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Science, Technology and Indian Society: An Anthology of Perspectives

June 2016

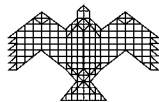## NATIONAL INSTITUTE OF ADVANCED STUDIES
Bengaluru, India

SCIENCE, TECHNOLOGY AND INDIAN SOCIETY: AN ANTHOLOGY OF PERSPECTIVES

V V Binoy
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Contents

Foreword

Bridging science with society and reaching developments of science and technology to every stratum of the social system, and making scientists aware of the concerns and expectation of general public is the key for conflict free harmonious sustainable development and economic growth in a democratic plural society. A close examination of the causes of clashes between science or Government with people, no matter whether it is nuclear power, stem cells or genetically modified crops, are the result of the shortage of effective and honest communication between scientists, policy makers and public. In many contexts, people consider science and technology as unapproachable and show little interest in understanding rationales and facts; despite the fact that in current era, a few aspects of human life are left uninfluenced by science and technology. Meanwhile, in many a situation scientists and policy makers also failed in understanding the mindset of the people and the need for communicating science and policies in a language understandable to all the stakeholders. This approach has resulted in resistance by the society against the implementation of many science and technology policies in India, which could prove to be beneficial to meet the current and future challenges facing India.

India right after independence, committed to developing scientific temper as one of the fundamental pillars of modernization. However, due to unique multicultural and multi-strata nature of its society, communicating paradigm changing science or policies to the society has not been achieved. This scene is further complicated by the multiple value systems, economic and educational inequality, visible urban-rural divide and the top-down rather than evidence based approach followed in implementation of policies. Besides, today the complexity of science and technology has reached such a level that it requires the support of specialists and integration of the approaches from science, social science and humanities to make

people understand the merits and de-merits of existing and new technologies on a periodic basis. Such an interdisciplinary approach is gaining strength in India like in other developed countries.

NIAS is one such leading institution in the country that aims for the promotion of interdisciplinary research. Our efforts have been to bring luminaries in the field of science, technology, social science and humanities under one umbrella and have a dialogue to converge different knowledge systems so that we are able to come up with more effective strategies and solutions for solving problems facing India. According to Henry Wadsworth Longfellow "a single conversation across the table with a wise man is better than ten years mere study of books" and this is true in the case of communication also. As part of its Foundation Day Celebrations in 2015, NIAS organized a seminar titled 'Sharing Experiences of Communication on Important National Paradigms and Pursuits' in which brightest minds of the nation in science, technology, culture, environment and social sciences shared their experiences and views on effectively communicating with society. This report, compiled from the transcripts of lectures on various topics delivered during the seminar could be a guide for scientists, social scientists, communicators, policy makers and politicians who are interested in understanding the dynamics of science, technology and Indian society. I am sure that the words of some of the most iconic names of the nation, who have spent their lifetimes in a particular area, will inspire the readers and commit all of us to do more for our country.

Baldev Raj

Communicating Strategy for Transforming Indian Railways in the 21st Century

SURESH PRABHU
Honorable Minister
Ministry of Railways
Government of India, New Delhi

India's population is already 1.25 billion now and we will be 1.6 to 1.8 billion soon. It is going to be a big challenge, to take care of its large population and to provide each individual not only what she needs, that is easier to do probably, but what they are going to aspire to have. However, knowing the trends of the global community where we will have to benchmark ourselves with the global incomes and standard of living, fulfilling the wants of the people is a herculean task. Even if we have to provide the basic facilities we should think about the size of Indian economy first. Secondly, the potential; what is India's potential?

India can really grow much faster than the current rate as we are blessed with enough natural and the human resources. If we utilize our human resources to the fullest and make use of the natural resources to the optimum we could become a 20 trillion dollars economy. We will have to work on several sectors following a multidimensional strategy without wasting our natural resources. I do not think there is any country in the world like India, where every citizen is truly an entrepreneur. Entrepreneur by definition has to take risk; she also needs to have the ability to work hard. Every farmer takes risk while planting. Every small shopkeeper is taking risk. So we cannot say that we don't have entrepreneurship. For creating entrepreneurship and allowing it to grow the Government has to provide logistics at a rate affordable even to the layman.

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roads'. We are now investing into roads, which is not necessarily the best way to do. We need roads, but we also need a much environment friendly mode of transportation. Hence, we need to invest more therefore into railways. One of the major forces behind China's growth is the state of the art railway network they developed to provide connectivity for people to move from villages to cities and vice versa. If we want to convert railways into a major contributor to the growth of Indian economy this sector has to undergo complete reformation. Till date India invested very less into railways in comparison to roads. Result, railways lost the very lucrative share of transportation and the cost of transportation inflated. The share of the railways into cargo was probably at 80% sometime back and it fell down. Passenger traffic system of Indian Railway is also facing challenges that require immediate attention and restructuring. Number of passengers has increased substantially, but the modernization and augmentation of the network haven't grown up to accommodate those travelers. The passenger trains work with timetable, but they never adhere to areas of capacity constraint and superfast trains are not fast enough even to compare with the rest of the world. So, we need to invest more in railway if we need an efficient, environment friendly, cost effective and sustainable transport system.

Realizing this daunting challenge our government have decided to finance about 120 to 140 billion dollars for the development of railway in the next five years' time. This amount may have to be doubled in the following five years, and hence over a period of 10 years 450 to 500 billion dollars has to be raised for making railways work properly. If we work like this for two, three, five-year cycles, it is certain that the railways will add 2 to 3 % to GDP and drive the Indian economy. Modernized railways network if physically integrated with the markets of India the business will grow automatically and so is the equity between our states. In India we should say go east because it is eastern states that harbor lot of natural resource like coal. Additionally, we need to invest in areas

where there is already congestion. So, where there is only one line, which is fully blocked, a second line needs to be created, and places where both lines already fully working beyond capacity a third line has to come as soon as possible. Where to find money for the capital investment of this magnitude? One is from fare of freight, which is the major revenue of the Indian railways. Unfortunately that amount is not even enough to support the day-to-day expenses of the railways. The second is budgetary source, but given the overall fiscal deficit challenges getting support from that source also looks difficult. The only way we could think about is to raise money outside of budget resources.

Although the development of logistics is essential, the real challenge is how to manage the expectation of almost 27 million people, which is more than the population of Australia, everyday. Many of them will have some complaint to make; hence the government has decided to invest a large amount of money this time into improving customer service by implementing modern technologies. For instance, the quality of food supplied in the trains suffers because the contractors do not necessarily adhere to standards. Recently started 'e-catering' in more than 200 trains is helping to provide good quality food to the passengers. Similarly mechanized laundries have been started and the quality of linen has improved considerably. We have also started a customer service portal, where we respond to complaints that come on social media. Each of the division head as well as the members of the railway board has been encouraged to handle complaints themselves, in order to come up with solutions as soon as possible. Along with this customer service revamping, better services have also to be offered within the compartment. Hence, railways is trying to redesign the coach itself. Next is the railway station; there are plans to develop areas around the station with the support of the private sector and state governments. Twenty different companies will be created in 20 different states in order to implement railway projects as per the priority list of the state governments. We are

also increasing the capacity of some public sector undertakings such as Coal India or the Steel Authority of India, who want rails for raw material transportation or link to the market. We use their money and create capacity, which in turn will increase the railways revenue and the bandwidth of implementation. We have for the first time done energy audit because railway is one of the largest users of energy in the nation. We are trying to decrease the cost of energy, which is the second largest component of our cost, by open bidding and buying energy from different sources. Plans are in the pipeline to enhance the utilization of solar power and trains working completely on solar power will be on track soon. An authority will be constituted in the near future to decide the tariffs as well as fares on the basis of cost as well as to link budgeting with outcomes. These interventions are expected to catalyze paradigm shift in the way in which the Indian railways is functioning.

It is essential that railways work on transformative ideas, when it is aiming to develop transportation facilities of global standard. Human resource development is one key component and therefore we are working with four top companies to look at human resource audit. We have an innovation cell and look forward to more ideas from the public. Indian Railways has already signed MOUs with Mumbai University and BHU. Indian railways is planning to build centers of excellence in collaboration with 3 Indian Institutes of Technology (IITs), National Institute of Advanced Studies (NIAS), Bangalore and various other universities. The railways of course is also trying to create a university, meanwhile these initiatives will provide us the academic support necessary for promoting railways as a commercial as well as a socio-economic organization in the years to come.

We are trying to transform railways into a growth engine of tomorrow and for that, all of us will have to work really hard in the next few years' time continuously, consistently.

Communicating, Priority and Quality in Education, Science and Technology

C N R Rao

National Research Professor, Linus Pauling Research Professor
Jawaharlal Nehru Centre for Advanced Scientific Research
Bengaluru

In India, science and education occupy an extremely important position. Unfortunately, today the education scenario in this nation is something of serious concern and future progress is doubtful if this situation does not improve. First, let us look at the school education in the country. The quality of schools needs to be improved a lot. We have more than 2000 schools in Karnataka alone; there are schools where teachers don't appear at all during the year. The quality of education at school level in India is about 100 odd in world ranking, whereas the USA is ranked about 25 or 30. The highest quality school education in the world today is in a small country Finland, followed by South Korea. The reason they are doing so well in school education is because of extraordinary importance given to teachers and teaching. Teachers are highly respected in these countries compared to India where teaching profession is one that is sought after when nothing else is available. The teachers are extremely well paid in Finland where it is extremely easier to become an administrator, which is opposite to what is happening in India. In olden days, the amount of fees paid starting from school to college level was not much; in many contexts the quality of education in high schools was much better than that in colleges. Since the quality of teaching in schools and colleges is not good, there is mushrooming of coaching institutions and tutorial classes. A parallel education system exists and this issue needs to be addressed on an urgent footing. Let us look at school education in rural India, which is good in Kerala. The enthusiasm among children in rural India is heartwarming, but they

get nothing. They go to schools which are in bad shape. The silver lining in school system in rural India is Jawaharlal Nehru Navodaya Vidyalaya. When Rajiv Gandhi was Prime Minister, it was decided to start Navodaya Vidyalaya, which was supported by the following government of V.P. Singh. Every state except Tamil Nadu had these schools; there were 520 of them all over India. The promise of opening more Navodaya Vidyalayas by the previous government did not take shape. School education needs urgent attention since in about 10 to 15 years we will have another 3 to 4 crore more children coming for education.

The marks system should be replaced by grading system. Creativity requires different type of mindset and those who are creative may not get very high percentage. Michael Faraday and Newton may not pass these examinations. The depressing education scenario is due to several competitive examinations, and marks system, failure in such examinations leads to frustration among students. The urgency is to open new and better schools in rural India, improve the quality of teaching. At a higher level, people in universities and colleges are so hardened that they are so insensitive to low quality. We have few universities in the top 100 of the world ranking. This issue is not so significant compared to the problem of non-existence of several top quality universities/institutions in the country. We don't have enough good institutions to absorb even the talented Ph.D. holders. At the same time, we have 67 engineering colleges in the city of Bangalore alone. Last academic year we admitted roughly 10 lakh students to engineering colleges in India whereas the entire USA admitted about 78000 or 83000. Most education is such that it doesn't produce quality people, neither does it produce outstanding people who excel in their field. Most people take up education for employment. We seem to produce in numbers, but not of quality; no expertise is produced in specific areas. Percentage of GDP invested in education should be increased. Though several governments have promised an increase, there is no improvement even for higher education. Industry should not feel that education

is government's problem alone. South Korea is what it is today because of extraordinary investment in education and equally high investment in science where almost 8% of the GDP is invested in education, and science gets 4 to 5% of the GDP. Industrial contribution to education is marginal in India.

About 15 to 20 years ago, India contributed 2.5 % to world science and China 2 %. China has grown to be such huge contributor in terms of quantity; it is almost 14 to 15% of the world contribution to science now. China has already overtaken or about to overtake America in terms of the quantity of science published. Almost two third of the input of publications come from China; they want to produce 30,000 PhDs per year. There were about 16,000 per year, a few years ago. I think they have reached about 20,000 or 21,000 last year.

Those who want to succeed have to work very hard beyond the call of duty. There is so much to be done and so difficult to do. Indians as a race, Indians as a community are quite capable. There are amazing examples of C V Raman and J C Bose who have made ground breaking contributions by working in India. The challenge before us is to deal with education at school level, college level, problems with examination and marks system, multiple entrance examinations and competitive examinations. Our funding system should improve. We should encourage our faculty members to innovate and set up companies. Positive encouragement should be given to the industry to invest in the sector of education and tax incentives would create a positive atmosphere.

The message for India's success is "DDT: Doggedness, Dedication and Tenacity".

Running a Multidimensional Space Programme in Emerging India

K Kasturirangan

Chairman

Karnataka Knowledge Commission, Bengaluru

Space research program was initiated in India in early 1960; thanks to the vision of Dr. Vikram Sarabhai, a pioneer in space science. He saw an opportunity for a developing country like India since this program can be used for communication as well as the estimation of natural resources. Thumba was chosen as the rocket-launching place to study the atmosphere and ionosphere. Instruments were built, the rockets were brought from France, USA and other countries and international collaboration became the hallmarks of the first step that Dr. Sarabhai took. The political support was provided by Pandit Nehru and later by Indira Gandhi.

The Satellite Instructional Television Experiment used foreign satellite and ground systems in India for communication primarily to bring knowledge related to agriculture, forestry, environment, water, education to rural India. The American Landsat satellite was used for remote sensing purposes. Ariane Passenger Payload Experiment (APPLE) was one of the first communication satellites built by India. Later our nation witnessed the development of Bhaskara and Aryabhata and various launch vehicles. Having completed APPLE, an issue to be addressed for communication and broadcasting was the time frame in which a satellite can be built and made operational in India. Since this was unacceptably long the Government and space research organization decided to buy the third generation satellites from abroad. Four INSAT satellites were bought from USA. Subsequently INSAT 2 and 3 series were indigenously developed. The institutional framework of building satellites was left to Prof. Satish Dhawan. The India INSAT

coordination committee defined the system of communication though all the stakeholders. A similar system was set up in the context of national natural resource management system under the Planning Commission.

The Space Commission, the highest decision making body was set up under the Chairmanship of space research organization with cabinet secretary, finance secretary and principal secretary to the Prime Minister as members; the Commission reports to the Prime Minister. There were advancements in the indigenous development of Polar Satellite Launch Vehicles (PSLV), Geosynchronous Launch Vehicles (GSLV), remote sensing and communication satellites. The entire space program to this day engages 500 small, medium and big industries working with ISRO and, 60% of the launch vehicle budget goes to the industry. There are about 18000 people working and the budget is rupees one billion. Applications handled by the space program include remote sensing, regular telecommunication, broadcasting for television, education, and telemedicine. ISRO have achieved 46 satellite launch vehicle missions in India. Our 74 spacecraft missions have accomplished applications in communication, broadcasting, remote sensing and more recently in global positioning (GPS) and navigation systems.

Let us discuss some important questions that have immediate concern regarding the future of Indian Space Program? Will ISRO transform into an Indian Space Program of which ISRO will be the core but not necessarily the only system? How do we increase the capacity of transponders say from 300 transponders within ISRO to 500 or 600 transponders, and to 1000 transponders if commercial component is added? Do we invest more public money into it? How do we expand the capacity keeping in tact the core capability of ISRO? This is where the industry can contribute; they could help ISRO in building communication satellite, remote sensing satellite or launch vehicle. Increasing international

cooperation and collaboration and procuring available technology, if it is cost-effective, are the options for enhancing capacity of the organization. For instance India worked with France to develop a very useful satellite for monitoring tropical weather conditions. The space program has given a major thrust to academic activity in the country but R & D capacity has to be further enhanced. The academic institutions and ISRO should work together to address the requirements of the space program. We also need to create new missions and improve the existing missions of remote sensing or communication systems in terms of the efficiency, delivery, optimization etc. The Indian satellite of future should address specific applications such as agriculture, disaster management, education, health system, railway (RAILSAT), water management and hydrogeomorphological mapping (HYDROSAT). The Indian space program should move from general-purpose satellites for remote sensing or communication to the special purpose ones to meet user demands.

If we look at the present situation of communication, there are many things that need to be enhanced to provide better services. If we build more and more satellites and launch vehicles, we learn more in terms of heritage, reliability and marketability. More successful satellite launches with our own vehicles gives better credibility with customers and more global acceptability. For a country of our size and economy, we should have autonomy in satellite navigation. We need to be much more aggressive to coordinate in terms of slots so that we can park our satellite and operate. Same is true with regard to frequency resources; we have C band, KU band, and to some extent KA band and now we should look for QA band. The future strategy for communication and navigation should address the issue of frequency, slots, technology and large satellites. A unique satellite called ASTROSAT will be launched soon to look at wavelengths of x-ray and gamma rays as well as ultraviolet. This venture could make India a leader in multi-wavelength observation. Planetary exploration involves Chandrayaan, Mangalyaan, but

ultimate strategy will be to look at and prepare a database with respect to exploring nearby planetary objects.

Currently, thanks to the American Satellite Kepler, there are around 1850 exo-planets that have been discovered. Some of the exo-planets are very close to what we call terrestrial planet where life can be sustained because of temperature and other features of that particular orbit. Search for planets, which have got the potential of nurturing life is going to be an area of intensive research in the near future. Currently ISRO is in the process of developing reusable and recoverable launch vehicle. The need for human space flight depends on several factors. We need to consider how much of it could be an indigenous version, how much would come with collaborator arrangement and ultimately whether we should go for a module, which could be fitted to one of the futuristic habitation in space? There is a question of time, there is question of human as well as financial resources and, there are questions of usability, necessity, strategic needs, national pride and political considerations. There are some activities going on in ISRO in this direction.

Industry, international collaboration and commercial viability will play a major role in the future Indian space program. Currently global space economy, the expenditure of the Government, and private agencies and the revenue coming out of it, is about 314 billion, in 2030 it will reach 850 billion. Indian space economy is 2% of the global one; in 2030 it shall be 10%. The present public expenditure of 0.05% could be boosted up to 0.25%. Policy issues should address space as a pioneer, space as a protector, and space for prosperity. We need to have national space legislation and a basis and regulation for commercial space activities.

To conclude, space certainly is a very interesting location now for the humankind to access. If you are going to consider yourself as a single entity floating in the vastness of space, then you have a

unique status and that is being not an Indian, not an American, but that of an 'earthian'. Then earth is only an oasis in the space, which one can divide in terms of geography, political boundaries and so on. This perspective of humanity is something which should be more and more recognized in the way which we deal with ourselves and others, in the years to come.

Indo-US Nuclear Deal in the Context of Paradigm Changes for the Growth of Nuclear Energy

M R Srinivasan

Former Chairman, Atomic Energy Commission and
Former Secretary, Department of Atomic Energy
Government of India

Let us look at several aspects of India's engagements with the world in nuclear matter. After an initial monopoly of the USA in nuclear weapon technology demonstrated by the bombing of Hiroshima and Nagasaki, Soviet Union too developed nuclear weapons. In 1953, President Eisenhower announced the "Atoms for Peace" program to declassify knowledge on nuclear technologies that had potential for peaceful applications. The Secretary General of the UN set up an advisory committee to look into the peaceful uses of nuclear energy and the members were from USA, USSR, UK, France, Canada, Brazil and India. Dr. Homi Bhabha was chosen by the committee to be the President of the First Geneva Conference held in August 1955. When USA had started discussions on regulation, safety and inspection after the passing of Atomic Energy Act of 1954, Dr. Bhabha was India's Principal spokesman in these matters and he argued that assurances of non-diversion to non-peaceful uses were justified only when a country obtained enriched uranium from the US or USSR or any other country. India agreed to safeguard clauses because the Tarapur reactors operated on US supplied enriched uranium. Dr. Bhabha was particular on reciprocal obligation by the US to use any plutonium it obtained from spent fuel from Tarapur, solely for peaceful purposes. There were no safeguards for India's first research reactor Apsara built with UK supplied fabricated nuclear fuel assemblies with enriched uranium since it was solely for research purposes and isotope production. When India negotiated with Canada on building a 220 MW nuclear

power unit, the principle of reciprocity was stated clearly. France too backed India's view that safeguards could apply to special nuclear material and not to natural uranium or any equipment. France even permitted the secondment of some Indian scientists and engineers to work at one of their nuclear establishments. The International Atomic Energy Agency (IAEA) had been set up in 1957 and safeguard implementation in respect of both Tarapur and the second unit of Rajasthjan Atomic Power Station with Canadian support, got transferred to IAEA.

In the mid 1960s, USA, USSR and UK were mainly concerned with drafting the Nuclear Non-proliferation Treaty (NPT), which fixed the cut-off date as 1 January 1967. India, Pakistan and Israel refused to join the treaty, which came into force in 1970, and continue to remain outside the NPT to this day. Though pressure was brought on Indira Gandhi, the then Prime Minister, to sign the NPT, India advised its international agencies that it would not sign the NPT as it was discriminatory. However, this position did not adversely impact the Indo-Us cooperation on Tarapur or Indo-Canadian cooperation in Rajasthan. France too refused to sign the NPT. Dr. Sarabhai was successful in negotiating with France on building a reactor of 15 MW at Kalpakkam. French and Indian industries collaborated to make most of the components in India. When France backed off from supplying enriched uranium, India developed a mixed uranium-plutonium carbide fuel Fast Breeder Test Reactor.

After the unfortunate demise of Dr. Sarabhai, Dr. Homi Sethna took over as Chairman, Atomic Energy Commission in 1972 and his first major decision was to conduct a Peaceful Nuclear Explosion (PNE). Both USA and USSR were engaged in using nuclear explosions for civilian applications and following these developments, India concluded that PNE was a legitimate scientific activity to embark upon. India carried out its first nuclear test described as PNE on 18 May 1974 at Pokhran deserts of Rajasthan. USA was upset about

this, the Prime Minister of India was accused and Canada decided to suspend all nuclear cooperation with India. European and Japanese denials too followed. Whereas, India argued that PNE had been a legitimate civilian activity pursued by the US and USSR. India had started work on the Madras Atomic Power Station in 1967. Both USA and Canada embargoed all supplies of materials and equipment to India. This led to a massive indigenization program; Department of Atomic Energy and Indian industry rose to the challenge. India took up building a number of PHWR (Pressurized Heavy Water Reactor, PHWR) units of Narora, Kakrapara, Kaiga and Rajasthjan expansion. There was a special problem related to Tarapur fuel that USA had committed to supply for the entire life of the plant; USA later arranged to get France supply the fuel. After 1993, India received supplies from Russia; both the US and Canada denied India spare parts or technical feedback on equipment of their origin. Towards the end of 1980s, with the help from China, clandestine supplies from Europe and North America, Pakistan had procured enough weapon grade enriched uranium to produce two or three bombs. It was then Prime Minister Rajiv Gandhi proposed to the UN Special Session on Disarmament in 1988 calling for time bound elimination of all nuclear weapons. The US rejected it while the USSR welcomed the initiative. It was then the majority of Indian Policy makers concluded that possessing nuclear weapons was a matter of necessity. In mid 1990s, the US began to push the Comprehensive Test Ban Treaty (CTBT). Initially India bungled by cosponsoring the treaty with the US but later retracted from it. The government headed by Shri Atal Behari Vajpayee took the important decision of carrying out Pokhran II tests on 11 and 13 May 1998. Pakistan too carried out its tests before the end of May 1998. Nuclear sanctions on both India and Pakistan were tightened. India grumbled and US advised patience!

 Let us look at the Indio-Russian and Indo-French relations on nuclear matters during 1990-2000. The USSR-India agreement on Kudankulam had been signed towards the end of 1988 but

remained dormant for a decade. Confusions prevailing in Russia and short-lived governments in India were some of the reasons for the delay. A supplementary agreement was signed between India and Russia in 1988. Pokhran tests did not adversely impact the Indo-Russian cooperation, though US was heckling Russia for its intent to build nuclear power reactors in India. Although the Chairman of the Atomic Energy Commission of India was to visit Paris towards the end of 1989 to discuss France-India cooperation in the construction of Light Water Reactors (LWR) of French design, the visit was postponed due to election. After the election, the decision was not to import LWRs from France and India did not take any initiatives for France-India cooperation. French President Chirac had suggested the possibility of separating strategic and peaceful activities and placing the latter under IAEA safeguards to build French PWR (Pressurized Water Reactor) in India. Such a separation had enabled France to receive PWR technology from the US. Unfortunately, the great expectations of a big surge in the construction of nuclear power units (LWR) using French, Russian and US technology did not happen except for an agreement with Russia on Kudankulam.

Creating a big generation capacity is our biggest weakness. While we must develop solar and wind power, reliance on nuclear is necessary.

Realizing Affordable Health Care for All

DEVI SHETTY
Chairman and Founder
Narayana Health, Bengaluru

The dream we have is to do heart operation for 800 dollars; we may be 7 – 10 years away from that magic figure, but it's going to happen. The question is why should it happen? It should happen because 100 years after the first heart surgery, only less than 20% of the world's population can afford a heart operation, the rest if they ever require a heart operation are going to die. Are they only old retired people? No, they also are young breadwinners of the family. India requires 2 million heart operations annually and all the heart hospitals in the country put together perform 1.2 lakh heart surgeries. What happens to the rest 1.9 million? They just die over a period of few years and in the process we perhaps produce one of the largest numbers of young widows in the world.

Can something be done about it? Yes, because heart surgery is one surgery, which has predictable results, but then we have to change the way we think and must look at making policy changes. Doubling the budgetary allocation for health care is not going to address this problem; the way heart surgery is delivered and the rest of the health care is given has to be changed. Narayana Health (formerly known as Narayana Hrudalaya) has thought and worked on a different model of delivering health care, which is of a large health city with infrastructure to do 60 heart surgeries in a day. Now Narayana Health have 30 heart hospitals across the country and 12% of the heart surgery done in India is in this institution. Around 10 years ago when there was drought in the state of Karnataka, patients lost their capacity to pay for the health care, so we convinced our government to launch a health insurance only for operations (gallbladder, heart operation, brain operation,

kidney operation) and bridged 400 hospitals across the state with it. The premium was 11 cents that is five rupees per month and the Government of Karnataka became the reinsurer. At the end of 10 years, more than 7 lakh farmers had varieties of surgeries and 85,200 farmers had heart operations, just by paying five rupees per month. Currently in India, we have 850 million mobile phone subscribers, if we have a policy to collect Rs.20 from each mobile phone subscriber we can take care of the surgical cost of the entire population of the country and that can be done without any budgetary allocation from the government.

Narayana Health is trying to prove that you don't need billions of dollars to change how things are done; it just requires a different mindset. Let me share some of our success stories in this line. We have 100 towns in India, with a population of half a million to one million, where there are no heart hospitals or cannot afford it, as it is very expensive to build a heart hospital. Normally building and equipping a super specialty heart hospital costs about 25 to 30 million dollars and a time frame of two to three years. However, we worked with L&T, which is India's largest construction company, with a target to build hospitals of same quality for 6 million dollars in six months. L&T took the challenge, the first hospital was built in Mysore, we ended up spending seven million dollars and it took us eight months and this hospital is doing all types of major operations like any other corporate hospital. The cost of the surgery could be reduced considerably and make it affordable to more people if we are able to produce the materials required indigenously. For instance, ninety-nine percent of the hospitals in the country still use linen gowns and drapes during the heart or brain operation. One can never sterilize linen, once it is soaked with blood, it can be dangerous, but because of the cost reasons hospitals don't change it. We were ready to pay Rs. 2500, four years ago, for a disposable gown and drape, but multinational companies wanted Rs. 5000. Later we discovered that, irrespective of who wants to make gown and drape, they have to procure material from a company called

Alstoff. We contacted young entrepreneurs from Bengaluru who started a company called Emaralis and now they are supplying us local made superior quality gown for Rs. 900. Later Emaralis got CE marking and now the company is awaiting US FDA approval, and with enough export orders price can come down to Rs. 500 in near future.

Another area where we brought in remarkable change is the post surgery care. When a patient gets admitted to a heart hospital, the spouse, generally the wife stays with the husband; a spouse in a hospital whether it's in US, Europe or India is legally not allowed to touch the patient. The irony is we don't involve her in the patient care, and then exactly four days after the heart operation she is asked to take care of the husband. Three years ago in association with Stanford University, our institution developed a curriculum to train spouse to be the primary caregiver after the heart operation. There are 12 tasks that she has to learn, medical procedures such as checking the blood pressure, pulse rate, wound dressing, physiotherapy etc. These protocols are taught by showing them short films of a minute, which now is on YouTube. Now when a patient gets admitted, these films are downloaded to the mobile of the primary care giver so she can learn how to do these tasks. Surprisingly the readmission rate following discharge came down by 50%. Interestingly six months ago British Parliamentary Commission chose this effort as the best patient empowerment tool, and now British government wants this project to be launched across NHS Hospitals in the UK. There are several hospitals in US that want to use this effort because post procedure and discharge, spouse is the only person who stays with the patient. In this country people sell their house to get a very expensive valve operation done; post operation they need to take a medicine called Warfarin, which is nothing but rat poison, to keep the valve functioning and blood from clotting. However the patients have to consult a doctor and test blood every month or two in order to decide the dose, otherwise they can bleed to death. These patients, mostly villagers,

stop taking medicine and consulting doctor when get better after the operation. Such patients will die within 3-4 months. In order to have an organized way of following up these patients, an algorithm was created with the support of Stanford University. We then trained an employee/ a volunteer on this algorithm and provided mobile phone to contact the patient. Now, when a patient gets discharged, the number of volunteer/employee is given to him/her and today this person gets over 300 to 400 enquiries a day and provides support to manage the health issues of a few thousand patients in India, Africa, and other Asian countries. If the employee doesn't hear from a particular patient for one month, she will call him/her, and let the patient know that if she/he is going to die if the medicine is stopped. So because of this mechanism a few thousand patients are alive; and the cost of maintenance is only Rs. 55,000 a month.

The biggest problem, which is going to hit this world, is shortage of doctors, nurses and medical technicians; India is short of 3 million doctors and 6 million nurses. India produces 26 million babies a year and this country has the worst maternal mortality rate in the world. We need at least 2 lakh gyanecologists, 2 lakh anesthetists, 2 lakh radiologists and 2 lakh pediatricians, if we want to bring this figure down considerably and we don't have more than 20,000 of these specialists. The situation in other departments is not different from that of the gynecology and neonatology described above. Rural population of our nation is badly affected by this scarcity of health care professionals. India has 25,000 Primary Health Centers (PHC) and government is spending billions of dollars on it but nobody goes there because there is no doctor. Our institution came up with a joint venture with Hewlett Packard named 'e-health clinic'. This project is aimed to create 30,000 PHCs across the country and this is built on a shipping container, which is virtually free and can be centrally air-conditioned with solar power. An AYUSH doctor (certified practitioner of Ayurveda, Yoga and naturopathy, Unani, Sidha and Homeopthy) consults there . The blood tests are done

with dry chemistry and the entire EMR (Electronic Medical Record) is on cloud. We created 18 such clinics and then we stopped, why? Because the policy of the country today doesn't allow AYUSH doctors to prescribe 48 basic drugs required in the PHC. We have a very interesting situation, prescription right is in the hands of MBBS doctors, who do not want to leave the city and work in rural region while, AYUSH doctors who are ready to practise in villages are not allowed to prescribe life saving drugs. Interestingly, in US, 67% of the anesthesia is given by nurse anesthetists. In India a nurse with 25 years of experience is not allowed to give an intravenous injection. We have created first world regulatory structure with third world infrastructure.

If we want to find a sustainable solution for the lack of availability of medical professionals in rural India, we need to understand the reality at grass root level. Unfortunately for children from poor families in India, though they have aspiration to become doctors, medical education even if you get a so-called reserved seat is extremely expensive. It is important to get children from poor families of India to become doctors because in this profession one requires to work for 18 to 24 hours a day and across the world, doctors who have changed the way healthcare is delivered almost always came from deprived background. So 7 years ago, we took a decision that we wanted 2000 children from villages of West Bengal to join the medical college every year. All these kids require is passion to become doctors and we give them a scholarship of 10 dollars a month and also mentor them. This model could be extended to other branches of medical education and different states of the nation.

The next big thing in healthcare is not going to be a magic pill or a faster scanner or a new operation method; it is going to be Information Technology (IT), which will change the way healthcare is delivered. The outpatient departments may become history in 10 years and every patient would consult her/his doctor online. We

started taking benefit of IT in our own way by launching 'Online Diabetes Clinic'. Our doctors use Whatsapp as a medium of communication with patience. On request, the diabetologist talks to the patient and takes the history on a piece of paper. Then she takes a picture of the medical history which is now an EMR! Next time she doesn't have to ask the same questions and the patient also has a copy. Now the diabetologist receives a picture of the patient and the drugs she is on. Since many people in rural India can't read the name of medicine, photograph can help the diabetologist. The beauty is not treating online, the beauty is the diabatologist is happy to work from home, while doing other jobs, and patient can get her service for a fraction of a price that has to be paid while consulting a full time specialist. There are thousands of diabetologists, dermatologists, pediatricians who are at home, they can virtually take care of the basic health care of the whole world just online and this is the transformation, which will dramatically change the health sector. We invest in technology to do the costing, we have Oracle ERP on the cloud, we have 30 hospitals, by around 12 o'clock in the afternoon all the senior doctors, senior administrators get an SMS on their mobile phones with previous day's revenue, expenses and EBITA margin. It is very important for doctors, senior administrators, everyone to know what exactly is happening financially in an organization that is working with wafer-thin profit margin, the attempt is to keep your nose above water. We believe that charity is not scalable, but good business principles are scalable. The best gift you can give to this world is not giving anything free, but at a price they can afford, for that financial discipline is very important.

Narayana Health has proven that providing quality health care does not require any huge investment but creative ideas and dedication to implement. India has the resources to meet the needs of every citizen. I repeat if we want change we need to change our mindset and the approach to the problems.

Information Technology Industry, Society and Aspiring India

S Ramadorai

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There is no field left, which does not incorporate information technology as an integral part and this trend it is only going to accelerate as we look at the future. We must distinguish the potential impact of such changes on a developing country like India that has a population of 1.25 billion, which is likely to grow to 1.6 billion with its heterogeneity and mix of haves and have-nots. In this context, it would be interesting to explore what is the chemistry generated when prowess of Information Technological (IT), the large Indian society and an aspiring young population come together?

The origin of Indian IT industry traces back to the 1960s and India's first IT company, Tata Consultancy Services (TCS) was started in the year 1968. TCS invested in training and skill development in the area of IT in a massive way and sent their engineers overseas to do programming onsite mostly for American firms because the market did not exist in India and importing computers was very expensive. Even then TCS imported few computers in 1974 against all odds and commitments and very high rate of computer duty. From this humble beginning Indian IT industry has grown up to the size of 160 billion dollars and it employs more than 3.2 – 3.3 million professionals, which has also created an indirect employment for almost 10 million. TCS alone employed more than 3,20,000 people, one of the largest in the world by far. The pervasiveness of technology allowed similar growth potential for other sectors as well, such as health care.

IT succeeded in India because the entire ecosystem of stakeholders

especially, universities, research bodies and the youth came together with industries and showed that they are able to benchmark their best practices. There was partnership between educational institutions and companies. Highly qualified educational institutions including several in the private sector took roots across the country. Meanwhile, industry took active role in reshaping the curricula and supplementing learning to enhance skills and there were exchanges between industry employers and university faculty members. Several new models of trainings have been developed and reached out to the science graduates. The industry scaled up these activities to attain international acceptance and has entered into agreements with multiple countries so that the mobility of the skilled work force is possible. This international certificate in IT skills went a long way in establishing our credibility at the global stage. Although the government became a critical factor and decision maker in this ecosystem much later, the economic reforms that were launched in the early 90's and easing of the curbs to do business catalyzed the ecosystem change. Policy reforms enabled development of telecommunication facilities and the necessary infrastructure required for the software development. NASSCOM started in 1988 has worked with the government to shape the policy and has promoted the brand 'India' abroad. In many ways the IT growth story should serve as a case study on how the government can be a facilitator in the ecosystem rather than a regulator or a controller.

The convergence of several relatively new technology developments including the Smartphone revolution, Internet of Things (IoT), social media, cloud computing and the big data analytics is impacting the Indian society and business in a transformational way. Today ordering vegetables or booking a cab is a call away, buyers and sellers are more connected than ever. It is promising time for entrepreneurs; it is easy to know what the best way to go is. Some of the younger people today might have not gone to the physical bank of brick and mortar but do all the possible financial transactions online.

There are several developmental challenges also. One blemish that we would spot while reviewing India's IT growth is the uneven economic emergence. Poverty and unemployment still remain big challenge and the rise to prosperity has not been inclusive enough. Our much-touted demographic dividend requires being properly skilled and the National Skill Development Corporation has been addressing this issue. Vocational system is highly respected in Germany and other countries where 60% of the top ranked people in corporate come through the vocational system. Technology could play a major role in mobile learning, immersive learning, simulators, multi-media based learning, gamification, and local language support. Rural broadband network can provide connectivity at rural or district level. With the mobile phone ownership scheduled to shortly reach the 1 billion milestone in our country, our ability to touch and transform the lives of our citizens is very imminent.

We are at cross roads, almost every citizen is holding a powerful computing device, yet our natural resources are stretched to the limit, sanitation and waste disposal are poised for major disruptions. How do we look at that from a technology perspective? The next waves of innovations in IT drive the creation of efficient, optimal, clean and renewable energy solutions. We are placed 27th out of leading 47 rice producers in the world. Digital farming initiative holds great promise from both productivity and sustainability point of view. Digital technologies can help effectively manage the farm environments. Unmanned Aerial Vehicles (UAVs) fitted with sensors can map the terrain to capture a wealth of information related to variation of moisture and nutrient content. Intelligent decision support system can provide optimal crop management plan. Technology has created a vast impact on health care also. Robotic devices are deployed to perform precision surgeries. Satellite imagery is used to predict epidemics months in advance. Exoskeletons such as the ones seen in movies like 'Iron Man' have applications in assisting people with disability.

Let us look at some noteworthy examples where IT made a great impact. The Passport Seva Project through the Seva Kendras across the country process more than one crore passport applications per year. 'Bhoomi' is another governance project for computerized delivery of 20 million rural land records to 6.7 million farmers through 177 government owned kiosks in the state. Indian Railway Catering Tourism Corporation (IRCTC) have implemented an online railway ticketing service and scripted India's biggest e-commerce success story. The site can handle over 7000 bookings every minute and it can embrace mobile-based technology. Akshaya initiative of government of Kerala, started with a mandate of ensuring IT literacy for at least one member in each of the 6.5 million families in the state, has expanded its scope to service vehicles for economic development and to facets of e-learning, e-transaction and e-governance. Effective resource management is the key to the sustainability of the cities and the Internet of Things will open up opportunities for improved building management, more efficient traffic flow, clever ways to provisioning bus service, more efficient health care, better water and waste management and policing.

Let us look at the flip side of the developments in IT. As systems become more and more interconnected and handle more information, their exposure to vulnerability increases. Cyber security awareness will have to go hand in hand with digital literacy and this training needs to be provided right from the school level itself. A huge demand for cyber security professionals who can configure, manage and monitor IT systems from a cyber security perspective will need to be rapidly addressed. We should develop expertise in intrusion detection, cyber resilience and learning systems to detect intrusions in advance.

We live in a very exciting time to have the unique opportunity to carve our own futures and this is perhaps the biggest gift of information technology. As individuals, as organizations and as a nation what we build is in our hands, our failures and success are our own.

Biotechnology: Meeting Aspirations of Growing India

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The Indian science bureaucrats have the enormous luxury to have endless debates on the implementation of a new technology and postpone decision-making forever, no matter even if that decision affects a million people. Such debates on vaccines, GM technologies etc. are continuing for decades without any sign of reaching a consensus in the near future and extraordinary regulatory requirements and demands are being made for such novel technologies whose dangers are not clear yet. Interestingly, in comparison to the biotechnologies being utilized by the developed nations the technologies whose merits and demerits are being debated in India today are essentially obsolete. There is no doubt that collapsing this huge edifice and building new foundations for the sustainable development in India requires not only the understanding of science and society but also the dynamics of the interaction between them. Unfortunately, an amazing alienation of science from people, coupled with the separation of government from people is happening globally and it is unchallenged that in the absence of an ideology, which binds people together and relates them to the government it is very difficult to achieve sustainability and development without conflict.

Let us examine the case of biotechnology, in India the costs and benefits of this system are still under debate and not being able to come up with an agreement with different stakeholders, the government has frozen the application of these technologies in many sectors including agriculture. However, this branch of

science has a very special role to play in the current scenario where humans have moved from understanding nature's engineering to engineering nature. It is well understood that all forms of lives have been evolved from single cellular organisms and that common origin means that the chemistry of all living things, in other words the metabolism of all organisms on the planet earth, is related to each other. This knowledge of the shared chemistry and the thread of life connecting all living things, the nucleic acids, in synergy with information from other branches of life sciences such as genetics, evolution, embryology etc. built the foundation of biotechnology and armed humans to address riddles in health or agriculture more efficiently. In the last ten years, our ability to engineer one or two genes at a time has grown up towards the ability to engineer entire genomes and metabolic pathways. Result, now we have GM food, GM mice, life saving drugs from GM organisms etc.

In this context a very important question arises, even after having this much potential why biotechnology has failed to get the trust of people and policy makers in India? A hundred years ago it was possible to explain a technology and its function to the public without much difficulty, which is no longer so. This complexity of the modern science and technology has been extraordinarily misused by various agents for their personal benefit and induced a great fear towards novel technologies amongst the people. Such a baseless fear catalyzed by the existing extraordinarily poor science communication and disengagement of scientists with the community estranged science form the society and created the distrust in government policies and the resistance towards the novel technologies in our nation. GM technology was also a victim of such mistrust and in many contexts the scientific community failed to convince the lay people and government about the safety and benefits of the biotechnology and moratorium on the implementation of these technologies in the agriculture fields continues till date.

Finding sustainable solution for complex issues in health and agriculture needs a marriage between science, economics and politics, which is not rare in history. Formation of the European Molecular Biology Organization (EMBO) was the result of such an attempt by the scientists and leaders of different European states after realizing that certain kinds of science are too big for any country to do on its own. Communicating science up to the grass root levels of the society is extremely important in political systems where decisions are taken democratically. Furthermore that communication needs to go multiple ways; from scientist to society, from scientist to politicians, politicians to industrialists and back and forth; and unless this happens we are in great danger. In a multi-stakeholder society like India, a democracy where power relations are too complicated, bringing a change in the society is very difficult because it will immediately draw the enmity of all those who have been deriving benefits from the previous circumstances. Hence, in order to satisfy various agencies the bureaucrats and policy makers take the simplest decision that is to have another committee and postpone the decision. However we cannot postpone the decisions on biotechnology-based products, which could contribute significantly to our health, agriculture and economy unendingly. We need a new kind of debate on the safety and benefits of the most modern biotechnologies, like the rest of the world do, and unless we realize this we are not doing ourselves any favors at all.

Intergenerational Aspects of Politics in the Context of Contemporary India

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Can one define intergenerational aspects of politics in contemporary context in a satisfactory way? What follows are some experiences which are very loosely connected to the topic. Now, of course there is a lot of talk about generational shifts happening in all aspects of life, in business, in society, also in public life. We often hear that younger generation is trying to step into politics, we see some types of politics emerging which we think are of the new generation, new definitions of politics and public life; and a lot of people seem to think that younger generation is by and large better in all aspects. Yes, in most aspects one may agree, but in politics in my experience younger generation hasn't really meant anything better. So this is where I sort of diverge from the consensus on this subject that younger is not necessarily better, because if you look back at the previous generations of personalities in public life, what strikes us are their levels of commitment to public life, their definition of what is public life and politics, their vision and the quality that they brought to public life. So if you apply those parameters to the younger generation that is getting into politics today, many of these aspects are missing. Of course in popular media we might see a few younger personalities, who might embody these aspects, but those are a few and they do not represent the entire younger generation that is coming into public life. By and large what one observes is deterioration in levels of commitment, vision they have for public life and their understanding of what is politics. The newer generation is not really embodying the best that we have seen in the past. Politics is generally defined as a part of legislature, which is only one aspect of politics, and there is a difference between what

legislature and executive have to do. Many a time legislators think their job is that of a municipal officer or an assistant engineer or they assume the responsibility of the executive, and they want to be executive rather than elected representative.

The interactions of legislators with the public in the past and the type of interactions we have with the public now have undergone a sea change. Those days it was mostly at the level of a community, at the level of a village, or at the level of a society. Today when most of the legislators interact with their voters, it is very much specific, the interaction is defined on a one-on-one term. So now you don't measure your public representative or a member of the public life in terms of his or her utility from the community point of view, from a village point of view, from a constituency point of view, or from the society's point of view; but the relationship has narrowed down to what does the specific voter get out of this relationship. So from a very public oriented one in the past, it has come down to a very personal oriented relationship.

In Karnataka we have just conducted a socio-educational survey. The purpose of it was to identify the number of people belonging to various castes and religions. The Supreme Court has many times observed that many of the decisions being made and the many policies being designed in government do not have any hard data to back it; so there has been discussion within Government of India and Government of Karnataka for the last ten years that we should have a caste-based census. The last one was done in 1931, so after about 10-12 years of deliberation we did carry out a census in Karnataka. Being in charge of a district that abuts Bengaluru city, Bengaluru rural district, I had an opportunity to supervise government activities there; one of the jobs was to just observe how the survey work was going, and hence we did a couple of inspections. This was an opportunity to learn a few things out of this process by interacting with the enumerators. The enumerators came out with many interesting experiences that also translate into

interesting observations of our society. To begin with, in Bengaluru rural district as per the latest census that we carried out, there are about 2,45,000 households, which is more than that of the 2011 census. Interestingly 2,29,000 out of this 2,45,000 households have Below Poverty Line (BPL) cards. The land value in this district is in the range of 50 lakhs to 5 crores per acre and here it is very difficult to get a manual labourer, male or female, for less than 300 rupees a day. If 300 rupees per day is the minimum wage, a person can earn Rs. 6000, if he/she works at least 20 days a month. Many families in this area have more than one person working, although they are wage labourers and the cut off rate for BPL is 12,000 rupees per annum. We found that another 4,456 BPL cards were ready for distribution and 4200 cards were in the final stages of verification. So approximately about 2,37,000 households would have, perhaps by now gotten BPL cards, that comes to about 97%. Moreover, another 14,800 applications are pending disposal! Only ones left without BPL card in this area are the government employees who by default cannot get a BPL card since they cannot fudge their income.

During the analysis of the data collected we observed that 70% of the respondents have marked their income as 11,000 per annum, giving an impression that these houses are with a single earning member. There are a lot of garment units working in this area and many men and women are employees of these industry. However they would reply that their family earns only 11,000 per month and would insist that the enumerator should note what they are telling. Certain people forced the enumerators to avoid recording refrigerator, television, car or tractor they have. There are many joint families also in this area where two or three brothers and their spouses and kids are living under one roof. However, they would insist to be recorded as separate households in order to retain their BPL cards or whatever other benefits come for an individual household. Many of them were in a dilemma; whether to reveal their Aadhar numbers or not; if they do not reveal their Aadhar,

they were worried that they would lose some benefits that may come to them in future, but if the enumerator records the number, they may lose the multiple benefits they were receiving right now. We also observed that many of the tenants, who may belong to schedule communities, were reluctant to disclose their caste in presence of the house owner. These incidents are not anecdotes; reaction of 50 to 70% of respondents was like this.

If this is the situation prevailing in our society, where are the values that we embody as a society? For instance in Bengaluru 95% of the buildings are being constructed violating the law. Meanwhile 90% of the houses were built as per the rule 20 years ago. In a matter of one generation, say 20 years, we have changed, perhaps not in the best interest or right direction. We are experiencing maladministration, mal-governance and corruption everywhere. But these issues are not reflected in public discussions and debates about public life or politics. Often we take propositions in vacuum, in isolation and we take them to be true and then debate on them. If we want to tackle these problems we must acknowledge the changes that are happening in our society and should make our policies considering them, only then we can move forward.

Changing Cultural Paradigms

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Culture is something about which everyone has a view. We all know, we are experiencing and we are seeing that culture is changing but calling it as a paradigm change or a process of evolution which has been going over centuries is very difficult. Paradigm can be described as "constellation of concepts, values, perceptions and practices shared by a community, which forms a particular vision of reality that is the basis of the way in which a community organizes itself". Paradigm shift is a sudden change like the science changed when Darwin's Origin of Species was published. The word culture comes from the Latin word '*cultura*', which means cultivation or growing. Cicero calls it *cultura animi* the cultivation of the spirit or the mind, and then it was adopted by the other languages. Even in the English language usage of the word culture with a sense of 'collective customs and achievements of people' started from the early 19th century only. Interestingly no Indian language has or rather had a word for culture. The word '*samskruthi*', which is being used as synonym for culture in many Indian languages, might be originated from Mathew Arnold definition of culture, which got popularity in the early 20th century. According to Arnold "culture is the particular country norm to which an individual is born, its one's total way of life and no culture can appear or develop except in a relation to a religion".

When somebody is talking of Indian culture and changing of paradigm it depends on which glasses are you seeing it through? If you say Indian culture you have one kind of vision, which is inclusive, which is Indo-Aryan, Dravidian-Aryan, Indo-Islamic, and

Indo-British. But when you say it in one of our Indian languages and you call it as '*Bharathiya samskruthi*' the complexion changes. When you say *Bharathiya samskruthi*, which is from the same route as *samskara* and *samskruth* certain coloring happens. This demarcation is relevant in the context of the debate that is going on about saffronization and Hindutva on one hand, and globalization and westernization on the other. Hindutva itself is a term coined by Vinayak Damodar Savarkar, who was an atheist. In Maharashtra today he is revered as much as an author and a freedom fighter. We could see that in one of his poems he envisions *svatantrata* (freedom) as a goddess *Bhagavati*. However the interesting part is the connotations for Marathi words like *Shivaspadhe* and *Bhagavathi* would take him to Shivaji and that rule, and so here is an atheist who is envisioning the independence the *svatantratha* as Goddess *Bhagavathi*, as Bankim Chandra Chattopadhyay in *Vande Mataram* envisioned India, *Bharat Mata* as goddess Durga. Similarly in a poem written in 1912 Mythili Sharan Gupt, who was a close friend of Nehru and a member of congress party, wore khadi and spun charkha all his life, states that 'the light of knowledge which shines in the world had originated here in India and this is the blessed land which is famous and the inhabitants of this land are Aryas and they're masters of the knowledge of arts and technology'. In essence what Mythili Sharan Gupt, Savarkar and Bankim Chandra had written is same as what is being said by the notaries of Hindutva and saffronization although context has changed significantly. These examples raise a relevant question, is it possible to find the time at which saffronization has started changing Indian culture?

Bharatiya Samskruthi is based on *dharma*, *artha*, *kama* and *moksha*. Root of *dharma* is *dhr*, which means to hold. So dharma is that which holds together, which sustains. According to the great epic Mahabharatha people can get *artha*, *kama* and *moksha* through *dharma* which is the righteousness. Jain philosophy defines *dharma* as '*vastu swabahva dharma*' ,the innate nature of things is *dharma* and nature has to be eternal otherwise it's not dharma. Most celebrated tone on culture

in Hindi is Ramdhari Singh's book '*Samskruthi ke Char Adhyaya,*' and it looks Indian culture in terms of four encounters the first between Aryans and Dravidians, second Buddhists and Jains, third Islam and Aryans, and fourth is the British and Indian and this process has been continuing. Another factor that influenced the way in which we perceive Indian culture is the minute of Macaulay which aimed to produce a class of persons, Indian in blood and color but English in taste, opinions, morals and intellect. Can we go back to the roots? If somebody says that globalization and westernization that we are experiencing today is the result of this minute of 1835 and this process has been going on for over 150 years or so?

We are talking of the paradigm shift or change but we ourselves are the products of mixed cultures, like Rabindranath Tagore said that he was a product of a confluence of three cultures, Hindu, Mohammaden and British. Satyajit Ray called himself a combined product of east and west; and the culture of current Indian generation could also be considered as the combination of the east and west. On one hand we have the feeling that Indians must do away with the western lifestyle and influences that left behind by colonial powers while on the other we have the modern science and technology, which is taking us in a different direction. The information super highway is bringing about inter connectedness with the wider world, in real as well as in the virtual world and the moment when we may become the world citizens is not so far. It is expected that for quite some time the two streams, one which we have given the name the Hindutva and saffronization, and the other as globalization would probably go on colliding; and maybe something would come out of it as the collation of Hindu and Muslim cultures gave rise to Urdu. However there are no final answers to this conundrum whether we are seeing paradigm change in culture or whether we are seeing the continuum of change, which has occurred in Indian culture over the millennia.

Corporate Social Responsibilities: Past, Present and Future

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Corporate Social Responsibility (CSR) unfortunately has become a subject for seminars whereas it should really be so integral with the organization, that there should not really be any discussion about the need for it or the way to go about it. CSR is a right thing to do. Industrial corporations, industrial organizations, business organizations, the corporate are really babies in this world, which is millions of years old, industrial organizations are barely500 years old. They are still evolving and many of their practices are in their very, very early stages compared to life on earth. Compared to the evolution of the world, they are perhaps in the last one-minute or last half a minute of the existence of the world. Their products are evolving. Their approach to customers is evolving. Their marketing systems are evolving. The corporates have also shifted gears over time from purely investor-based entity to a more customer-centric, employee centric, supplier centric and more stakeholders are getting added. There is definitely a gathering of momentum, though at a slow pace, of thinking that there should be a new meaning for an industrial organization or corporate organization, and people are beginning to question what is a company meant for? What is the corporation meant for? Is it only to serve investors or is it also meant to serve people who could not invest, not because of their fault but probably because of some historic reasons, which is where the corporate social responsibility fits. So, just like every other thing evolves, the structure of enterprises will also begin to evolve. The meaning of industrial corporations as to what purpose they should be serving in the world is also evolving.

In such a scenario, the Tata Group was founded more than 150 years ago with the philosophy that the prime purpose of an industrial corporation is to improve the quality of life of society. In order to achieve this target we need to run our industrial enterprises well and profitable, and a part of that profit could go back to the society. That is the way Tata Group has lived over the years. NIAS is an excellent example of that philosophy. Indian Institute of Science where this institute is housed is also an example of that kind of philosophy. Tata started with this philosophy 150 years ago and never worried about measuring it; it was part and parcel of the DNA of the company. The group never waited to make profit and then to spend some percentage of that into corporate social responsibility. That is not the way the subject should be looked at and if one starts looking at the subject in this manner, CSR is going take an incorrect direction. Whereas in the case of the Tata Group, we have always felt that when you run a company, you will buy raw materials, you will pay your employees, you will pay your suppliers and you will spend money to run your operations. So, just like any of these, you need to spend money on society; work in society to make sure that it becomes an integral part of the operations of the company. Profit, if it comes, is a result of that, which is why the founder Mr. Jamsetji Tata said that for industrial enterprises the community is very much integral part of the company. Community is neither an outsider, nor a participant, but is actually the prime purpose of an industrial corporation. In fact JRD Tata put it even more succinctly and to quote one of his speeches in Chennai sometime in the 1950s, "Every company has a special and continuing responsibility towards the people of the area in which it is located and in which its employees and their families live. In every city, town, or village, large or small, there is always need for improvement of health, relief, leadership, and guidance. Thus the most significant contribution an organized industry can make is by identifying itself with the life and problem of the people of the community to which it belongs and by applying its resources, skills, and talent to the extent it can reasonably spare them to serve

and help them". In fact, in early 1990s when Mr. P.V. Narasimha Rao was the Prime Minister of the country; he had called all the major industrial chieftains of India for a meeting. Mr. Rao made a plea to all of them that he would like the industry to spend some of its resources and money on society, and that he would be happy if companies spend 1% of their profits on the society. Since Tata Steel had never computed such a measure, we took the last five years' data and found that in the previous five years, this company had spent somewhere between 5% to 14% of the net profits on society. The percentage varied because there were times when the company did not make good profits and the figure increased to 14%. Thus it was only the denominator that was varying. The numerator or money spent on society was more or less the same as it was a planned numerator.

In early 2000 or so, when Mr. Kofi Annan the Director General of United Nations announced the Global Compact of the United Nations, it had 12 signatories; Tata Steel was one of the 12 signatories. It was also the only signatory from India. Today, Global Compact has several thousand signatories; thus there have been various attempts over the years to change the mind of the corporate from purely investor centric, self-centric, and internal centric to thinking about society. In spite of several scriptures and several millions of years of experience, which have always said that any entity needs to serve the society, this subject of corporate social responsibility is even more important for India perhaps than for any other country. Inequality in India is one of the highest compared to anywhere else in the world. Part of the inequality is because of our caste system, which is sort of ordained as to who will do what work and who will not do what kind of work. Added to this is the industrial revolution of the last 150 to 200 years in India and may be 400 to 500 years around the world, which actually escalated the difference between the well off people and the people who are not well off; and between people who get opportunities and people who are not getting opportunities. There are statistics that shows that inequality

actually has become wider in the last 150 years in India than that in any other country in the world. The inequality of opportunity could be loosely defined as a situation where a person's gender, place of birth, her/his wealth or any of other social parameters are causing a difference in getting an opportunity; this will give rise to high levels of inequity. If India has got several challenges, it also has got fantastic opportunities; but mere presence of opportunities is not a guarantee for success and we have to solve many problems. We have got infrastructure problems, access to education and health, to name a few. The number one priority should be given to solve the inequality problem. Money, investments and growth can solve lots of other things; but if the problem of inequality is not solved, if people in the society do not have equal opportunities and if 10, 20 or 30% of the population is going to dominate the whole society, that society is not going to be stable for very long. In this context, one of the most important dimensions of corporate social responsibility is to address the problem of inequality of India and if that problem is not addressed and solved, every other development that will take place in every other field in science, technology, education, health care, and infrastructure will become null and void.

Today's students are anxious about reservations and the importance of merit. Though merit is very important, is driven by social circumstances. For example, being born to decent parents who have some money to educate matters, the size of the town where one grows up, which has good enough schools or colleges matters. These play a critical role in ensuring that one is equipped to latch on to opportunities. This country is full of such people and the power of this country can be unleashed much more. In the future, there will be more and more realization of this aspect and institutes like NIAS actually need to bring this subject up to make people, administrators and people's representatives understand consequences of not solving this problem and suggest ways to solve it.

The subject of corporate social responsibility is not that there is a law to spend 2% and therefore companies spend, which is what is happening. There are some companies that ask what is the best way to spend 2%? Can we strategize on that? The subject is not about strategizing how to spend this 2%, but about internalizing the philosophy of the purpose of an industrial corporation, which is to improve the quality of life of the society. In life often we all behave the way we get measured. If a student is measured by marks the student will focus on marks; she/he may not focus on how to gather knowledge or how to build a personality or how to learn a lot of things. Similarly, if you keep telling the companies that we are going to measure them with market capitalization then companies will not change their behavior. Companies will change their behavior, the moment we tell them that we are going to judge them on the total returns to the society. The 2% idea of the government changes the mindset of people, but then in this country perhaps nothing works without a little bit of force. So that little bit of force is important, but the fundamental aspect is that people ought to appreciate that this country or for that matter any other place will not survive unless there is a social equilibrium. This country does not have a social equilibrium today and that social equilibrium of this country is deteriorating day by day as we can see from the instances that we read in the paper and we ourselves experience. Social equilibrium has to be reached and in the current world where corporations are the prime creators of wealth (there was a time when the governments were the prime creator of wealth many, many years ago, but over time the responsibility is being taken by the corporation) they also need to take on responsibility of solving some of the fundamental problems of the human civilization. Thus it is the industry's job to make sure that the social equilibrium is reached.

Understanding Endemic Corruption

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Much of the debate on the relationship between social norms and corruption has been confined to comparisons across countries. Consequently the focus has tended to be on international rankings of corruption. But a gap between what is morally acceptable by a society and what is legally correct can exist within individual countries as well. When a colonial power introduces a new legal system on a colony with a different set of social norms there is often a difference between what is morally acceptable in the colony and the requirements of the legal system. The fact that Indian morality was different from that underlying British law was argued as far back as the last decades of the eighteenth century by Warren Hastings when he was impeached for corruption.

The process through which this gap emerges, and corruption gets consolidated can be seen as a sequence of four steps. In the first step a gap emerges between the descriptive morality and the legal norms. This could be because a new legal system has been imposed on an old descriptive morality; because social transformations have caused the emergence of a new descriptive morality that is inconsistent with the law; because the law has been changed; or for any other reason. Second, when the gap remains for a period of time, the descriptive morality generates a moral justification to defy the law. This defiance can take the form of protests to change the law, or when that is considered to be too difficult, it can consider various means to work around the law. Third, when there is a widespread effort to work around the law the effectiveness of the legal system is seriously impaired. Fourth, this encourages a more widespread distrust of the law, leading

to even greater willingness to ignore it, so that breaking the law becomes the norm.

This process encourages corruption in several ways. There is little respect for the rule of law on the part of those entrusted with power. Without the oversight of an effective legal system, there is no pressure on those entrusted with power to be committed to public interest. The freedom provided by a dysfunctional legal system will allow those entrusted with power to also grant benefits to those who are not entitled to receive them. And a dysfunctional legal system will also allow for those entrusted with power to demand rewards for providing benefits from both those who are not entitled to receive them as well as those who have a right to them.

Any evidence of the existence of this dynamics in societies with a gap between the descriptive moralities and the legal system would point to at least three lessons in the development of an anti-corruption strategy. First, the existence of such a gap enables individuals to be perfectly consistent with the existing descriptive morality even as they follow practices that are legally corrupt. The existence of such morally acceptable corruption sooner or later reduces the abhorrence for all corruption. A meaningful strategy to fight corruption would then remove all scope for a difference between what is legally corrupt and what is morally corrupt. Anyone carrying out a legally corrupt act cannot then claim any moral cover. Second, the dynamics generated by the gap between the descriptive morality and legal norms can create disruptive practices that become deeply entrenched. This would be particularly true when it generates practices such as the acceptance of perjury. In such cases efforts to reform the legal system through administrative measures alone may be insufficient. It may also be necessary to address the larger jurisprudence and the descriptive morality in a way that reduces the gap between the two. Third, the ability of the legal system to combat corruption is influenced by the relative dominance of cooperative

and non-cooperative corruption. Non-cooperative corruption is when those entrusted with power generating illegal private gain from tasks that are legal in themselves. When a government official asks for a bribe to give you a legal birth certificate, it would be a case of non-cooperative corruption. Corruption of the non-cooperative kind is confined to those entrusted with power, and can be fought by mobilizing the rest of the community against this group. Cooperative corruption, in contrast, is when those entrusted with power generate illegal private gain by carrying out illegal acts for a client. In such situations there could be pressure from the client on those entrusted with power to carry out such illegal acts. There is then a wider constituency that benefits from corruption. When this constituency is large enough, it can successfully resist the enforcement of the law.

A meaningful strategy against endemic corruption would then be to reduce the distance between the descriptive morality and legal enforcement. The legal system can then be transformed in a way that is perfectly consistent with an evolved descriptive morality, thereby removing all scope for a moral justification of a legally corrupt act.

Innovation Ecosystems in India

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The story that will be shared is also an invitation for engagement because innovation ecosystem can only become inclusive if different kinds of perspectives are brought on the choices of individual institutions and initiatives at a different level. National Innovation Foundation (NIF) was set up with all kinds of uncertainties and complexities, and is the only institution perhaps which could have filed around 730 patents in the name of common people including children, farmers and artisans. How could we do that in limited resources? If you look at the market rate, the cost will be around Rs 3 to 4 lakhs per patent in India and US patent will be about Rs 15 to 20 lakhs. We were able to achieve this because the entire patent attorneys, from top companies of the country, did not charge for their time. We engage with about 200 scientific labs every year to validate and add value to the knowledge of people. These scientists also took no fee from NIF. Henceforth NIF, a small organization with limited resources, was able to register 7 patents in USA and 725 in India, on an average cost of Rs 15,000 to 20,000. This support being contributed by the scientific community, IPR community, the business people and foundations are the capital of NIF. Our experience proved that the myth, 'India doesn't co-operate and collaborate' is wrong and when there is a cause, a public cause, people find both moral and legal ways of helping. So the story of NIF is essentially a journey of collaboration, a journey of co-operation, a journey of co-optation, which appear to all actors as their common mission and we also developed some new concepts during the process.

The network essentially started about 25 years ago as a social movement and the basic concept was that the nameless, faceless person who innovates something important for the society gets an identity. A lot of people who innovate, don't know the utility and importance of what they have done. Hence, we walk, every six months, from village to village, in different parts of the country as the part of ShodhYatra, to discover and expose the knowledge being generated at the grass-root level. There are four teachers we learn from in every Shodh Yatra, teacher within, teacher around i.e. among the peers, the teacher in nature and teacher among common people. During this year's Shodh Yatra, we found healers who had written record for their experiments, information about which solution works, which solution may work, which solution may work only with a referral to chance. We also realized that one of the goals of our civilized society should be to honor people at their doorstep.

We all have experienced certain processes of science and innovation, at our homes, at our workplaces, but we seem to ignore those experiences because we are the victims of inertia. Our institutionalized inertia is so deep and we all are great about cribbing about what is wrong. Children incidentally have very little inertia. It is interesting to note how curiosity of the children can in some sense help us to overcome our institutionalized inertia, which is the central problem of our society. We have numerous examples at NIF where innovations by children have been commercialized / licensed by private companies. Many of these ideas can influence public policy and the quality of our life. We need to create reciprocity and respect in the exchange of ideas and knowledge between formal and informal sectors. How can we create a new parity and social contract between knowledge producers of formal and informal sectors? With cooperation of social science councils, the medical council, science and engineering academies we are in the process of coming out with a code of conduct that will make it impossible for any professional, ever in future, to extract knowledge from the informal sector without due credit, due acknowledgement and due reciprocity.

How do we design the pathway for Frugal Future? India is on a growth path but growth does not necessarily mean ostentatious assumption. Frugality must not only be a sign of scarcity prone times and lives, but should be used to make us more responsible. 'Swantah Sukhaya' (*for one's own happiness*) is the greatest motivating force of our society. Most people who did outstanding work in their lives in the history of this country were motivated by this ideology. The notion of getting incentives from outside all the time, the recognition, award, should not be the real driver, because the real reward comes from inside. There are many ways in which we can learn from innovations; we can learn at artifact levels, learn as a metaphor, and learn at a heuristic level. We can also learn from the great power that nature has of correcting itself. Can we bring that into our institutions and technologies, rather than cribbing about why somebody didn't do a good job? Users also can become part of the innovation design. A design is never complete; it assumes new form and shape and always gets modified by the influence of the users.

Innovations transform and incentives inspire, but not just material incentives also non-material incentives, not just individual incentives but also collective incentives. So as a group if we recognize those who are achieving outstanding results for their creative ideas and efforts, it will make our society much more inclusive, more empathetic, and more innovative.

GM Crops

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Probably no other technology has been scrutinized so much like GM technology. Nearly about 90% of the current cotton production in India is from Bt cotton, but still we are debating, we are still wondering whether genetic modification should be continued for other crops or not. To develop one new variety or an improved hybrid of any crop including cotton, tomato or brinjal using the conventional methods of crossing and selection, a scientist needs to spend at least 10 to 12 years. But with GM technology it can be reduced to half. The most important advantage of GM technology is crossing the barriers of species. Conventional methods allow crossing only between parents from the same genus or species. However, using GM technology genes controlling a particular trait from totally different species can be brought in to the target crop without any undesirable trait transfer. GM crops are designed to resist biotic or abiotic stresses such as pests, diseases or drought. By cultivating such varieties farmers can not only enhance the return from their farms by reducing the money to be invested for pesticide or irrigation but also avoid the deterioration of the quality of their environment.

Bt cotton could be quoted as an excellent example for the success of GM technology. Generally several pests attack cotton, in that bollworms, larvae of a Lepidopteran insect are the worst. However, cotton plants could be made selectively toxic for the Lepidopteran larvae by adding DNA from *Bacillus thuringensis*, a soil bacterium, into the plant's genome. Bollworm larva ingesting the toxin produced by this bacterial DNA in the plant cells dies due to the ruptures in its alkaline midgut. Interestingly the toxic protein produced by

the Bt gene are insoluble in acidic condition and hence it is safe for humans and other mammals, which hold an acidic stomach. If they switch to Bt variety, cotton farmers could practically stop spraying pesticide for controlling bollworms, which currently they do 15 to 20 times during a crop. As of now nearly 95% of the entire cotton cultivating areas in India use Bt varieties and farmers are reaping benefit of the GM technology. This Bt technology could be extended to the crops like red gram, pigeon pea etc. Additionally, crops that could endure herbicides (Roundup Ready or RR), ring spot virus resistant papaya, drought and flood tolerant crops, bio fortified golden rice containing betacarotene, which could solve the problem of Vitamin A dependent blindness are also being developed using GM technology by different laboratories.

There are apprehensions about GM crops, such as it could adversely affect the health of the people or animals who consume it and can cause damage to the environment by killing microbes and contaminating the genes of local plant species and weeds by cross-pollination. Bt plant products have been found to be safe when tested on rats, guinea pigs, fish and broiler chicken. Furthermore, research failed to find any difference in the earthworm population, micro flora or the fungal population between the plots cultivating Bt and non-Bt varieties for many years. The suspected cross between Bt cotton with wild weeds of Malvaceae family, the plant group which cotton belongs to, has not been reported till date. American Association of Advancement of Science, European Commission and Royal Society of Medicine have also supported the safety of the GM crops.

Although, currently 28 countries are cultivating 9 different crops genetically modified for resisting pests, disease or herbicide, in India because of the lobbying by different groups a moratorium has been put on these crops. Until now only GM cotton has given sanction by the government and indigenously developed seeds of many varieties of crops are waiting for approval. There is a

firm opinion that scientists spend lot of time in developing the technology, but they often fail to communicate it to the society ultimately for whom the technology is being developed. We need to convince all the stakeholders about the safety and benefits of GM crops and compile the results of studies on the safety of GM products beings carried out all over the world immediately and share with Indian public in a language which they can understand. Then only we could save farmers and agriculture in India.

War of the Worlds: Human-Wildlife Conflict and Indian Agriculture

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Nonhuman primates, particularly macaques, have had a long history of association with humans across the Indian subcontinent but, in recent years, rapid urbanization, recruitment of crop fields, encroachment of forests and establishment of monocultures as well as the provisioning of macaques by people due to religion and tourism, their easy accessibility to garbage and the often unplanned translocation of macaque troops to new areas close to human habitation have led to increasingly difficult relationships between them. This has manifested, among other problems, in extensive crop- and kitchen raiding by particular macaque species—the rhesus and bonnet macaques in northern and southern India respectively, aggression by both humans and macaques towards one another leading to attacks and often-serious human injury and the occasional transmission of zoonotic diseases.

One of the most important causes of this conflict is the fact that, today, about 60% of our land is committed to agriculture and less than 24% continues to be under forest cover. Certain macaque populations, therefore, face severe habitat loss and fragmentation but, in addition, tend to gravitate towards agricultural lands as crops are extremely rich in nutrition and relatively easy to access, especially during harvest. Himachal Pradesh is an example of an Indian state, severely plagued by crop-raiding rhesus macaques. The state Forest Department reported, in 2006, a population of about 5,700 macaque troops (*c.* 2,76,000 individuals), of which about 1,360 troops (*c.* 70,000 individuals) inhabited urban and rural areas of the state. According to the Kheti Bachao Andolan, a

farmers' organization, more than 53% of all crop damage annually could be attributed to macaques, amounting to an estimated monetary loss of INR 2,200 crore from 2007 to 2012. There were also well-documented instances of villages and agricultural lands being abandoned in certain parts of the state, the socio-economic implications of which have never been evaluated. The complexity of the situation is, however, best summed up by the observation that although the state Government allowed the free culling of monkeys between 2007 and 2010, simply because they were unable to handle the problem, the actual numbers of monkeys killed were negligible, primarily because of the ambivalent attitude of the people towards the macaques, an important religious icon.

In southern India, there appears to be an apparently successful coexistence of bonnet macaques with the local people in a variety of non-forest habitats although the intensification of agriculture in rural areas and the increasing intolerance towards the species in urban localities has possibly been leading to a quiet, but steady, decline of many commensal macaque populations across the region. While first-order anthropogenic impacts, such as road kills, trapping for the pet trade and other forms of interference, are well documented, a crucial question is whether there are second-order impacts of human provisioning of macaques on their social biology and ultimately, reproduction and survival?

Our own studies in the Bandipur Project, over the last fifteen years have convincingly documented that provisioning of macaques by humans, particularly tourists and travellers, may be seriously affecting bonnet macaque populations even in our forests, which are protected for their wildlife, leading to significant population declines in the species across their distribution range. Troops of completely wild bonnet macaques are now rarely observed in interior forests, with most troops being permanent residents along roads that line and run through these forests. The provisioning of these troops by tourists with rich, but patchily distributed, foods

seems to have led to intense competition and increased aggression amongst the adult females of this species, leading to enhanced social tension. A unique response of the females to such competition is to emigrate and establish small troops, which are then monopolised by single adult males, with behavioural profiles unusual for the species, leading to the emergence of a novel social organisation—unimale, multifemale—now widespread in this population of bonnet macaques. Human interactions with bonnet macaques, including the simple act of feeding monkeys, can thus have profound effects on their behavioral ecology, in this case, at two organizational levels – those of the society and of the individual.

While demonstrating the remarkable social flexibility and behavioral ability of a species that allows it to successfully adapt to very different socio-ecological habitats, including disruptive anthropogenic regimes, our studies reveal that such fragmented troops are relatively more vulnerable to negative stochastic influences and predation, mainly by leopards, and concomitantly, there appears to have been a significant extinction of unimale troops in forested tracts, with emigration to human habitations increasing troop survivability. These observations raise the critical questions of whether bonnet macaques and other similar weed macaque species are on their quiet, but steady, road to extinction in natural habitats and whether we are destined to lead an inevitable, but difficult, life with them in the future.

Given our understanding of the different dimensions of human-macaque conflict, attitudes and perspectives of the affected people and the potential behavioural responses of the concerned species, it is essential to manage this ever-increasing problem effectively. The onset of conflict cannot usually be predicted by numbers or types of macaque individuals involved while conflict is often related to levels of human tolerance, which is dynamic and can only be determined by efficient monitoring. In general, however, the control of conflict necessitates the use of both preventive

and reactive management methods. The former primarily involves population control through surgical sterilization, oral contraception, endocrine regulation or immunocontraception, keeping in mind the importance of sterilizing females, effective garbage management, and strict legislation against provisioning in human-populated sites and in protected areas.

Reactive management practices typically involve regulated culling or capture of problem troops or individuals, development of monkey sanctuaries, establishment of insurance schemes for crop damage and compensation funds for confirmed injuries from macaque attacks. There must, however, be no translocation of macaques to protected areas or to other sites of human habitation and the legislation against export to other countries for scientific research must be continued.

In the future, we need to study the ecological and behavioural plasticity of macaques in human-modified landscapes, identify the socioecological correlates of problem troops, examine the population viability, individual mortality and behavioral profiles of sterilized individuals, conduct data surveys of the sociocultural and economic realities of local communities and perception surveys of their attitudes towards macaques and their conservation.

In terms of management, we need to effectively manage the agriculture-forest ecotone, establish local and central management committees, including researchers and managers, institutionalize regular and reliable monitoring programmes for macaque demography and behaviour, conduct public education protocols to impart knowledge about macaque behaviour and appropriate rules of human-macaque interaction and finally, develop effective long-term conservation plans for the affected macaque species.

SPEAKERS' PROFILE
(Arranged as per the Contents)

Suresh Prabhu is currently the Union Railway Minister of India. He was, at various times during the Premiership of Atal Bihari Vajpayee of 1998 to 2004, Industry Minister, Minister of Environment and Forests, Minister of Fertilizers and Chemicals, Power, Heavy Industry and Public Enterprises. He was elected a member of the World Bank parliamentary network and chaired the South Asia Water regional group of the World Bank. He was also Chairman of Task Force for Interlinking of Rivers with a status and rank of Union Cabinet Minister. He has been rated as one of three future leaders of India by Asia week.

CNR Rao is the National Research Professor and Linus Pauling Research Professor at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and Honorary Professor at the Indian Institute of Science (both at Bengaluru). His research interests are mainly in the chemistry of materials. He is a Fellow of the Royal Society, London, Japan, French and Russian as well as other science academies and an Honorary Fellow of RSC. He is the recipient of the Einstein Gold Medal of UNESCO, the Hughes and Royal Medals of the Royal Society, the August Wilhelm von Hofmann medal of the German Chemical Society, the Dan David Prize and Trieste Science Prize for materials research and the first India Science Prize. He has published 1600 research papers; authored and edited 48 books. He is the recipient of Bharat Ratna, highest civilian honor of India.

K Kasturirangan was Member (Science) in the Planning Commission, Government of India (during July 2009 to April 2014). He is presently the Chancellor of Jawaharlal Nehru University and Member, Atomic Energy Commission. Earlier, he was Chairman of the Indian Space Research Organization (ISRO), Director of the National Institute of Advanced Studies (2004-2009) and also a Member of Upper House (Rajya Sabha) of the Indian Parliament (2003-2009). Kasturirangan was also the Vice President of the International Academy of Astronautics, President of the Indian Academy of Sciences and Indian National Academy of Engineering. He has been conferred the Award of "Officer of the Legion d'honneur" by the President of the French Republic and also honored with Padma Shri, Padma Bhushan and Padma Vibhushan by the President of India.

MR Srinivasan is Member, Atomic Energy Commission since 2005 and has served as one of India's foremost nuclear energy experts and science bureaucrats. He was the Chairman, Atomic Energy Commission and Founder Chairman of the Nuclear Power Corporation of the Dept. of Atomic Energy during 1987-1990. He served as Advisor, International Atomic Energy Agency, Vienna (1990-1992) and as Member Planning Commission (1996-1998) and Member of the National Security Advisory Board (2000-2005). Among his awards have been Padma Vibhushan, Padma Bhushan, Padma Shri, the Indian National Academy of Engineering Lifetime Achievement Award, and the Homi Bhabha Lifetime Achievement Award from Indian Nuclear Society. He is author of the book '*From Fission to Fusion: The Story of the Indian Nuclear Power Programme'* and numerous international publications.

Devi Prasad Shetty is the Chairman of Narayana Health (formerly known as Narayana Hrudayalaya) Group of Hospitals, Bengaluru. He is the first heart surgeon in India to enter into neo-natal open-heart surgery, the first doctor in the world to perform open-heart surgery to close a hole in the heart and the first user of an artificial heart in India. Currently, Narayana Hrudayalaya is the biggest telemedicine center in the world, established in some 19 countries. He also founded Narayana Nethralaya, Rabindranath Tagore International Institute of Cardiac Sciences and '*Yashasvini*' the cheapest health insurance scheme in the world. He is celebrated with Padma Bhushan (2012), Padma Shri (2004), E&Y entrepreneur of the year (2003) and Karnataka Ratna Award (2001).

S Ramadorai is currently the Chairman of National Skill Development Agency (NSDA) in the rank of a Cabinet Minister. He is also Chairman of the National Skill Development Corporation (NSDC). In October 2014, he retired as the Vice-Chairman of Tata Consultancy Services Limited. Ramadorai is Chairman of the Bombay Stock Exchange (BSE Limited) and Air Asia (India) Private Limited. He is also Chairman of the Council of Management at the National Institute of Advanced Studies and Governing Board at the Tata Institute of Social Sciences. Mr. Ramadorai was honored with Padma Bhushan by the President of India and CBE (Commander of the Order of the British Empire) by Her Majesty Queen Elizabeth-II.

K VijayRaghavan is the Secretary, Department of Biotechnology, Government of India since January 28, 2013. Before that, he was the Director of the National Centre for Biological Sciences of the Tata Institute of Fundamental Research. He is a J.C. Bose Fellow of the Department of Science and Technology and was awarded the Shanti Swarup Bhatnagar Prize, India's most prestigious science award, in 1998. He is a Fellow of The Indian National Science Academy and The Indian Academy of Sciences. He is an Associate Member of the European Molecular Biology Organization. Vijay Raghavan was elected Fellow of the Royal Society and the Foreign Associate of the US National Academy. He was awarded the Padma Shri in 2013, by the Government of India.

Krishna Byre Gowda is the current Minister of State for Agriculture, Government of Karnataka (Independent In-charge) and Member of Legislative Assembly of the Byatarayanapura Constituency, in office since June 2008. He has served three times as a Member of Legislative Assembly (MLA) of Karnataka state. Mr. Krishna Byre Gowda has served as the President of the Karnataka Pradesh Youth Congress between 2007 and 2011, and currently holds the office of General Secretary of the Karnataka Pradesh Congress Committee, since 2012.

Chiranjiv Singh was the Ambassador of India to UNESCO in Paris. He retired in 2005 as Development Commissioner of Karnataka and Additional Chief Secretary to Government of Karnataka. During his career he held various positions in the central and state governments, some of which are: Principal Secretary, Agriculture; Secretary, Culture and Tourism Depts.; Director, Information, Culture, and Tourism, Govt. of Karnataka; Special Assistant to the Minister of Agriculture, Irrigation, Food and Civil Supplies and Rural Development, Govt. of India; Additional Director General of Tourism, Govt. of India etc. For his services rendered to the state he was awarded the "Rajyothsava Award" in 2005 by the Government of Karnataka.

B Muthuraman was the Vice Chairman of Tata Steel, India's largest steel manufacturer and Chairman Tata International. He is also the former Chairman of the Board of Governors of XLRI- Xavier School of Management, Jamshedpur and National Institute of Technology, Jamshedpur. Muthuraman was also nominated as the Chairman of the Board of Governors of IIT Kharagpur by the Honorable President of India. He has been awarded the Padma Bhushan by the Indian government in 2012.

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