

SPACE TECHNOLOGY APPLICATIONS FOR RURAL DEVELOPMENT IN INDIA

G. MADHAVAN NAIR

It gives me immense pleasure to be with you today at the Colloquium on 'Grassroots level Planning and Local Government Institutions in India' organised by the Academy of Grassroots Studies and Research of India (AGRASRI). It is a great privilege and special honour for me to deliver the 8th Bharat Ratna Rajiv Gandhi Memorial lecture in this august gathering, which in the past was delivered by eminent personalities like Shri Mani Shanker Aiyer, Shri Shivraj Patil, Shri Kutumba Rao, Prof. UR Rao, Prof. MS Swaminathan, Dr. RA Mashelkar and Dr. C. Rangarajan. I am also pleased to note that AGRASRI has been organising this annual event since 2002 to commemorate the contribution of our former Prime Minister, Bharat Ratna Shri Rajiv Gandhi, a great visionary with a passion for modern technology, who strongly advocated its use in all its facets, and take India to the 21st Century in a transformed manner. A quote from Rajiv Gandhi while addressing the joint session of the US congress and India is appropriate here:

"I am young, and I too have a dream. I dream of an India - strong, independent, self-reliant and in the front-rank of the nations of the world in the service of mankind..."

Rajiv Gandhi introduced India to modern science and technology, which he considered as the very essence of development. He said, '*Freedom and racism cannot co-exist. Science and poverty cannot co-exist.*' He wanted Indian industry to develop to its fullest capacity. He laid great emphasis on the Green revolution and Yellow revolution which he looked upon as being extremely important for development of agriculture.

It was Rajiv Gandhi who initiated the telecom revolution in the country, which has resulted in a massive increase in tele-density across the country. Today's Information Technology boom in India is because of his prudence on the importance of ICT. He had increased government support for science and technology and associated industries, and reduced taxes and tariffs on technology based industries, especially for computers, airlines, defence and telecommunications. Rajiv Gandhi dreamt of a 21st century India at par with the rest of the world and recognition of India as part of G8 + 5 countries is an indication in this line.

■ Text of the **Eighth Bharat Ratna Rajiv Gandhi Memorial Lecture** delivered by **Dr. G. Madhavan Nair**, the then Chairman, Indian Space Research Organisation (ISRO), Govt. of India, on 20th August 2009 at Hotel Bliss (Darbar Hall), Tirupati, under the aegis of Academy of Grassroots Studies and Research of India (AGRASRI), in Collaboration with Rajiv Rural Development Foundation at Tirupati (A.P).

Rajiv Gandhi also realised that democracy would be meaningless unless it was decentralized at the grassroots level, and this led to the strengthening of the Panchayati Raj. It is the most vibrant system of democracy at the panchayat level in operation today. Nearly 85% of funds under rural development today are being used through Panchayati Raj system. He also advocated a minimum of 33% representation for women in the Panchayati Raj system, which is one of the major steps towards empowerment of women.

Rajiv Gandhi was especially concerned about the deteriorating environment. He believed that the destruction of the environment would lead to a vicious cycle of poverty and displacement. Today, when we hear the concerns raised by the entire world community and the programmes initiated across the world to protect the environment, we are astonished and surmised to know what a visionary he was!

Space Technology also received a great boost during his time, and application of space technology for natural resources management got tremendous impetus. For the first time, satellite images were used to prepare groundwater prospect maps, at detailed scale, for finding drinking water in villages, which eventually became an integral part of the Rajiv Gandhi National Drinking Water Mission, aiming to provide safe drinking water in all needy villages and habitations of the country.

As it is the Academy of Grassroots Studies and Research of India (AGRASRI) organising this event, and in the context of the theme of the colloquium, I thought, it is appropriate for me to talk on '*Space Technology Applications for Rural Development*'. I profusely thank the organisers for inviting me to deliver this prestigious lecture, and honoring me with '*Bharat Ratna Rajiv Gandhi Outstanding Leadership*' award.

Rural Development

As you are aware, among the developing countries, India is ranked as one of the fastest growing economies. India's GDP growth, as per our Planning Commission, would cross 10% towards 2025. We are all aware, while our country is progressing well in the economic front, the major livelihoods of rural India, the agriculture, is suffering due to various uncertainties, and currently shares only 18% of GDP.

As told by Mahatma Gandhiji, '*India lives in its villages*'. Nearly 700 million of our population lives in 600,000 villages. In spite of various efforts to improve the living standards of rural masses, around half of our villages still have poor socio-economic conditions. The rural mass depends on agriculture and allied activities for their sustenance, which is often associated with unforeseen risks. Most of the villages are deprived of basic amenities and services, such as infrastructure, sanitation, education and healthcare. Rural India is also characterised by low literacy due to livelihood compulsions. Transforming rural India is thus a great challenge.

Though India has taken significant steps over past decades towards reducing poverty, large numbers of people are still below poverty line - which was 46% in 1985, 36% in 1995 and around 26% in 2005. There is also a clear gap between rural and urban poverty. The challenge is to bridge the divide between the 'haves' and 'have-nots', dealing with poverty and inequity. Hence, rural development as an integrated concept of growth and poverty alleviation has been a paramount importance to the country.

The many efforts of the government for rural development, as we are aware, include: National Food Security Mission (NFSM), Rajiv Gandhi Rashtriya Krishi Vikas Yojana (RGKVY), Pradhan Mantri Gram Sadak Yojana (PMGSY), Rural Housing (RH), Integrated Wasteland Development Programme (IWDP), Accelerated Rural Water Supply Programme (ARWSP), Total Sanitation Programme (TSP), National Rural Health Mission (NHRM), etc. Towards realising the growth potential of rural India, Bharat Nirman, a business plan for rural India, was conceived by the government, and is being implemented. It addresses various related components such as irrigation, all weather roads, rural housing, rural water supply, rural electrification and rural telecommunication connectivity.

We need to substantiate the government's efforts to start a revolution, which can take its 6 lakh villages 'fast forward' in time - converting them into economically viable units and growth engines. Realizing the advantage of space as a vantage point, the visionary in Dr. Vikram Sarabhai, the father of the Indian space programme, saw an opportunity to exploit the space technology as a resource for community outreach, capable of serving the remote villages transcending geographical boundaries. And today, India's space programme distinctly exemplifies how space technology could be the harbinger of rural development.

Space Technology

Making a modest beginning in 1963 with the launch of a small sounding rocket from Thumba (near Thiruvananthapuram), we have come a long way in establishing space systems like the Indian National Satellite (INSAT) and Indian Remote Sensing (IRS) satellite systems that form a crucial part of our national infrastructure for telecommunication, television broadcasting, meteorology, natural resources survey and management. We have succeeded in building our own satellites, INSAT and IRS, and our own Polar Satellite Launch Vehicle (PSLV) for launching the IRS class of satellites and Geosynchronous Satellite Launch Vehicle (GSLV) for launching the INSAT class of satellites.

At present, we have a constellation of IRS satellites covering the whole globe with a revisit period of 2 to 26 days to cater to various applications. Starting with IRS-1A in 1988, we have launched many remote sensing satellites into orbit such as IRS-1B, IRS-1C, IRS-1D, IRS-P3, Oceansat-1, Resourcesat-1, Cartosat-1, Cartosat-2, Cartosat-2A and RISAT-2. Today, India has 9 IRS satellites operating in orbit making it one of the largest constellations of remote sensing

satellites in the world. The data from these satellites have been put to use for various applications ranging from agriculture, fisheries and forestry to urban planning and environment monitoring.

The Indian National Satellite (INSAT) system, currently with nine of them in orbit, is one of the largest domestic satellite communication systems in the world. INSAT, since its commissioning in 1983, has brought in vast advancement in telecommunications, television broadcasting, radio networking, meteorology and disaster management services. Presently, INSAT family of satellites with 220 transponders in frequency spectrum of S, C, Ext-C and Ku bands is providing communication network across the country.

Space Technology Applications for Rural Development

Satellite communication and earth observation satellites have demonstrated their capabilities to provide the services relating to healthcare, education, weather, land and water resources, land records, agricultural advisories, etc., relevant at communities/ village level. The value-added, high-resolution earth observation images provide community-centric, geo-referenced spatial information for management of natural resources, such as land use/ land cover, terrain morphology, surface water and groundwater, soil characteristics, environment and infrastructure.

Satellite Communication

One of the major components and driving force related to rural development is communication. It has been given highest priority for bringing desirable social and behavioural change among the most vulnerable rural society. Satellite communications has the ability to simultaneously reach a large population, spread over vast distances, and inherently is a powerful tool to support development education and training.

ISRO had undertaken several projects that focused on development of humanity through sophisticated satellite-based communication. Right from the inception of utilizing space programmes for development, the experiments like Satellite Instructional Television Experiment (SITE), Kheda Communications Project (KCP), Jhabua Development Communications Project (JDCP), Training and Development Communication Channel (TDCC) have been carried out. We started with the basic premise that television communication would facilitate rural development, and we demonstrated the impact of television broadcast and interactive programmes on the rural society.

Tele-Education

The tele-education programme launched by ISRO, serviced by the exclusive satellite 'EDUSAT', is primarily intended for school, college and higher levels of education to support both curricula based as well as vocational education. With 5 Ku-band transponders providing spot

beams, and one Ku-band transponder providing national beam, and 6 extended C-band transponders with national coverage beams, EDUSAT is specifically configured for audio-visual medium, employing digital interactive classroom and multimedia multi-centric system. Many important institutions such as the IGNOU, UGC, IITs, and many State Education Departments and Universities are making use of the EDUSAT network. Presently, more than 34,500 classrooms are in the EDUSAT network out of which 3,400 are interactive terminals.

Tele-Medicine

A healthy citizen contributes to make a healthy nation. Over the years, the government has introduced various healthcare initiatives and policies, which has resulted in the increase in life expectancy of our citizens. However, providing healthcare to millions of people in rural India is really a formidable challenge. It is a matter of concern that a meager 3% of the qualified doctors, who are attached to about 23,000 Primary and 3,000 Community Health Centres, are available to attend to the 70% of the Indian population. Satellite communication technology, combined with information technology provides a technological means of taking the benefits of the advances in medical sciences to large sections of people spread out in remote and inaccessible villages. ISRO's telemedicine network has enabled many poor rural villagers hitherto denied with quality medical services to get the best of medical services available in the country. As of now, we have 377 telemedicine nodes consisting of 320 remote/ district/ medical college/ mobile hospitals connected to 57 super specialty hospitals in different cities through ISRO's satellites. The ISRO telemedicine network is expanding to various regions in the country and has become one of the most visible and sociological applications in the world today.

Earth Observation

Rajiv Gandhi had a lot of concerns for the Indian farmers. He wished that the yield in the drought prone areas is as important as the yield in non-irrigated and rainfed areas. He wanted to ensure that water resources are used efficiently. He paid more attention to the irrigation projects and minor irrigation systems. He emphasized on introducing the modern methods in irrigation. In view of the scarcity of water and rainfall, he wanted to improve the weather forecasting system for accurate planning and decisions. In this line, I would like to share some of the operationally demonstrated remote sensing projects, which served the country's pursuit and Rajiv Gandhi's dreams for rural development.

- ❖ About 16% of the country's geographical area is characterized by wastelands, both cultivable and non-cultivable; and reclamation of such lands is a must for enhancing agricultural productivity, improving ecology, and also for non-agriculture related uses. Mapping and monitoring of wastelands over entire country has been carried out using remote sensing data at the behest of Ministry of Rural Development for planning and implementing various reclamation activities. It is observed that during the period 1998 to 2003, about 8 mha ha of wastelands have been reclaimed.

- ❖ In India, 60% of total food grain production comes from the irrigated area, and the management of water supplies for irrigation in command areas requires information on total demand and its distribution. The multi-temporal satellite data forms the basis for the performance evaluation in terms of cropping systems, cropping intensity and the water-use efficiency. Towards this, 14 large irrigated commands in 5 States (Andhra Pradesh, Assam, Maharashtra, Rajasthan and West Bengal), covering a total culturable command area (CCA) of 3.3 mha have been studied for their performance.
- ❖ To increase the irrigation efficiency, the gap between the irrigation potential created and that utilized through micro level infrastructure development is to be monitored. The Cartosat data is being utilized in irrigation infrastructure assessment under Accelerated Irrigation Benefit programme (AIBP). The satellite data has also been used to map the current status and to monitor the spatial extent of water logging and soil salinity & alkalinity in more than 800 major and medium irrigation commands.
- ❖ Under the 'Rajiv Gandhi National Drinking Water Mission' of Ministry of Rural Development, remote sensing technology has been used for preparing groundwater prospects maps on 1:50,000 scale in 10 states. Favourable zones/ sites for constructing thousands of recharge structures are also identified in these maps. With such remote sensing derived information, the success rate of bore wells has gone around 90% in most of the States. The project is now being extended, in phases, to cover the entire country.
- ❖ Watershed Development Programme is one of the major initiatives in the country towards conservation of soil and water resources in the rainfed area for enhancing agricultural production, and to ensure livelihood security to rural people, besides eco-development. Such endeavour needs scientific databases for evolving suitable strategies for planning. Remote sensing applications have responded to such requirements of watershed development. The Integrated Mission for Sustainable Development (IMSD), carried out for 25% of country's geographical area, has catered to the needs of Drought Prone Area development Programme (DPAP) and National Watershed Development Programme for Rain-fed Areas (NWDPA). We have also enabled the local planning officials at desert/ dry areas with land and water resources development plans.
- ❖ I would like to emphasize on the community driven watershed development programme in Karnataka called 'Sujala Watershed Development Project', which is implemented by Government of Karnataka with the World Bank assistance. The project is implemented in 5 drought-prone districts covering an area of around 0.5 million ha, and benefiting more than 400,000 households. The main objective of the Sujala project is to improve the productivity of degraded watersheds, reduce poverty and strengthen local communities and institutions. The project aims to increase the productivity of the watersheds through physical and financial interventions, alternate farming systems, adoption of agro-forestry and agro-horticultural systems integrated with livestock and income generating activities

through micro-credit enterprises. The communities are involved in the participatory planning, implementation and maintenance of assets, while the NGOs and the Government departments act as facilitators. The unique feature of this project is the way remote sensing, GIS and the Management Information System (MIS) are dynamically linked with the impact assessment, both in terms of development of natural resources as well as socio-economic indicators. It is important that such success stories in the dry land agricultural areas are scaled-up, and replicated in different agro-ecological regions of the country, which would bring 90 mha of dry lands into optimal productive capacity.

- ❖ The Department of Land Resources of Ministry of Rural Development has recently embarked upon an important and most ambitious programme, the 'National Land Records Modernization Programme (NLRMP)'. This programme aims at creating 'conclusive titles' for all land holdings in the country, and making the scientific development efforts of the Government 'citizen-centric'. This phenomenal task requires right mix of technologies as suited for timely realization of its goals.
- ❖ The synergy of contemporary technologies like remote sensing, Geographical Information System (GIS), GPS & ICT have led to an overall change in the planning process. Cadastral-referenced databases by geo-referencing village and cadastral maps in Chhattisgarh, Gujarat and Maharashtra States serves as a model for implementing it all over the country. The ample advantages of the project include scientific land-use planning and their implementation at absolute local level. Such databases also are very useful for planning and mitigation activities during disasters.
- ❖ Farming in our country strongly depends on the weather. From the satellite meteorological observation point of view, India is having the INSAT/ KALPANA VHRR system operating over the past two decades, providing continuous monitoring of the weather systems over the Indian region. This system has enabled deriving various meteorological parameters such as cloud cover, cloud top temperature, cloud motion vectors, atmospheric winds, and sea-surface temperature. One can also monitor the developing weather systems such as Tropical Cyclones. One of the key elements for improved weather forecasting is to substantially augment the surface observation network, and networking it with the central weather modeling station. In this context, I would like to mention about the development of low-cost Automatic Weather Stations (AWS) and Doppler Weather Radars (DWR) by ISRO associating Indian industries. The indigenously developed AWS is capable of recording weather data on a continuous basis and transmit through the INSAT system. The data from AWS network and the DWR will be of substantial use in the models being operationally run by the National Centre for Medium Range Weather Forecasting (NCMRWF) and the India Meteorological Department (IMD) for providing meteorological Services for agricultural purposes.

Disaster Management Support

India is one of the most disaster prone countries in the world with increasing vulnerability to cyclones, floods, landslides, droughts and earthquakes. In order to strengthen India's resolves towards disaster management, ISRO has evolved the Disaster Management Support (DMS) programme, which is a convergence of space communications and remote sensing capabilities. Today, INSAT and IRS satellite systems provide disaster management support for the preparedness, early warning, risk information, impact and damage assessment and emergency communication. The space based information is used by the stakeholders for various disasters such as floods, cyclones, drought, forest fires, earthquakes, etc., for relief and rehabilitation measures. INSAT Mobile Satellite Services (MSS) terminals are being put to use during emergencies for providing necessary connectivity.

Village Resource Centre

Among the many societal development related initiatives, I would like to emphasize on a unique programme of ISRO called 'Village Resource Centres (VRC)'. It is being implemented in association with the stakeholders at local levels, to reach the benefits of space and other IT enabled services directly to the common man. The VRCs are a step to bridge the societal divides, and are proving to be vital in improving the quality of life in villages - by way of providing locale-specific advisories for farm sector development, livestock management, local governance, skill development for livelihood support, awareness creation, market information, building disaster resilience, etc. All these services are reaching the doorsteps of common man, in local language. So far over 470 VRCs are set up in 22 States and Union Territories, and many more are in the offing. The uniqueness of VRCs is the knowledge connectivity between the experts at agricultural universities, research institutes and doctors at hospitals, and the village community. We are also making the natural resources data available at VRCs, which could be used to work out development plans at local levels.

Way Ahead

We have many more programmes using space based inputs in the years to come for planning and development. At the behest of the Planning Commission of India, ISRO is launching a National Mission - 'Space based Information Support for Decentralised Planning'. It would provide ICT enabled geo-spatial platform involving local bodies to carry out developmental activities under Panchayati Raj in a decentralised, speedy and transparent manner. The Mission aims to harness the space technology and the information systems at the local bodies to create information base and provide services. We also focus on capacity building at Panchayat level to use these space based inputs. We are sure, that if the human resources at Panchayat level are enriched with the knowledge of using space based inputs, many issues related to land use or reclamation of

wastelands, agriculture, horticulture, infrastructure development, water harvesting, etc., specific to the local environment can be solved.

The future is bright and full of promise. Let us carry the spirit of our former Primer Minister Bharat Ratna Sri Rajiv Gandhi with our insatiable desire to know, explore and understand. I am happy to state that the Indian space community would continue to harness the space technology to evolve new programmes and avenues towards transforming rural India.

Let me conclude my talk with the quote of Pandit Jawaharlal Nehru. I quote,

"The ambition of the greatest men of our generation has been to wipe every tear from every eye. That may be beyond us, but so long as there are tears and suffering, so long our work will not be over."

I sincerely thank the Academy of Grassroots Studies and Research of India for giving me an opportunity to present the space-based solutions for rural development before you.

Thank You.



Padma Vibhushan Dr. G. Madhavan Nair, the then Chairman of the Indian Space Research Organisation, Govt. of India, delivering the **Eighth Bharat Ratna Rajiv Gandhi Memorial Lecture** on 20 August, 2009 at Hotel Bliss (Darbar Hall), Tirupati, under the aegis of AGRASRI.