aquifers and quantitatively estimate surface water bodies. Continuous meteorological imaging from space has, for the first time, provided a powerful tool for improved weather forecasting which is the basic requirement for an agricultural country like India. Ability to predict and provide real time information on extreme disasters such as floods, cyclones and drought has led to the identification of measures to substantially mitigate the damage due to such disasters using appropriate structural modifications.

Sustainable development of natural resources is obviously dependent on maintaining the fragile balance between productivity functions and conservation practices through monitoring and identification of problem areas requiring application of energy intensive agricultural practices, crop rotation, bio-fertilizers and reclamation of underutilised lands. It calls for the integration of various renewable and non-renewable resources, characterisation of coherent zones of agricultural identities and identification of physical constraints as well as ecological problems at the level of each watershed. Combining space derived vital inputs on soil characteristics, agricultural practices, underground and surface water resources, forest cover, environmental status and meteorological information with collateral data on cultural and socio-economic factors it is possible to indentify suitable conservation measures and appropriate bio-technological methods to enhance productivity on a sustainble basis. In a few selected watersheds, where sustainable integrated development strategy has been implemented as in the cases of drought prone districts of Ananthpur, Ahmednagar and Panchamahals, two healthy crops are now grown and the water table has gone up by almost 5 meters in the last three years as against non-availability of even drinking water in summer months. Detailed cost-benefit analysis carried out in these watershed areas have shown that the entire cost of implementation of integrated development strategy can be recovered within a period of two years from the increased agricultural output alone, besides the vast improvement in environment that can change the quality of life.

INSAT series of satellites have initiated a new communication revolution in the country establishing human connectivity across the entire nation including inaccessible remote areas. In addition to providing point to point and point to multi-point communication, INSATs are today used for providing a variety of value added services such as emergency communication, disaster warning, fascimile transmission,

video-conferencing, computer communication and extensive VSAT networking using very small aperture antennas. The most dramatic impact of INSATs has been in the rapid expansion of TV dissemination in the country through installation of more than 750 TV transmitters providing access to over 85% of our country's population to regional and national broadcasts. Educational broadcasting which started with 100 hours of programme per month to 4000 schools and colleges has now been augmented with the dedication of a full transponder for providing continuing and developmental distance education. The successful conduct of a number of interactive experiments conducted on a pilot scale has unequivocally demonstrated the capability of the satellite distance education system to provide meaningful education to even remote areas. With the proposed dedicated GRAMSAT satellite it is well within our capability to establish a virtual class room across the entire nation to enable dissemination of culture specific, language specific and region specific instructions even to the most inaccessible areas.

In the liberalised post GATT era, where governments, societies and individuals need to quickly respond to events and situations to enable them to compete in the global market place of interdependent economy, the paramount need is for timely collection, synthesis, analysis and dissemination of the vast data bank of information gathered from multiple sources. With the information being generated at the rate of 20 trillion bits a day, the accumulated information content of direct relevance is projected to exceed 150,000 trillion bits by 2005. In the words of Oltean "The Paradigm of today is the Neo-encyclopedism. It is essential to have information on information, the so called secondary information." In this technology era, data bases have become our modern encyclopedia and information has become the most powerful currency of power. It is self-evident that at the centre of the age of information super-highway is satellite communication, which has single handedly brought about a new communication revolution across the globe enabling us to establish instantaneous human connectivity anywhere, overland, air or sea.

The benefits that can accrue from the information super-highway are virtually unlimited because the information super-highway is not an empty road but a royal gateway to the world of information and technology base which makes it not only a communication highway but also education, resources and health highways. Information has become the most powerful currency of power which can generate new ideas and it is ideas which create goods and products. Industrial

establishments, banking institutions and administrative machinery are totally dependent on the efficiency of the communication infrastructure. The challenges posed by rapid technological obsolescence can only be overcome through rapid communication, instantaneous access to information and establishment of adequate data base without which neither the technological establishments nor the industrial undertakings can compete in the globally integrated economy. Unlike in the past, when predominantly agriculture based nations endowed with rich natural resources had the advantage, the comparative advantage in the globally integrated world economy has undoubtedly shifted to those countries with brain power which are determined to absorb, adopt and assimilate the spectacular developments in science and technology and harness them for their national development.

Extraordinary developments in coding and digital compression techniques now permit transmission of video programmes at very low bit rates for most economical use of the space segment. Significant advances in video compression techniques today permit high quality transmission of CD stereo programmes at 192 kilo bits per second and video pictures at less than 4 mega bits per second. Ability to transmit eight to ten channels on a single transponder which can be received with antenna dishes as small as 45 cms has substantially reduced the cost of satellite communication which is bound to have a dramatic impact on satellite based educational and developmental services. Availability of about 200 channels from a single satellite location can entirely change the complexion of home entertainment. The emergence of satellite based digital audio broadcasting which can be received anywhere with simple, low cost receivers is expected to revolutionise radio broadcasting technology.

Availability of smaller and cheaper VSATs has already brought in tens of thousands of users into the network and is threatening to expand to cover millions of users. Innovative uses of VSAT combined with the developments in advanced modulation techniques such as TDMA, DAMA and compression technologies has resulted in several value added services being introduced, including video conferencing, multi-media services and internet access. Simple low cost systems incorporating a mini-camera and voice-over data at 28.8 kbps are already available to provide video-phone teleconferencing systems using "plain old telephone service (POTS)" lines to transmit digitally compressed video and audio signals. Globally, households using two-way video communication are expected to increase to five million by 2000, and fifty million by 2010. By 2020, two-way video

communication is expected to become as common place as telephone and television. Virtual reality will no doubt become the next generation communication service within the next two decades.

The remarkable increase in computing power with powerful PCs, parallel computation techniques and super computers, have made it possible to store, access, and disseminate vast amounts of information and data, enabling planners, scientists, technologists and policy makers to quickly respond to rapidly evolving events and situations. Micro computer systems with the capability of executing 10 giga bits of instructions/second are already available in the market. Transmission technology has been revolutionised with the use of network topologies, decentralised switching and multi-plexing systems with high bandwidth and self healing ring architectures. Digitisation of information flow together with the video compression technology have virtually removed the distinction between TV, telephone and data dissemination resulting in the emergence of a whole new industry based on multi-media technology. Multi media services involving trillion bits per second to transmit high resolution video, three dimensional images, voice, data and image communication in different desired combinations have suddenly become feasible. Multiple access protocols have been successfully developed both for use in Local Area Networks (LAN) and in wide band Wide Area Networks (WAN) to enable simultaneous transmission of high definition TV, digital data, voice, fax and internet services using Asynchronous Transfer Mode (ATM). Information on demand, video on demand, bandwidth on demand and direct to home television have become the buzz words of the age of information super-highway, implementation of which on a selective basis is essential to enable India to successfully compete in the global market in the liberalised atmosphere.

Invariably all over the world personalised communication is gaining ground for which the present satellite mobile communication is the precursor. The land mobile satellite systems with small mobile terminals are primarily designed to meet the requirements of the transport sector, emergency communications and remote area communications, in a big way. Several Low Earth Orbiting (LEO) satellite systems such as the Iridium System of Motorola, Global Star of Loral, Odyssey of TRW, ORBCOM of Orbital Sciences Corporation and Global ICO are under different stages of implementation for providing data, messaging and voice services to millions of users across the globe. The proposed establishment of large LEO

constellations such as the Teledessic involving 840 satellites in low earth orbit or the stratospheric sky station can effectively duplicate fibers in the sky and provide wide bandwidth communication facility either directly or through the public switched networking system which can be accessed by individuals across the entire globe, through simple hand held communicators.

Significant increase in rural income and employment opportunities is of utmost importance for improving the quality of life in rural areas and to check the migration of people to urban conglomerates. The absurd concept of rural economy, based essentially on the sale of raw agricultural products has led to the deplorable situation of the per capita income of the rural poor continuing to remain just one fifth of that of his urban counterpart, in spite of the country gaining self-sufficiency in food. It is interesting to note that the ex-factory urban industrial activity today generates less than 25% of the total GDP as against the agricultural activities which generate over one third of our GDP. Poverty alleviation must not only address increased agricultural production but also its equitable distribution, particularly among the poorer sections of the society, whose capacity to purchase food grain in the open market is only marginal. The need for preservation, storage and equitable distribution of food has yet to receive the attention it deserves. Without development of appropriate agro based industries in rural areas to maximise the value addition to the rural agro-products, the poor farmer would continue to be the victim of exploitation by middle men.

Accomplishment of rapid industrialisation requires substantial economic as well as intellectual inputs into infrastructure development particularly in the vital sectors of energy, communication, transport and housing. Gross neglect of energy sector has made our industrial establishments, which are already crying for modernisation, even more inefficient and uncompetitive. While the energy production in the country needs to be improved by an order of magnitude, politicisation of environmental issues has become yet another stumbling block in our path to progress. Objective scientific approach to evolve a healthy strategy of development consistent with environmental protection is surely possible, given the capability of space technology to monitor the environment and provide cost-benefit analysis to arrive at optimum strategies. Technological capability built up in the country is capable of providing new directions in material processing, low cost habitat construction on mass scale, urban planning, industrial expansion and better health care facilities using

tele-health services, provided our planning process which has become irrelevant and got marginalised is revitalised again.

4. Policy Issues

If rapid industrialisation and carefully planned liberalisation are essential to tackle the problem of providing economic security, achievement of these goals is possible only through the implementation of proper long term policies and not through the presently followed beneficiary oriented ad-hoc approach. Instead of actively developing vibrant private entrepreneurship, our socio-economic policies have totally relied on licensing policy and subsidies which have only resulted in the perpetuation of inefficient corrupt system leading to innumerable scams. Instead of science and technology, incestuous obsession with politics has become the greatest enterprise of modern India. Considering that atleast 2.5% growth in the GNP is required as demographic investment to support 1% increase in population, the country has to achieve a minimum growth rate of 8% per year to provide economic security to the growing population. The extraordinary rapid growth of the Asian Tiger countries is the result of carefully planned liberalisation policies and restructuring of their public expenditure to provide larger allocation to the societal imperatives which can rapidly improve the quality of life. Meagre allocation of just 3% of GDP for education, 2% for health care and less than 1% for R & D cannot lead to the improvement in the quality of life. Unless the allocation for the service sectors, like energy, transport and communication which account for 50% of our public expenditure is substantially reduced through privatisation, there is no way we can enhance the allocation to essential services like health care, sanitation, education and rural development.

Economists are unanimous in their view that the fundamental mistake made by India was to follow the policy of Import Substitution (IS) strategy, which is primarily dependent on internal market forces, as against a dynamic export promotion policy followed by expanding economies. Combined with licensing system which has been greatly abused by our political system, this policy has only resulted in "reproducing beautifully the disadvantages of communism without any of its benefits". Instead of generating growth of investment and capital through export earnings, the IS strategy which primarily depends on Governmental investment, subventions and interventions, has only helped in creating an inefficient public sector giant, which with a massive capital investment of over 125,000 crores provides a return

of less than 2% on the capital. On the technology side import substitution by its very definition is at best a second hand imitative technology which discourages innovation, making the country incapable of competing in the integrated global economy.

India's telecom policy, which has been under the total monopoly of the Government till two years ago is a glaring example of our short sighted policy. Even though it has been finally liberalised facilitating the entry of private entrepreneurship, unless the bureaucracy is made to implement the Government policy in a proactive spirit and the tariff is structured rationally, rapid expansion of telecom services will continue to be hampered. Prevention of video uplinking has resulted in a large number of private A to Z, TV networks uplinking to foreign satellites from foreign soil. Our ostrich like policy with its outdated regulatory measures has not been able to stop the invasion from the skies – it has only resulted in the large outflow of precious foreign exchange to other countries through advertising services, lease of transponders on foreign satellites and establishment of uplinking facilities on foreign soil. Over 10 global satellite operators are vying with each other to exploit the fertile Indian telecom market, fully convinced of the great market potential of the cash rich 300 million middle class people and have accordingly designed the foot prints of their satellites to cover the Indian subcontinent. Privatisation of TV broadcast services using Indian satellites would have stopped this invasion and also provided a better control over the media content. Restriction of uplinking facility to Indian private entrepreneurs on Indian satellites would have also effectively barred exploitation of the fertile Indian market by outside operators. Imminent introduction of DTH-TV on the Indian scene will push the country into a deeper muddle, unless rational and transparent policies are adopted and implemented. If TRAI transforms itself into an intelligent policy maker, it can greatly help in promoting rapid expansion of communication network even in rural areas by allocating a part of the revenue collected from franchising DTH and other communication services to cross subsidise rural communication networks.

The end of the world war, agreement reached at the Rio Summit, general acceptance of Montreal Protocol and signing of GATT have in principle created a new conducive atmosphere for the promotion of international cooperation. While GATT has introduced a few concessions to the developing nations for a limited period of time, we will be dreaming of an utopia if we presume that these agreements have eased our way to compete in the global market on equal footing,

without building self-reliance in science and technology. Developed countries will continue to exploit the developing nations by placing road blocks such as fair geographical returns policy, application of quota system, planetary environment bargain, technology control regimes and dubious arguments based on level playing field and human rights. Science and technology has become the most powerful currency of power, monopolised and zealously guarded by a few advanced nations who have no scruples in employing technological hegemonism as a means of influencing and controlling the developing world. Unless our industries are encouraged to invest a significant part of their total sales in R & D and a vibrant partnership is forged between our R & D establishments, institutions and industries, our industries will continue to depend on licenced production to the detriment of national growth.

Given the ground reality of the international environment, it is important for us to recognise that the future vision of the nation can only be built on promotion of science and technology and its extensive application to solve our problems on a self-reliant basis. When the socio-political system truly recognises that through application of science and technology alone that we can create wealth, it would be possible to face the challenging task of achieving a self-reliant technological base, sustainable integrated development at micro level, eradication of massive illiteracy, rapid industrialisation, promotion of environmental integrity and providing adequate health and nutritional care, all of which are well within the capability and reach of our scientific community.

Conclusion

The fundamental aspect of long term sustainable development has to be based on the paradigm of technological innovations, economic determinism and physical constraints imposed by environmental imperatives of striking a judicious balance between ultimate exploitability and regenerative capacity.

Inter connectivity of both natural and anthropogenic phenomena occurring anywhere on the earth through weather, climate, geosphere and biosphere, have inextricably linked the fate of each country with the rest of the world. The fact that increase in green house gases, deforestation and depletion of ozone result in global warming affecting the entire global climate, disturbances in El Nino and EnSo off the coast of Peru can result in severe drought across Asia, Africa and Australia and volcanic eruptions and industrial activities can change

the pattern of rain precipitation across the world, clearly indicate the necessity of taking a global view for the survival of humankind as a whole. Unless a holistic approach is adopted for achieving environmental friendly sustainable development to provide basic food, economic and health security to all the people on the planet, the concept of the global village will continue to remain a myth.

In spite of the population explosion and the complex problem facing the nation, I firmly believe that it is indeed possible to substantially augment the carrying capacity of the land on a sustainable basis, double or even triple the food grain production, achieve rapid industrialisation and improve the quality of life provided we abandon banded short term fixes. We have to clearly recognise that one cannot hope to cross a chasm in two leaps and have to necessarily take a big leap forward if we are to gain the status of a healthy nation. As Jagdish Bhagwati stated, even the die hard bureaucrats have finally recognised *"the growing dissonance between India's traditional claim to respect and attention and her shrinking ability to command them as her economic policies and failure have become more widely known and a subject of derision which has led to the worst psychological state of having a superiority complex and an inferior status".* Only by making the next decade, a decade of determination for achieving integrated sustainable development, and consciously working for it with a single minded devotion, can India once again occupy its rightful pride of place in the community of nations. As President Kennedy, with his remarkable insight, stated over thirty years ago, *"Never before has man had such capacity to control his own environment, to end thirst and hunger, to conquer poverty and disease, to banish illiteracy and massive human misery. We have the power to make this the best generation of mankind or to make it the last".* I hope we will have the wisdom to choose the former.

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A Brief Sketch of his Outstanding Achievements in the field of Science and Technology

Prof. U. R. Rao is a very renowned space scientist who has made original contributions to the development of space technology in India and its extensive application to communications and remote sensing of natural resources. Prof. Rao started his career as a cosmic ray scientist, under late Dr. Vikram Sarabhai, which work he continued at MIT, based on which he was able to firmly establish the diurnal and semi-diurnal variations of galactic cosmic rays and their relationship with the electromagnetic state of the interplanetary space.

Convinced of the imperative need to use space technology for rapid development, Prof. Rao undertook the responsibility for the establishment of satellite technology in India. Under his guidance, the first Indian satellite "Aryabhata" was designed, fabricated and launched from USSR Cosmodrome in 1975. Following this, Prof. Rao and his team were responsible for the launch of two experimental remote sensing satellites Bhaskara - I and Bhaskara - II, the first experimental geostationary communication satellite APPLE, two Rohini satellites on India's launch vehicle SLV - 3, INSAT - I series of four satellites, which revolutionised the communication scenario in the country and IRS - 1A and 1B two state-of-art remote sensing satellites. These have been followed by the launch of INSAT - 2A and INSAT - 2B, second generation geostationary satellites in 1992 and 1993 respectively.

After taking charge as Chairman, Space Commission and Secretary, Department of Space on October 1, 1984, Prof. Rao was responsible for accelerating the development of rocket technology, resulting in the successful launch of ASLV rocket capable of launching 150 kg. satellites into a low earth orbit in 1992. The perfect launch of ASLV (D4) which orbited SROSS satellite into a orbit of 437 x 938 km. in May, 1994 has fully established the reliability of ASLV launch vehicle. The recent successful launch of PSLV which launched a 850 kg. satellite into a polar orbit is again the result of the work carried out during his decade of tenure as Chairman, ISRO.

Prof. Rao has tirelessly worked towards the utilisation of the vast benefits from space technology for the development of India, in particular its weaker society. INSATs have initiated a total communication revolution in India, providing human connectivity even to the remotest corners and off shore islands of India. INSATs are now continuously used for promoting business communication, emergency communication, nation-wide radio networking, information networking services and rural telegraphy. Installation of over 150, selectively addressable, disaster warning systems along the cyclone prone eastern coast of the country are saving thousands of lives and livestock every year. The most dramatic impact has been in the expansion of TV from a

mere 11 stations to over 550 stations, providing access to over 80% of India's population.

The most significant contribution of Prof. Rao is in evolving highly innovative integrated management strategy leading to the development of sustainable management at micro level to meet the immediate needs of the present as well as the projected needs of the future generations without affecting ecological balance. His leadership in the application of space remote sensing to the development of the country has made space input a vital part of the management of India's national natural resources.

Prof. Rao's research interest spans a wide array of subjects ranging from cosmic rays to satellite and rocket technology. He has published over 250 scientific and technical papers in various journals of national and international repute. Recently he has written two books (1) "Space and Agenda 21 – Caring for the Planet Earth", Pub. by Prism Books Pvt. Ltd., Bangalore and (2) "Space Technology for Sustainable Development", Pub. by Tata McGraw Hill Publishing Co., New Delhi.

Prof. Rao is an elected Fellow of many academies such as Indian Academy of Sciences, Indian National Science Academy, National Academy of Sciences, Institute of Electronics and Telecommunications Engineers and Third World Academy of Sciences besides being a member of a number of National and International scientific bodies. Prof. Rao was the General President of the Indian Science Congress Association for 1995-96. Prof. Rao was the Vice-President of International Astronautical Federation (IAF) during 1984 to 1992 and continues to be the Chairman of the Committee for Liaison with Developing Countries (CLIODN) since 1986.

Prof. Rao is the recipient of many national and international awards such as, Group Achievement Award of NASA, Karnataka State Award, Vikram Sarabhai Research Award, Shanti Swarup Bhatnagar Memorial Award, National Design Award and VASVIK Research Award. He was also awarded PC Mahalanobis Medal, Yuri Gagarin Medal of USSR, Meghnad Saha Gold Medal, P. C. Chandra Puraskar, Zaheer Hussain Memorial Award, Aryabhata Award, Om Bhasin Award and Jawaharlal Nehru Award of MP Government. Prof. Rao was awarded 1992 Allan D. Email Memorial Award for International Cooperation, Frank J Malina Award for space education by the International Astronautical Federation and Vikram Sarabhai Medal of COSPAR.

Prof. Rao is a recipient of D.Sc. (Hon. Causa) from more than twelve Indian Universities and also the oldest University in Europe, University of Bologna (Italy).

Prof. Rao was awarded 'Padma Bhushan' by the Government of India in 1976.

He was honoured by the Prime Minister of India as 'Distinguished Scientist' at the 84th Indian Science Congress in New Delhi on January 3, 1997.