

## **“S&T Roadmap for Building a New India”**

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India is a young independent country having thousands of years of rich scientific heritage. As we celebrate our 75 years of independence, we have to bring out a vision for another 100 years. The scientists, policy makers, bureaucrats and political leaders should come together on a common platform and bring out a science and technology vision document for the next century. Post-independence India has made commendable progress in every field of science, kudos to visionary institution builders who initiated a chain of research organizations in the country. In the food sector, we became self-sufficient through initiatives like the green revolution and white and blue revolutions. In the medical sector, we have shown our prowess during the covid-19 pandemic by producing vaccines and equipment within a short period. The country's road, air, and sea infrastructure are as good as the developed country. Despite our strengths, we need to improve our scientific research focussing on the next century. Whatever we have achieved today may be outdated in the next century. We need to build a strong scientific workforce for tomorrow, so that problems affecting that society can be eliminated. Strong scientific research is the backbone of country. The research areas should be prioritized, focussing on the needs of the next century. Few focal areas for improving our country's strength are the following,

### **1. Cellular Agriculture**

According to latest Agriculture Census, the average size of operational holdings in India has decreased from 2.28 hectares in 1970-71 to 1.84 hectares in 1980-81, to 1.41 hectares in 1995-96 and to 1.08 hectares in 2015-16. Going by the current trends, we may find it challenging to find a place to do farming. With an ever-growing population, how do you find food for their survival? The World Resources Institute estimates that global demand for beef and other ruminant meats could increase by 88% between 2010 and 2050, driven by a growing world population. To meet overall nutrition requirements in the future, the Food and Agriculture Organization predicts that food production must increase by 70%. Transforming the current food system to provide healthy food is a significant challenge. We may be forced to develop alternative technologies to increase food production. People may be encouraged to grow vertical farming techniques and genetically modified crops. But will these be sufficient to feed the whole world? The future food production may be limited to labs. We may have to survive on *in vitro* produced food products. This new form of agriculture system known as **Cellular agriculture** has already been established in different parts of the globe. We can culture animal and plant cell products *in vitro* within our laboratory conditions. We need to give thrust to the second green revolution providing impetus on cellular agriculture to feed the future society.

### **2. Developing a database of bioactive compounds from natural resources**

With the emergence of new disease pathogens, we need to prioritize our research in developing bioactive compounds. A solid database of bioactive compounds needs to be developed so that future communities can use it

against disease-causing pathogens. The less explored marine flora and fauna need to be studied thoroughly, as these may contain potential target compounds against diseases and as health supplements. Similarly, microflora and fauna from our biosphere reserves must be examined to identify bioactive compounds. The all-natural wealth of the country needs to be digitalized.

### **3. Strict Biodiversity Conservation Strategies**

We need to control environmental degradation in the name of development strictly. We have to participate actively in science policy research in all developmental activities. We need to preserve our biodiversity centres for the country's future citizens. It's necessary for sustaining the life of our citizens.

### **4. Personalized Healthcare**

The country's healthcare needs to be improved so that people in every part of the country get world-class medical attention. All government hospitals should be connected through telemedicine facilities so that doctors can advise their peers sitting in other parts of the country. Using the projects like Indi-Genome project we need to build a database of genome of all citizens of the country. The moment a child is born, its genomic profile should be prepared and the details should be maintained in a database, which should be linked to a unique citizen identity like Aadhar. Focus on individualized, personalized treatment procedures should be emphasized.

### **5. Energy Sector**

Conventional energy resources cannot be dependent for a longer period. Fossil fuels depletion may occur in the near future. Keeping this in mind, we need to focus our non-conventional energy resources. New energy sources like biofuels, hydrogen etc should be given impetus. Tidal energy is least explored in our country. If we can tap tidal energy, we can make our coastal areas self-sufficient in energy resources.

### **6. Clean potable water**

Water is the elixir of life. Our governments must provide clean drinking water to all citizens. Water is a precious resource and we need to develop technologies based on nanotechnology to provide clean water.

### **7. Need to focus on AI based research**

The digitalization of the world is going in a fast pace and in future the countries that have a good resource in artificial intelligence (AI) technologies will over power others. AI technologies will be implemented in every sphere of life from transportation to healthcare. Driverless cars and trains will dominate our future transport systems

### **8. Cyber security**

With the dominance of the internet in every field, online cheating and fraudulent things will become a severe problem. The banking and defence details should be protected from cyber-attacks. We need to develop a strong research team focussing on cyber security.

### **9. Quantum technologies**

We have built a strong team in quantum technologies that is based on quantum mechanics. Computer-based on quantum principles will outperform digital computing. Technology has wide application in every field of science. It can be used in health care, and even to study evolutionary processes in biology. India had a solid scientific team in quantum research, starting from S.N Bose, C.V Raman, and Meghnad Saha and we need to build a new team for the future.

### **10. Waste Management**

With urbanization taking place quickly, waste management will become a severe problem in our cities. We need to develop decentralized steps in waste management instead of heaping all waste in a particular location. New technologies should be built to convert waste into valuable products at its source itself. For example, some mushrooms are capable of degrading plastics. If we can develop a product from such mushrooms, we can solve the plastic accumulation either in one house or a housing colony. Similarly, biological waste should be converted to valuable composts using microbial consortia.

### **11. Disaster Management**

The country needs to develop a robust disaster management team to overcome impending natural disasters utilizing satellite images to predict the disasters. Our weather forecasting and telecommunication network should be integrated into this disaster team.

### **12. Civil Engineering research**

One major issue our cities may face is space crunch. Providing housing for citizens will be a difficult task. This may, in turn, affect our future infrastructure developments. We need to utilize new technologies like 3-D printing in our construction works. Civil engineering research needs to be given more thrust for developing new materials for construction works.

### **13. Educational technologies**

The covid-19 pandemic has taught us the need for education 4.0. We need to focus our research in educational technologies so that our country's children keep abreast with the latest developments in every field, even if another pandemic strikes humanity in the future. Personal learning approaches should be given impetus.

### **14. Space colonies**

India has shown its potential in space research. Many countries appreciated our satellite programmes for humanity. We have already started programmes for human-crewed space missions and have the competency to develop space colonies. Space colonies are essential for saving future humanity from possible biological extinction. Future wars may happen in space competing for resources. We have to take a lead role to initiate an international body for maintaining peace in space colonies similar to present-day United Nations.

A country can succeed only if its scientific leaders have the vision. Whatever fruits of science we enjoy today are due to our visionary leaders'

foresight. The highlighted points are high priority areas that need to be addressed on a war footing. Apart from these areas, basic science is one area that we need to prioritise in research and scientific teaching. The foundation of a country resides in its strength in basic science. Our glorious scientific history highlights the importance of basic science. Many students are moving away from basic science research in the current situation, as these involve tedious tireless years of dedicated work. The trend of students going to jobs in app-based companies will inadvertently affect science education. Policymakers should take steps to provide compulsory primary science education till graduation. We can excel in the next century with a good science policy research team.

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