



Historical Perspective of Remote Sensing – Some Reminiscences

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Ancient India apparently had a clear concept of Remote Sensing. In the epic 'Mahabharata', Sanjaya had been endowed, presumably, with some equipment which enabled him to report, in real-time, all the events at the distant Kurukshetra battlefield, whether they were open or camouflaged and occurred by day or by night. Coming to recent times, in 1858, Mr. Tournachon, a Frenchman, took photographs for the first time from a balloon which floated over Paris. Aerial photography was extensively used thereafter, particularly during the wars.

During the 1950's zoologists found that some snakes have special infrared sensitive spots on their heads. These spots enabled them to detect frogs, their prey, camouflaged in green herbiage, through the infrared radiation emitted by their bodies.

The term REMOTE SENSING was first used in 1961, when a U.S. Naval Project on the "Study of Aerial Photographs" was renamed as Remote Sensing. There was a problem of detecting soldiers in green khaki uniforms moving inside green forests. The problem was solved with the development of special false-colour photographic films and using them in aerial photography. The green vegetation abundantly scattering infrared radiation, present in sunlight, was recorded as crimson red on the developed film; while the radiation in the visible region scattered by the green khaki uniforms was registered as blue. The infrared scattering was characteristic of the type of vegetation; diseased vegetation registered as black, so also water bodies.

The introduction of remote sensing in India can be traced back to an interesting event. It began with a very small observation when the Indian Ocean Experiment was done - we had a revelation in 1963-64 that the ocean surface temperature of the Arabian

Sea off Bombay was about 30°C sometimes higher than land temperature during the monsoon. This was subjected to a lot of doubt. There is a tendency amongst scientists to have a hypothesis and not accept anything that is not in confirmation with that hypothesis. So, we had the feeling that the monsoon had a large dependence on the sea surface temperature (SST), particularly off the west coast of India. When I came to PRL in 1966 after retirement, this was uppermost in my mind. Dr. Sarabhai asked as to what could be done in Monsoon studies. I said that the area surface temperature has to be measured, but it is not possible to make it using thermometers in ships. This has to be done using an aircraft, making use of infrared (IR) techniques. Dr. Sarabhai said, "that's fine. Let us do it".

The peaceful applications of remote sensing technology to agriculture and forestry were presented in a couple of papers in 1968. The occasion was the U.N. Conference on the Peaceful Uses of Outer Space, of which Dr. Vikram A. Sarabhai was the Scientific Chairman. At the end of the conference he told me that Remote Sensing was a technology of great potential for India's development, and asked me to learn the technology and introduce it in India.

A few months later, there was an International Symposium at Ann Arbor, Michigan, on the Applications of Remote Sensing. A team of half-a-dozen scientists from India was deputed to that symposium by the Indian Space Research Organisation. Thereafter, members of the team visited different institutions in the U.S.A., where Remote Sensing Technology was being applied in various disciplines like Agriculture, Forestry, Hydrology, Oceanography, Geology, etc. We learnt much. Knowledge was freely imparted. At that time U.S.A. was preparing to launch an Earth Resources

Technology Satellite with sophisticated remote sensing equipment on board. U.S.A was keen that various countries of the globe co-operate in the venture and become aware of the utility of Satellite Remote Sensing Technology. (The first Satellite in this series was launched in July 1972).

When the team returned to India, it was found that our policy makers and science administrators were skeptical about the utility of this technology in India. That was in 1969.

Remote Sensing (RS) was a new technology and people had to be convinced. People said RS is not something new, but it is just Astronomy. Dr. Sarabhai decided to meet the then Prime Minister (Smt. Indira Gandhi)- outside office hours, after dinner at her residence. So we went with a set of colour slides on RS and 2 projectors - so that if one fails the other can be used (redundancy even there). There were 4 or 5 people for the meeting; Dr. Sarabhai, Prof. Ramanathan and myself were there to make the presentation on the application of Remote Sensing in Agriculture, Oceanography, Geology, etc. The Cabinet Secretary, Dr. M. S. Swaminathan and Shri Haksar were also there.

After our presentation, we came back. The Prime Minister just heard us and said nothing. I asked Dr. Sarabhai about it; he remarked; "that doesn't matter, PM didn't object and that means she approves".

After the presentation at the PM's residence, Prof. Swaminathan told me about the coconut wilt disease in Kerala. He asked if RS technology could be used for detecting the disease early; I replied that perhaps, we could. That is how the first experiment on Coconut Wilt-Root detection employing remote sensing technology was started.

We had no equipment. We wrote to the US (NASA) requesting for the help of a scientist who would come to India with a set of cameras and false colour films for this experiment. We required an aircraft also, besides the helicopter supplied by the USSR for use by Thumba Rocket Launching Station. For the project, the Kayamkulam Coconut Research Station was chosen as it had coconut plantations and was near Thumba. It was under IARI and they were also asked to collaborate. The Chief Scientist of the Research Station also came into the project, and so we had a team of scientists and a team of people to take the photographs. My job was only to collect all these people together. For navigation, we resorted to setting up small fires in the fields. They served as control points. These 'ground places' were in a pattern (single, square, etc.), so as to be easily identifiable.

We had the remote sensing survey carried out, and

we saw that some of the crowns looked different and the difference was because of the disease. Those crowns appeared 'less red' than the ones that were unaffected. The juice of the leaves of 'less red' trees were taken and examined under an electron microscope by IARI and the virus was seen in them. So before the farmers could see the appearance of the disease on the tree; this methodology could be used for detecting the wilt root disease. However, this technique could not give any cure – but that was not our job, we were only to detect it and we detected it. Our experiment was a great success; thus an 'acceptance' was found for RS.

Dr. Sarabhai had other ideas regarding 'acceptance' of the technology. He invited a large number of Parliamentarians and Heads of Departments in New Delhi, for a lecture on RS. I was asked to give a lecture about the technology to them. He had invited them personally (about 200 invitations – but only 100 turned up). The lecture was in the Constitution House, New Delhi. In a sense the audience was impressed. Dr. Sarabhai knew that an acceptance by those people was desirable for the success of the application of remote sensing in India.

The next was the project "ARISE" in Anantpur. That was the time when there was levy on rice. So the farmers had reported less area under rice. But the photographs showed the reality. Thus, the RS technique was more 'accepted' and people realised that they cannot "bluff" as that could be called off.

The technology got accepted generally and rapid developments took place thereafter. Even at the start, Dr. Sarabhai envisaged that ISRO should not be the end user. The Secretaries of all the user departments were informed about this tool and told that they should decide how best to use this technique. The NNRMS – National Natural Resources Management System – concept is an expansion of that idea.

Around that period, the UK was putting up a satellite. They offered space for a 40 kg payload for RS. They were told that Prof. U. R. Rao would use the 40 kg payload for his experiments and that a 40 kg payload for RS was not sufficient. It was decided that we would wait till we get a capability to put a sufficiently large payload (about 1000 kg). An inadequate use might act as a negative factor in getting satellite remote sensing accepted in the country.

So we had to wait till 1988 for this. But the waiting was worth it.

Before concluding I wish to refer to what Dr. Homi Bhabha stated in February 1962, in his open-

ing address to the first meeting of the Indian National Committee for Space Research. He said, "If India enters the fields of Space Research and Technology now, she would be on the same ground floor as U.S.A., who has a lead of only ten years in this field. Therefore in a couple of decades we could catch up." His forecast has been fully validated by the Indian Remote Sensing Satellite and the operational use of its data in Crop monitoring, Drought monitoring, Crop yield forecasting, Ground water

targetting, Monitoring of forest cover, Estimation of forest biomass, Waste land surveys, Districtwise land use surveys, Coastal erosion, Location of fishing zones, etc., for optimum management of India's natural resources.

The other day in Haryana, I had shown a picture from SPOT satellite of Dehra Dun and an IRS picture on the same film. It was difficult to distinguish between the two. We may be patting our back, but it is a patting we deserve.

