JULY-SEPT. '94

SPACE india

INDIAN SPACE RESEARCH ORGANISATION

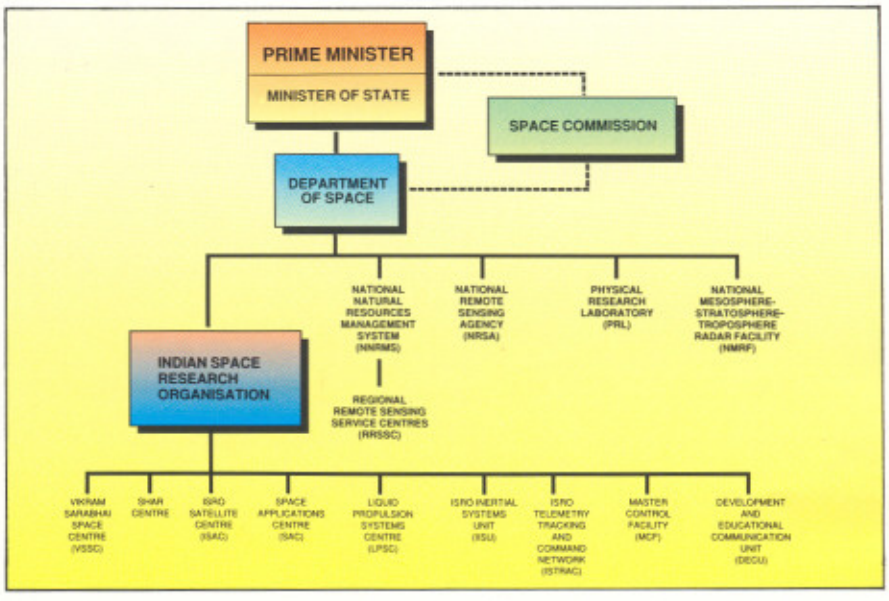
The Indian Space Programme

The setting up of the Thumba Equatorial Rocket Launching Station (TERLS) in 1963 marked the beginning of the Indian Space Programme. The Space Commission and the Department of Space (DOS) were established by the Government of India in 1972 to promote unified development and application of space science and technology for identified national objectives.

The Indian Space Programme is directed towards the goal of self-reliant use of space technology for national development, its main thrusts being: (a) satellite communications for various applications, (b) satellite remote sensing for resources survey and management, environmental monitoring and meteorological services and (c) development and operationalisation of indigenous satellite and launch vehicles for providing these space services.

The Indian Space Research Organisation (ISRO) is the research and development wing of DOS and is responsible for the execution of the national space programme. ISRO also provides support to universities and other academic institutions in the country for research and development projects relevant to the country's space programme.

Both the DOS and ISRO Headquarters are located at Bangalore. The development activities are carried out at the Centres and Units spread over the country. □



FRONT COVER

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EDITORS

S. Krishnamurthy
Manoranjan Rao

EDITORIAL ASSISTANCE

S.K. Dutta

PRODUCTION ASSISTANCE

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75th Birth Anniversary of Late Dr Vikram Sarabhai Celebrated

August 12, 1994 is a memorable date for the Indian Space Research Organisation (ISRO) for it marks the 75th birth anniversary of Dr Vikram Sarabhai, the pioneer who set the pace and direction for the Indian space programme. It is no exaggeration to say that all of ISRO's achievements till date are the result of pursuing the goals set by Sarabhai decades ago.

It is, therefore, only natural that ISRO and its Centres, mainly the Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram, should celebrate the anniversary in a befitting manner.

A two-day workshop on "Staging Systems," held at VSSC during August 11 and 12, 1994, marked the start of these celebrations. Inaugurated by Dr K Kasturirangan, Chairman, ISRO, the workshop brought together nearly 100 experts in the field, both from within and outside ISRO, to deliberate on the gamut of problems associated with staging of launch vehicles. The key note address was delivered by Distinguished Professor of ISRO, Dr S C Gupta. On the 12th of August, Dr Kasturirangan unveiled a bronze bust of Dr Sarabhai in the Space museum on the campus of VSSC. The same day, a photo exhibition on Sarabhai was opened by Shri Easwar Das, Deputy Director of VSSC.

A bust of Dr Vikram Sarabhai was installed at Space Museum, Vikram Sarabhai Space Centre, Thiruvananthapuram

Mr D Easwardas, Dy. Director, VSSC inaugurating the exhibition at VSSC.

In the evening, an exhibition on space, organised jointly by the Liquid Propulsion Systems Centre (LPSC) and VSSC, was inaugurated by the children of Balbhavan, an institution which is concerned with the welfare of children. The exhibition, which ran for five days, attracted tens of thousands of visitors. Another highlight of the celebrations was the organised visit by the students of standard X to LPSC and VSSC.

In Bangalore, the Astronautical Society of India (ASI), conducted a special technical meet at the ISRO Satellite Centre on August 13, 1994, to mark Dr Sarabhai's 75th Birth Anniversary. Dr A P J Abdul Kalam, Scientific Adviser to Rakshamantri, and Dr S C Gupta, Distinguished Professor, ISRO, were the speakers. Before the start of the Technical Meet, Dr Vikram Sarabhai Distinguished Professor U R Rao, who presided over the Meet, Dr K Kasturirangan, Chairman, ISRO, Dr Abdul Kalam and other senior scientists who had worked with Dr Sarabhai paid rich tributes to Dr Sarabhai.

Students express keen interest in the exhibits

Dr. K. Kasturirangan, Chairman, ISRO, paying tributes to Dr Sarabhai during the Technical Meet organised by the Astronautical Society of India (ASI) in Bangalore

Realising the Dreams of Dr Vikram Sarabhai

Dr K Kasturirangan, Chairman, ISRO, was initiated into India's space programme by Dr Vikram Sarabhai. He spoke to 'Space India' sharing his views about Dr Sarabhai and how his dreams have been realised. Excerpts:

On His First Meeting

I came in contact with Dr Sarabhai in July 1963, when I was to be selected as a Research Scholar at the Physical Research Laboratory (PRL), Ahmedabad. Dr Sarabhai talked to me, personally, about my interests, my career and my aspirations. More importantly, he asked me if the meagre allowance I would get as a Research Scholar would be good enough to maintain my family. What struck me on this very first meeting was that Sarabhai was an extremely humane person, very much conscious of the people's feelings, their problems and aspirations. At the same time, I found him to be charged with child-like enthusiasm as he started outlining his vision as to how India should adopt space technology for national development.

He was a visionary, a warm human being, a person who looked for the creation of institutions around individuals who could be moulded for that purpose. So, in a sense, I was encountering a very unique personality, probably the only one of his type in my career.

Besides being an intensely warm human being, one thing that

characterised Dr Sarabhai as a leader was his implicit faith in individuals. Once he entrusted a job to someone, he assumed that it would be done and that there was no point in pursuing it through frequent enquiries. He could achieve this, probably, because he selected the right person for the right job and, having done that, he made sure that the job entrusted to him would be done.

I found him to be charged with child-like enthusiasm as he started outlining his vision as to how India should adopt space technology for national development.....Dr. Kasturirangan

On Dr Sarabhai's Perceptions of Space Potential

When Dr Sarabhai started the space programme in India, Sputnik had been launched hardly four to five years earlier and things were just unfolding even in developed countries like the USA and the erstwhile USSR regarding the potential of this new technology for communications, remote sensing, meteorology, etc. But Dr Sarabhai was quick to catch on to this potential of space technology in the context of our own country's needs. He perceived that the very problems that India faced, like lack of proper communications, lack of suitable information system which could lead to optimum management of our natural resources — both renewable and non-renewable — and lack of good weather forecasting systems essential for agriculture, could be advantageously used to demonstrate the efficacy of space technology. He saw in space technology solutions to all the developmental problems of the country. Thus, even in those years, he visualised that if we could get into this technology, which was still in its nascent state even in advanced countries, we would be second to none in utilising its capability for grassroots development.

On Realising Dr. Sarabhai's Dreams

I feel that we have more or less followed Dr Sarabhai's initial vision of using space for the grassroots development. For example, today the services provided by the IRS and INSAT satellites are precisely what he had envisaged as operational capability of satellites, as far as India is concerned. Today, we are able to bring satellite telecommunications, not only to link major cities but also to several rural areas where telecommunication facility was very poor if not nonexistent and also to integrate the down-range islands to the main land. The transformation that TV broadcasting has brought about in this country, particularly in areas like education, health, hygiene, etc., is quite remarkable. Besides, being able to reach out to different parts of the country, TV has enabled exposition of our rich cultural heritage.

Look at what the remote sensing satellites have done today. The IRS system has been providing very crucial inputs to management of a variety of resources. Various agencies in the country today make use of the satellite data for assessment and management of various resources like forestry, agriculture, fisheries, snow-cover, water, minerals, etc.

And, of course, Dr Sarabhai had visualised that, if we have to have a sustained space programme for such a country of the size and diversity as ours, we should fairly be self-reliant and, therefore, he also envisaged capabilities to be built up in this country for launching IRS and INSAT class of satellites. So we have seen the day when we are on the threshold of achieving self-reliance in launch vehicle technology through ASLV, PSLV and GSLV.

Dr Sarabhai did visualise a variety of government institutions, industries, educational institutions and other agencies to play an important role not only in formulating the basic elements of our space programme but also participating in it as an active partner. In fact, in a seminar organised by him in August 1972, he really addressed the aspect of evolving a framework for the space programme through a very extensive participation of several agencies in the country: government, public and private. Today we have in the space programme several active partners, industries, academic and research institutions and the end users of the space benefits.

Thus, our space programme has more or less gone ahead the way Dr Sarabhai had visualised in those years. May be, we are now reaching a stage from where we could think of extending his ideas. But the fundamental direction that we are following even today is basically derived from his broad vision, that of a self-reliant space programme for national development. Of course, in some of the details there could be deviation between what he had thought of and what we are doing. But still I think that the basic framework remains, by and large, what he had visualised.

Vikram Sarabhai - The Man and the Vision*

Prof U R Rao,
Dr Vikram Sarabhai
Distinguished Professor

Who is Vikram Sarabhai, whose memory is still fresh in our minds, whose life, qualities, infectious enthusiasm and abounding energy inspired every one who came in contact with him — from kings to commoners and prime ministers to ordinary citizens? Even after 22 years since his untimely death, I find it difficult to speak of him in the past tense. Close and intimate association with Dr Sarabhai, as a student and, later, as a colleague, for over two decades has made his work ethics and philosophy a part of my life. The lapse of time since his death has only provided a better and more realistic perspective of this great son of India and his invaluable contributions to the building of modern India.

Like Dr Homi Babha, Vikram derived his early inspiration from his involvement in pure science which was always at the centre of his interests. With the passage of time, scientific acumen, combined with managerial capabilities, led him to utilise the powers of science and technology as an instrument for initiating socio-economic change for the betterment of the millions of inhabitants of our country. His characteristic breadth and diversity of interest enabled him to transform his novel ideas into vibrant institutions.

After his return to India from Cambridge in 1947, Dr Vikram Sarabhai started the Physical Research Laboratory at Ahmedabad for the study of cosmic rays and atmospheric physics with funding support from various private and public agencies. The overall programme of the laboratory was defined as the performance of an integrated study of different radiations which reach the earth from the sun, stars and their geophysical consequences. With his active interest in cosmic rays and interplanetary physics, it was natural for him to advocate strongly and to pursue vigorously the establishment of space research in India. Taking advantage of the unique location of the geomagnetic equator near the southern tip of India, he persuaded the government to establish the Thumba Equatorial Rocket Launching Station and the Space Science and Technology Centre for manufacturing sounding rockets of various types. It is a tribute to the excellent work done by the Indian Space Research Organisation under Vikram's leadership that a separate Department of Space was created by the Government of India in 1972.

Even though, initially, the attempt was to set up a base for conducting upper atmospheric research using space techniques, Dr Sarabhai soon realised the immense possibilities of the use of outer space for peaceful purposes, particularly, in the field of communication, meteorology and remote sensing. The exciting possibility of using advanced technology for national development and betterment of people's lives, particularly, in a developing nation like India where a large percentage of the population is in rural areas and is uneducated, became almost an obsession with him. He was keenly aware of the ever-widening economic, social and cultural gap between the developed and developing nations. The lack of resources and capital, of technical manpower and an adequate industrial base in addition to the lack of self-confidence, has only served to increase this ever-widening gap. He argued that the less developed countries which include almost 100 nations, poor in income, but have very diverse cultural, economic and social conditions as well as widely different political infrastructures, cannot afford to build up their technological level step by step,

Vikram, in his unique way, was able to combine the broad vision of a scientist, the gentle persuasive capability of a manager, hardheaded realism of a business man and the qualities of a sympathetic but tireless leader .... Prof U.R. Rao.

through the traditional path followed by the developed nations. If they opt to do so, it is obvious that their purpose would be defeated even before they make a beginning. I quote here from his presidential address at the United Nations Conference on the Exploration and Peaceful Uses of Outer Space in 1968 :

'... a positive approach for a way out of this predicament seems to lie in finding solutions where the particular disadvantage of developing nations, which is that they have little to build on, is made an asset rather than a liability. I suggest that it is necessary for them to develop competence in advanced technologies and to deploy them for the solution of their own particular problems, not for prestige, but based on sound technical and economic

* Talk broadcast by All India Radio on August 12, 1994.

Dr Sarabhai listening to a technical presentation. Prof U R Rao is seen behind him (second from right)

evaluation involving commitment of real resources. They would most likely discover that the traditional approach of planning to provide things like electric power or telecommunication services for a national infrastructure, based on projections of growth from past experience, leads to a dead end. They will also discover that an alternative approach lies in creating consumption centres alongside facilities for supply; that, as in the case of large nuclear power stations serving agro-industrial complexes, synchronous satellites could be planned in the context of a programme to be simultaneously undertaken for direct broadcast television to the entire countryside. Indeed, they would discover that there is a totality about the process of development which involves not only advanced technology and hardware but imaginative planning of supply and consumption centres, of social organisation and management, to leap-frog from a state of backwardness and poverty.'

The first major step in the realisation of satellite TV broadcasting, which was initiated by Dr Sarabhai in 1969, culminated in the conduct of the celebrated Satellite Instructional Television Experiment, SITE, in 1975 using ATS-6 satellite of NASA. This largest sociological experiment proved the efficacy of using the most powerful audio-visual media for broadcasting educational programmes to selected rural areas, paving the way for the initiation of satellite communication revolution in India. His basic conviction that "if we are to play a meaningful role nationally and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society," became the central goal of our national space programme. Vikram, in his unique way, was able to combine the broad vision of a scientist, the gentle persuasive capability of a manager, hardheaded realism of a business man and the qualities of a sympathetic but tireless leader.

Occasional setbacks and failures only helped to revive his spirit of confidence and determination to achieve success. He implicitly believed that "leadership for the development of creative, disciplined individuals highly motivated to ask basic questions is not leadership of the type we normally understand. A leader, if one chooses to identify, has to be a cultivator rather than a manufacturer. He has to provide the soil and the overall climate and the environment in which the seed can grow. One wants permissive individuals who do not have a compelling need to reassure themselves that they are leaders."

Dr Sarabhai was not just a great scientific visionary, a top class manager, a prolific institution builder and a dynamic industrialist, even though these traits alone would have made any person, a complete human being His keen interest in art and architecture, in music and literature was a part of his multi-faceted personality. He was equally at ease whether in discussing nuclear and space

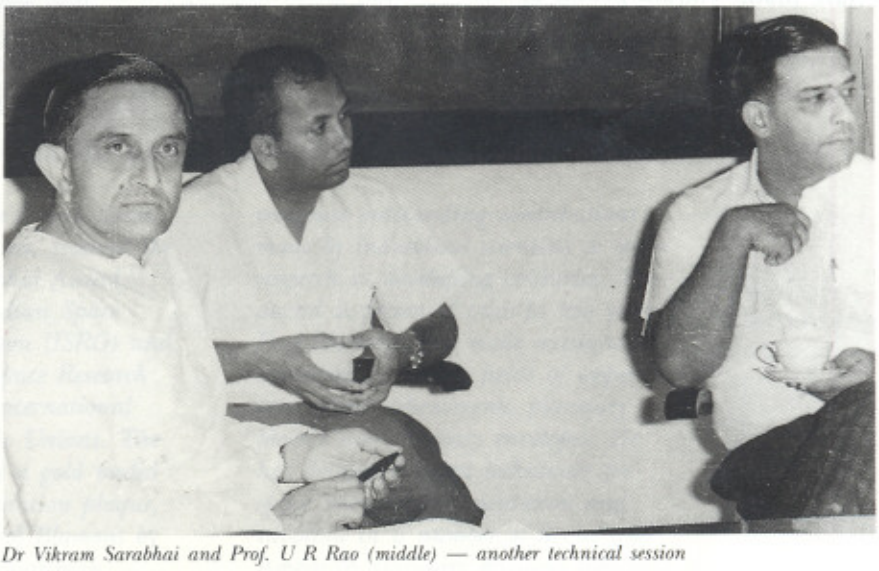
technology, human problems in the industrial empire, or in discussing artistic nuances of dance forms and drama with his wife, whom he joined in establishing an outstanding national centre for performing arts in Ahmedabad.

I have often asked myself how is it that Vikram was loved and worshipped by all and everybody who came in contact with him believed that Vikram was his close friend; how did he come to develop such a magnetic personality, firm in decision making yet kind to everybody, clear in perception yet gentle in guidance, brought up in aristocratic tradition yet responding to the pulse of the poor, trained as a pure scientist but fully aware of the need for rapid technological progress for the socio-economic uplift of the grassroots of our society.

On the night of December 30, 1971, just before his death, Dr Sarabhai and I had dinner together at his favourite resting place in Trivandrum. We were scheduled to travel the next morning to Ahmedabad, but alas... fate willed otherwise... instead we travelled with his mortal remains. All of us were numbed by his death... mechanically performing various duties. Our mind would neither accept nor comprehend that he was no more with us, that from then on we were to have only his living memory.

I believe that Vikram's stature does not rest mainly on his scientific achievements, which are many. The country as well as the world has seen many a greater scientist, or an administrator, industrialist, social reformer, manager or skillful diplomat, but Vikram's unique stature lies in brilliantly combining all these roles in one person. He was able to combine his intense desire to establish new institutions and innovative traditions with an excellent sense of economics and managerial skill. Above all, he was a very warm person — always smiling and never losing his temper, even in the face of the most adverse situations. His great dream was to help India leap-frog into a new era of science and technology; use advanced technology as an initiator of change and development for providing substantial qualitative improvement in the richness of rural and urban life. Many of us like me, who had been associated with him for almost two decades, believed and shared his dreams. It has been my proudest privilege to see some of Vikram's dreams come true during the last two decades.

Even though Vikram did not live to see his dreams come true, the rich legacy he left behind — the scientific culture he inculcated amongst us — has been the strong motivating factors in shaping our own lives towards the realisation of his dreams. As truly characteristic of him, when he sent me to finalise the cooperation with the Soviet Academy of Sciences (SAS) in August 1971, his instruction to me simply was "You know my philosophy. You decide what is best for the country." The outcome of this historic meeting was the birth of the 'Aryabhata' project, our first satellite, which was successfully launched in 1975 from the Cosmodrome in USSR. Aryabhata became the most significant milestone in the development of our space programme on a self-reliant basis. The subsequent launchings of a series of experimental satellites, Bhaskara, APPLE and Rohini,



Dr Vikram Sarabhai and Prof. U R Rao (middle) — another technical session

Dr Sarabhai with the late Prime Minister Smt. Indira Gandhi

followed by operational remote sensing satellites like IRS-1A & IRS-1B and multi-purpose geostationary satellites of INSAT-1 & INSAT-2 series have led to the establishment of a viable operational space system, transforming India into a global space power. The initiation of communication revolution in India, dramatic expansion of TV broadcast capabilities, quantum improvement in meteorological forecasting and use of remote sensing satellites for monitoring and management of natural resources, such as agriculture, forestry, landuse, water resources, marine resources, soil and wasteland mapping, urban planning and mineral prospecting leading to the implementation of sustainable integrated developmental strategies would have made Vikram proud of our achievements, if he were to be alive today and would have made him feel that his training (of us) had not gone waste! The operationalisation of satellite launch vehicles SLV, ASLV, PSLV and initiation of GSLV development, capable of launching our remote sensing and geostationary satellites, aimed at making this nation totally self-reliant, began with the seeds of sounding rocket programme initiated and nourished by Dr Sarabhai in the late 60's and early 70's. Extensive use of satellite technology in disaster management which today is saving thousands of human lives and livestock would have made Vikram very happy that his concern for the rural and illiterate people of India has been fully inculcated by his successors.

Even from a distance of 22 years since his death, Dr Vikram Sarabhai's figure looms large over the horizon of modern India. Vikram's presence is keenly felt, his dreams kept alive and his visions continue to guide the destiny of our space programme as, indeed, of all the institutions he helped to build. Dr Sarabhai's induction into the Space Hall of Fame, as the Father of the Indian Space Programme, only shows that his visionary ideas went well beyond the geographic boundaries of our nation into the concept of one global village.

Dr Vikram Sarabhai's accomplishments will continue to be a source of inspiration and his name supreme example of how a single individual can shape the destiny of a nation for generations to come. □

Vikram Sarabhai Award for French Scientist Prof J E Blamont

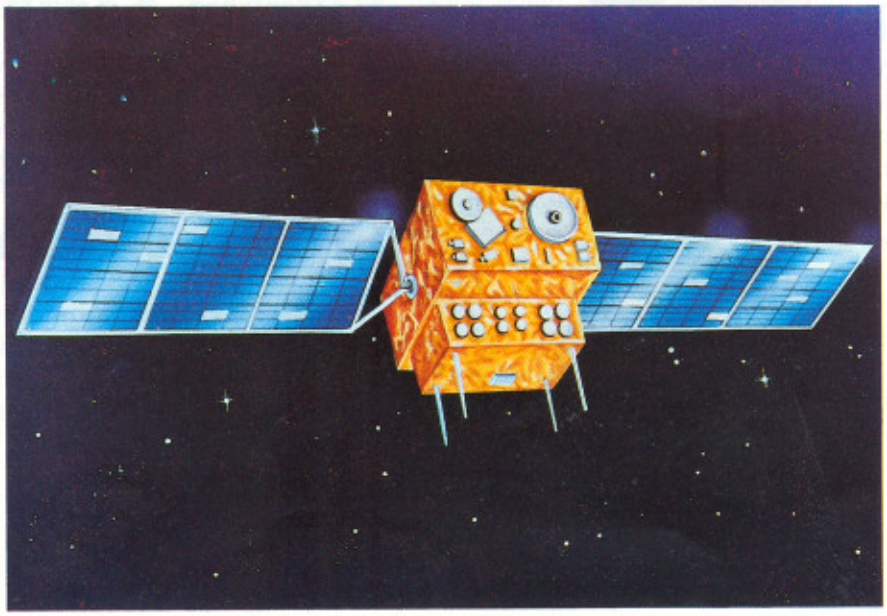
Prof Blamont of the French Space Agency, CNES, France, received the 1994 Vikram Sarabhai Award, instituted by the Indian Space Research Organisation (ISRO) and the Committee on Space Research (COSPAR) of the International Council of Scientific Unions. The award consisting of a gold medal and an engraved citation plaque, was presented to Prof Blamont by Prof R R Daniel, Chairman, COSTED Area Regional Office, in India and member of the COSPAR Bureau, on July 11, 1994 at the 30th COSPAR Scientific Assembly at Hamburg, Germany.

Prof Blamont's name for the International Vikram Sarabhai Award was unanimously recommended by the COSPAR Bureau.

The international Vikram Sarabhai Award was instituted in 1990 to recognise outstanding contributions made by individual scientists to space research in developing countries. The award is presented once in two years. Prof Blamont, has made outstanding contributions in the fields of upper atmospheric phenomena, planetary physics and cometary envelopes. He has developed expert techniques for space science instrumentation and involved in a number of Soviet and American planetary missions which have enriched the field of space research. India has also benefited immensely through his efforts, as adviser to Prof Vikram Sarabhai.

Academician Kotelnikov of Russia received the first award in 1990 and Prof C Y Tu of the Department of Geophysics, Peiking University, Beijing, People's Republic of China received the second award in 1992. □

IRS-1B Successfully Completes Three Years of Operation



The second Indian Remote Sensing Satellite, IRS-1B, successfully completed three years of operations on August 29, 1994. All the systems on board continue to function well with the remote sensing payloads providing quality imageries of the earth for a variety of applications.

The 990 kg satellite was launched into a 904 km circular polar sun-synchronous orbit on board the Russian Vostok rocket on August 29, 1991. The satellite, with a repetivity cycle of 22 days for taking imageries, has covered the whole of India 50 times so far.

The satellite carries two types of cameras — Linear Imaging Self Scanners, LISS-I with a resolution of 72.5 m and LISS-IIA & LISS-IIB with a resolution of 36.25 m. LISS-I provides a swath of 148 km while the composite swath of LISS-IIA & LISS-IIB is 145 km. The cameras operate in four spectral bands in the range of 0.45 to 0.86 micrometres.

The satellite monitoring and control operations are carried out from ISRO's Telemetry, Tracking and Command Network Stations at Bangalore, Lucknow and Mauritius with the Spacecraft Control Centre at Bangalore. The imagery data from IRS-1B is received at the National Remote Sensing Agency's (NRSA) data reception station, located at Shadnagar near Hyderabad and data is processed at NRSA Data Centre at Hyderabad, before disseminating to the users. The data is used for several applications such as agricultural crop acreage and yield estimation, drought monitoring and assessment, flood control and damage assessment, landuse/land cover mapping for agro-climatic zone planning, wasteland management, water resources management, ocean/marine resources survey and management, urban development, mineral prospecting, forest resources survey and management, etc. The Integrated Mission for Sustainable Development, started two years ago in the country, also uses mainly IRS data.

The data from IRS-1B is also now being received by EOSAT Co in USA, at its Norman Ground Station, Oklahoma. EOSAT Co is marketing the IRS-1B data to its customers all over the world.

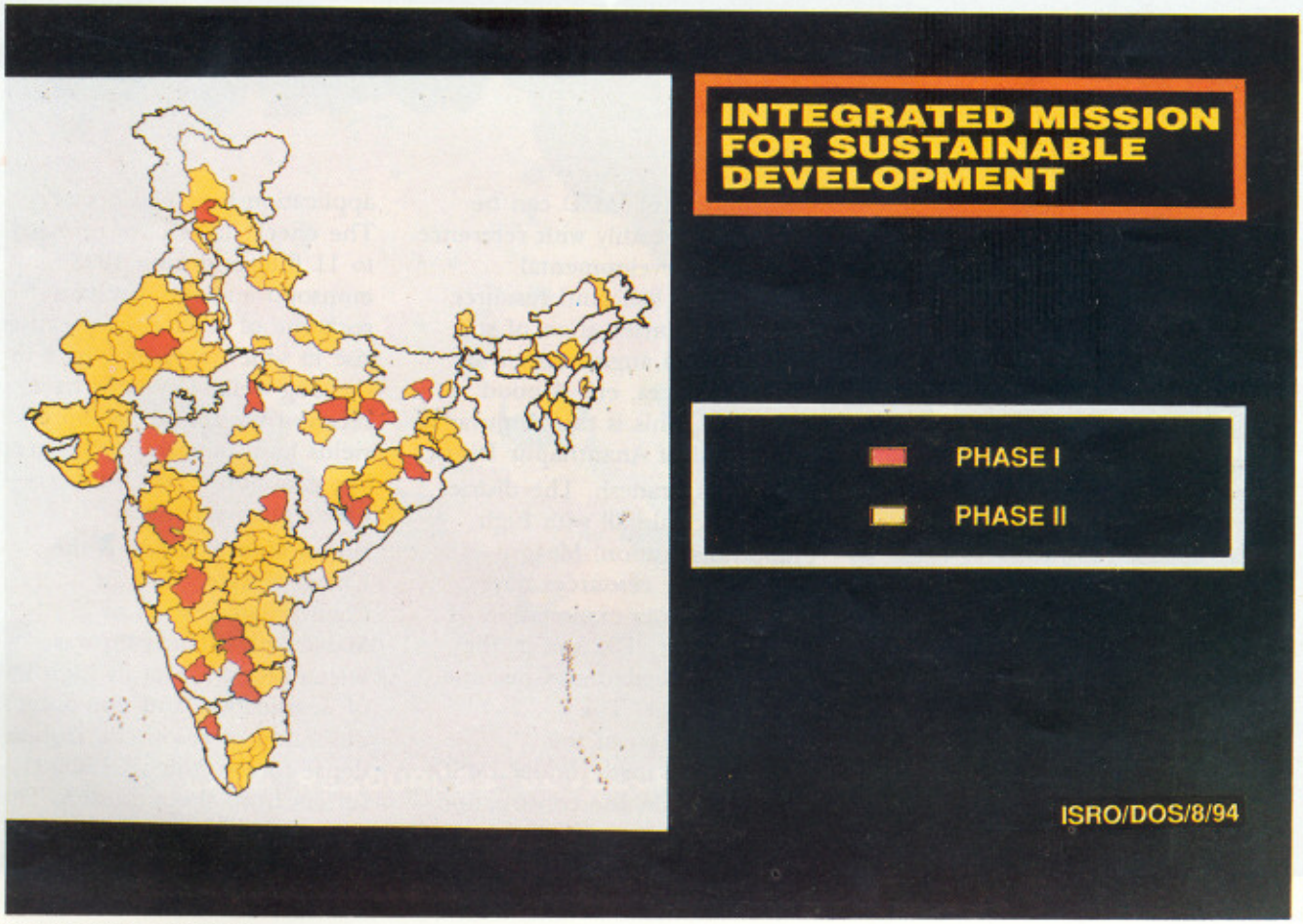
The next satellite in the IRS series, IRS-1C, which will have more advanced features than IRS-1B, is scheduled for launch next year. □

Moving Towards Sustainable Development

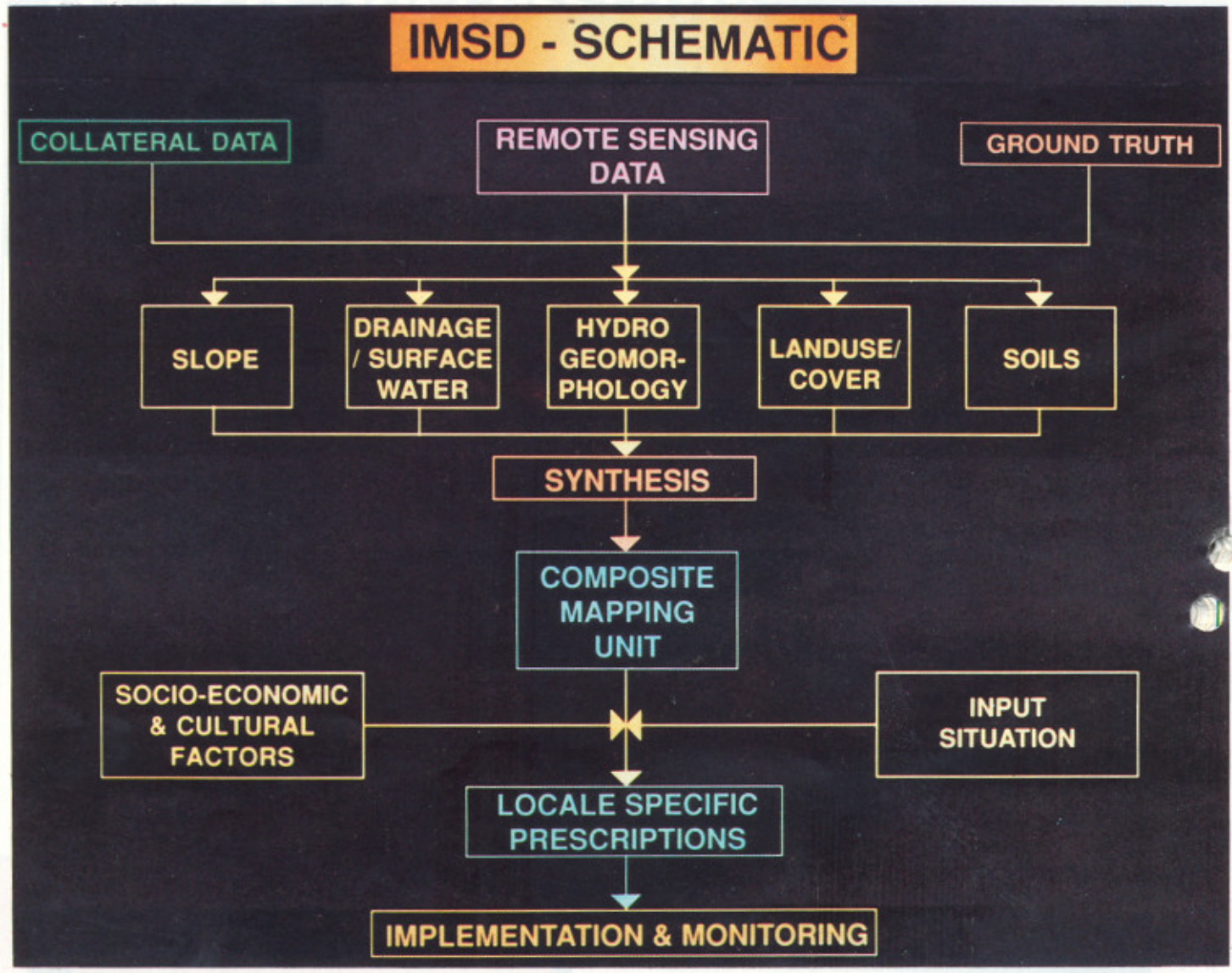
In 1988, the Department of Space (DOS) undertook pilot studies in 21 districts of the country to combat drought. The approach consisted in integrating thematic information on natural resources obtained from the Indian Remote Sensing Satellite (IRS) with meteorological and other relevant data. The pilot studies in which several departments and agencies of the central and state governments, agricultural universities, research institutions and voluntary agencies took part, demonstrated the efficacy of the integrated approach in combating drought on a long term basis.

The results of the pilot studies for the six districts of Ananthapur in Andhra Pradesh, Ahmednagar in Maharashtra, Bhiwani in Haryana, Dharmapuri in Tamil Nadu, Jhabua in Madhya Pradesh and Kalahandi in Orissa were reviewed by the Planning Commission in November 1991 and a high-level committee was set up to identify priority areas/ districts for undertaking similar pilot studies. In January 1992 the recommendations of this committee led the Planning Commission to conclude that the approach demonstrated through these studies could be accepted as a suitable model for development. Further, it was decided that the Department of Space should go ahead with the actual implementation of the action plans generated for the six districts mentioned above. Thus the Integrated Mission for Sustainable Development (IMSD) was launched by the Department of Space in June, 1992.

The term "integrated" in the IMSD refers to integration of (a) information obtained through different techniques like the remote sensing and conventional means such as ground-based surveys, (b) efforts of people with expertise in diverse areas like soil conservation, agriculture, forestry, public health and administration, (c) various programmes like integrated rural development programme, desert development



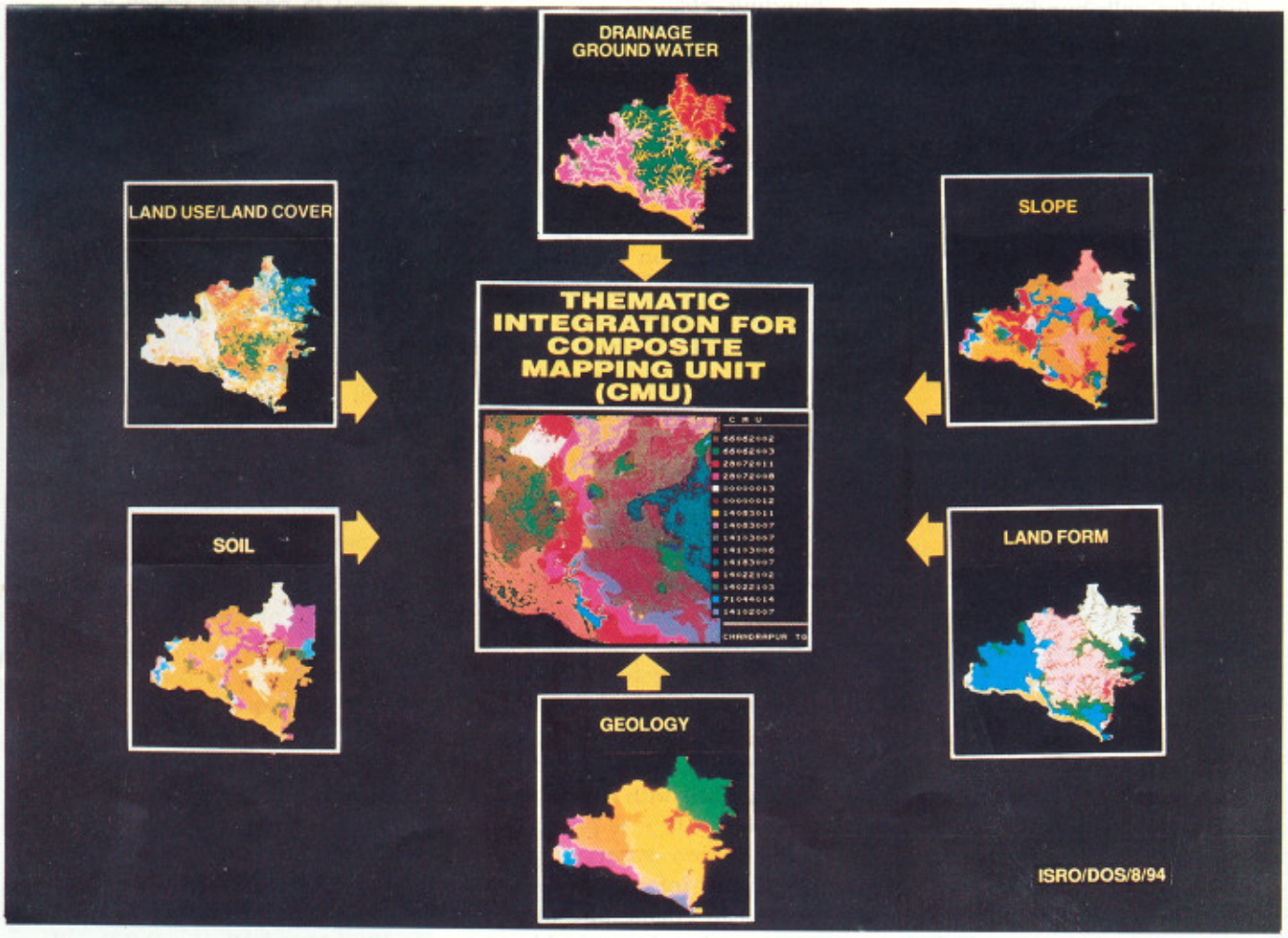
Districts selected under IMSD



programme, drought prone area programme, hill area development programme and so on, (d) socio economic programmes like the Jawahar Rojgar Yojana, training of rural youth for self employment, etc. Sustainable development takes into account the physical limits imposed by the ecological systems and regenerative capabilities of the natural resources. Development could become unsustainable for various reasons like over exploitation of the natural resources which would lead to short term gains but long term degradation. In other words sustainable development minimises adverse impact on the environment and ensures long term progress.

The concept of IMSD can be appreciated readily with reference to specific developmental programmes like land resource utilisation, conservation of soil moisture and augmentation of water resources, etc. A good example of this is the Vanjuvanka water shed of Ananthapur District in Andhra Pradesh. The district has erratic rainfall with high evapotranspiration. Meagre surface water resources have resulted in oyer-exploitation of ground water. The soil in the region has eroded and become saline/alkaline. The implementation of the prescriptions made under IMSD has resulted in the construction of 32 check dams, 1,200 hectares of soil bunds and tank silt application over 500 hectares. The check dams have received 8 to 11 fillings during 1993 monsoon and the resultant recharge of groundwater caused a rise in water-table by 1 to 4 m in the dug wells. Dry wells have also received water and the borewell yields have increased; thus crops like groundnut and mulberry have now been raised.

Yet another example is the Umagani water shed in Chandrapur District of Maharashtra. Umagani was selected because of its high level of degradation and non-optimal utilisation of resources. Inspite of dense forests, this watershed suffers from sheet erosion. The action-plan for development of water resources in the area


DRAINAGE
GROUND WATER
LAND USE/LAND COVER
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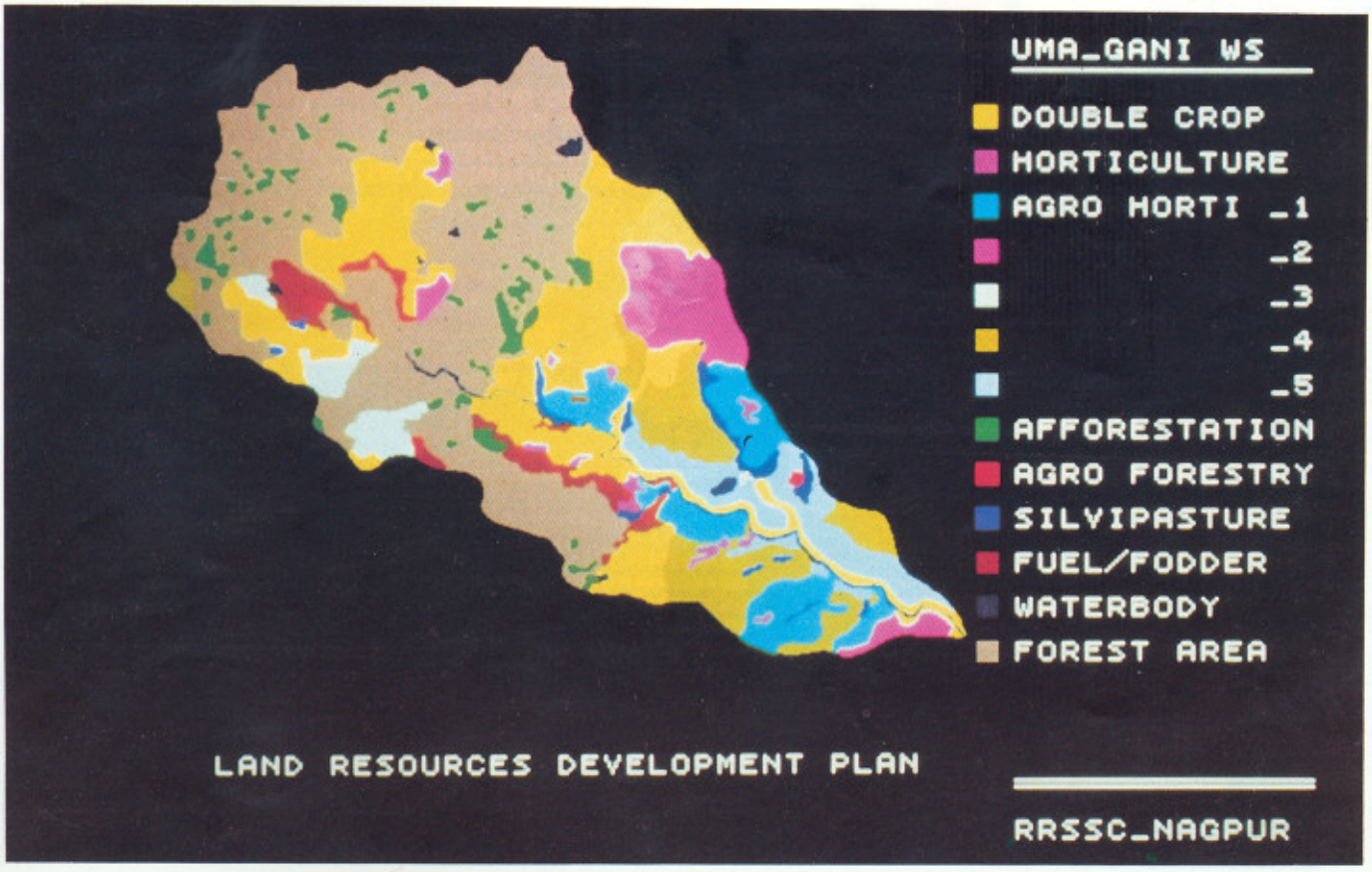
UMA_GANI WS
DOUBLE CROP
HORTICULTURE
AGRO HORTI _1
_2
_3
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_5
AFFORESTATION
AGRO FORESTRY
SILVIPASTURE
FUEL/FODDER
WATERBODY
FOREST AREA
LAND RESOURCES DEVELOPMENT PLAN
RRSSC_NAGPUR

includes nalla-bunding, underground bhandaras and farm ponds, shallow borewells and large diameter dugwells. Similarly, the plan of action for land resources development includes double cropping, afforestation, fuel and fodder development, agro-forestry, horticulture and silvipasture. The actual beneficiaries are being involved for implementation of these action plans and the cadastral boundaries are also being integrated with the resources data. The implementation plans have already been discussed and reviewed by the Gramsevaks and local farmers and others.

Thus water harvesting could be fruitfully done by conventional methods like check dams or gully plugging as well as by modern engineering methods like mini dams. The integrated approach takes into account the complementary nature of the conventional and the modern methods in ensuring continuous availability of water and preventive run-offs. Similarly, soil conservation measures include mulching, minimum tilling, bunding, etc.

The most crucial part of any developmental planning is information. For example the spatial information is most effectively obtained through remote sensing. Today the IRS-1A and 1B are routinely providing this information which can be directly used in diverse areas such as forestry, waste land mapping, agricultural crop acreage, drought monitoring, landuse, water resource management, etc. Importantly, it is necessary to combine the spatial data obtained from remote sensing with non-spatial data like numeric tables giving statistical information on a variety of socio-economic parameters. This is done by using tools like the Geographical Information System (GIS) which synthesises computerised data bases, graphic information, cartography, photogrametry and so on. Thus with the modern tools like GIS it is possible to really achieve synergy in processing information which alone can enable one to plan integrated and sustainable development. Today ISRO has its own GIS package which is operational and is also available commercially.

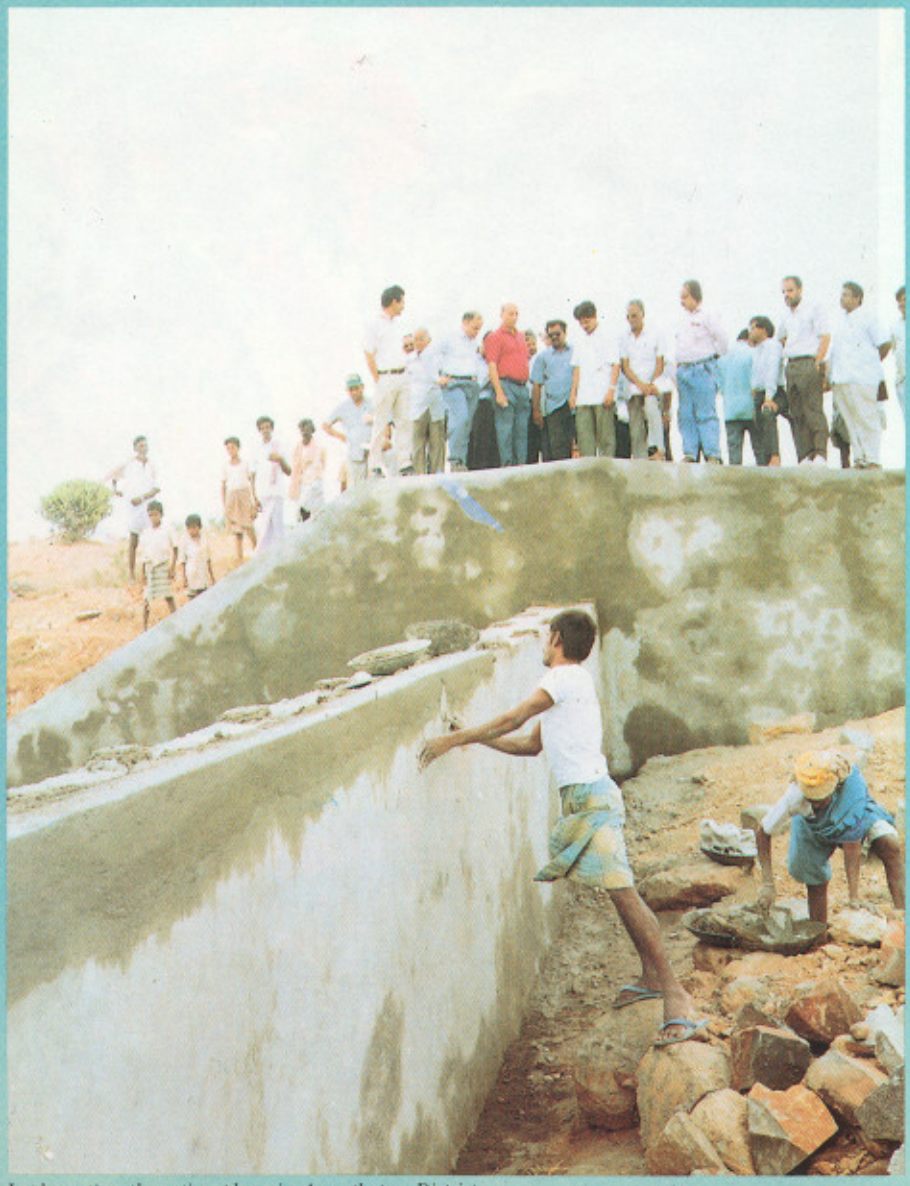
So far, under the IMSD, 157 districts of the country have been identified, covering nearly 45 per cent of the geographical area. These districts are perennially affected either by drought or by floods. They also include hilly and tribal areas. Care is taken to ensure that the IMSD knits itself well with other developmental programmes like drought prone area development programme, desert development programme, hill area development programme, etc.

Thus, the IMSD has proved to be a unique planning tool that transcends the traditional sectorial approaches. Successful accomplishment of the goals of IMSD, however, demands concerted efforts by Central and State departments as well as voluntary agencies. With the launch of IRS-1C, which has more advanced features than the currently operational satellites, IRS-1A and 1B, the IMSD will soon encompass the entire country.

Implementation of IMSD Action Plans – Ananthapur District Leads

The District administration of Ananthapur is leading in the implementation of action plans generated under the IMSD; following are the highlights.

- 15,000 hectares of soil conservation in arable and Government lands taken up and soil conservation being now done for 9-10 months in a year compared to 3-4 months earlier.
- 1,600 check-dams completed including 204 for drinking water sources (equivalent to the earlier efforts of a decade). Rock fill dams being dovetailed with the check-dams to avoid silting.
- 3,500 new borewells drilled integrating with the ground water recharged by construction of check-dams.
- 600 new check-dams to be taken up during 1994-95 as an advance action, along with 357 new drinking water borewells.
- Local species of trees such as Neem, Tamarind, Pongamia, Babul and Prosopis planted in 450 decentralised people's nurseries, including 59 through voluntary organisations towards development of about 40,000 hectares of wasteland.
- De-silting of 647, out of about 3,500 medium and major tanks, being taken up during 1994-95; 50 percent of resources coming from the local community. Non-governmental organisations involved in such operations.
- All the check-dams and soil conservation works marked on 1:50,000 scale and the ground water recharge and development being monitored by remote sensing satellite.
- The Vanju Vanka watershed in Ananthapur, now locally known as ISRO watershed, is supported from Employment Assurance Scheme and more than 50 per cent of the 13,457 hectares already developed in just one year during 1993-94.
- Voluntary action getting strengthened with 50 per cent contribution coming from voluntary organisations in several areas.
- Integrated drought relief and micro watershed development programme being taken up in 71 micro watersheds during 1994-95 by pooling resources from various developmental schemes. □



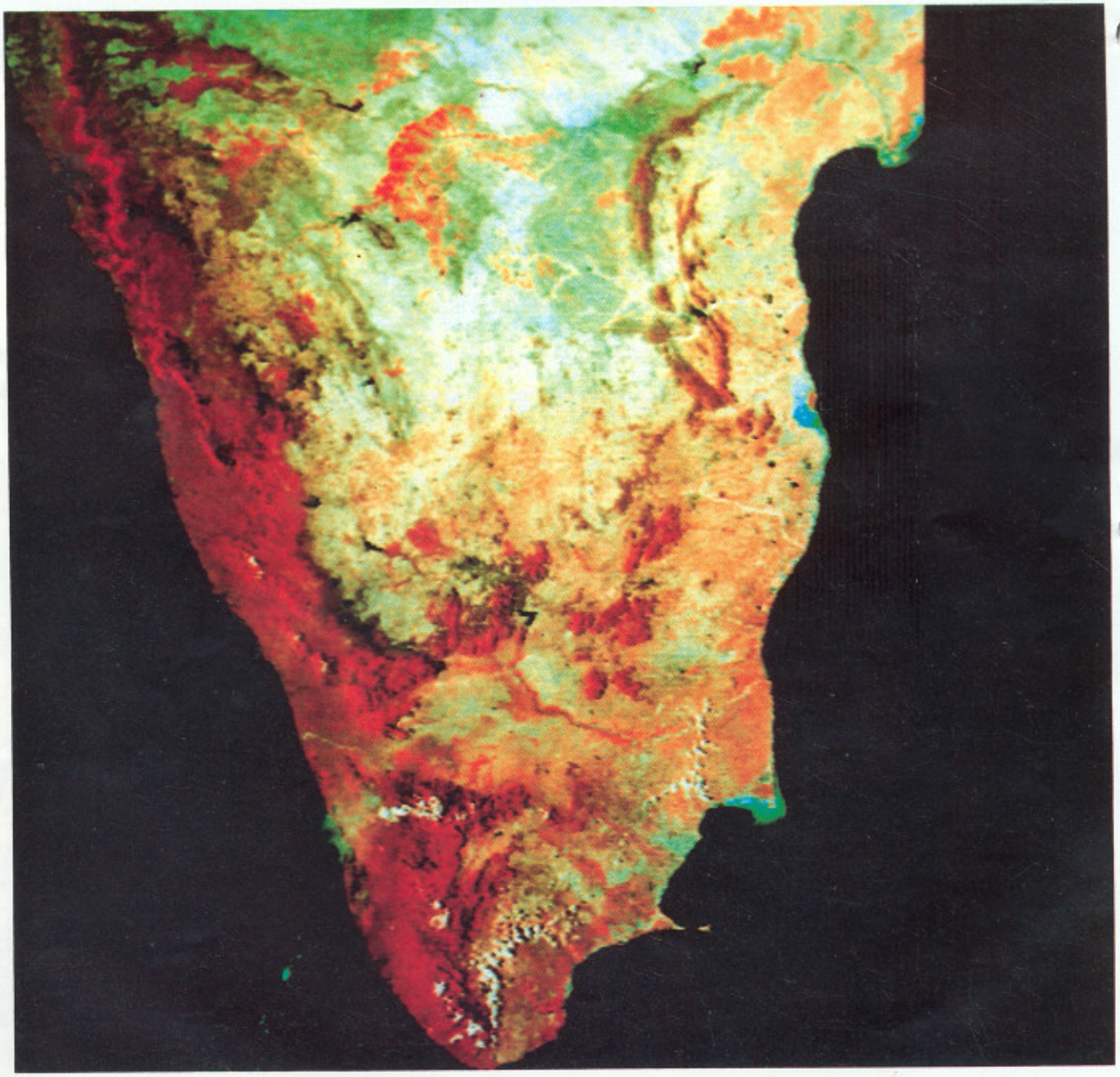
Implementing the action plans in Ananthapur District

Workshop on Project Vasundhara

A National Workshop on Project Vasundhara was organised on June 27, 1994 in Bangalore. The workshop, inaugurated by Mr D B Dimri, Director General, Geological Survey of India, and presided over by Prof. B L Deekshatulu, Director, NRSA, was aimed at disseminating the results of the project to a wider geo-scientific community.

The basic concept behind the project is to arrive at an integrated, or better still, a holistic appraisal of various types of data obtained through different means such as the remote sensing satellites, airborne instruments and ground-based segments. It is necessarily an interdependent programme that involves Regional Remote Sensing Service Centre (RRSSC) of the Department of Space, Airborne Mineral Surveys and Exploration (AMSE) wing of the Geological Survey of India (GSI) and the Department of Mines.

While the task of geo-scientific data synthesis is carried by the



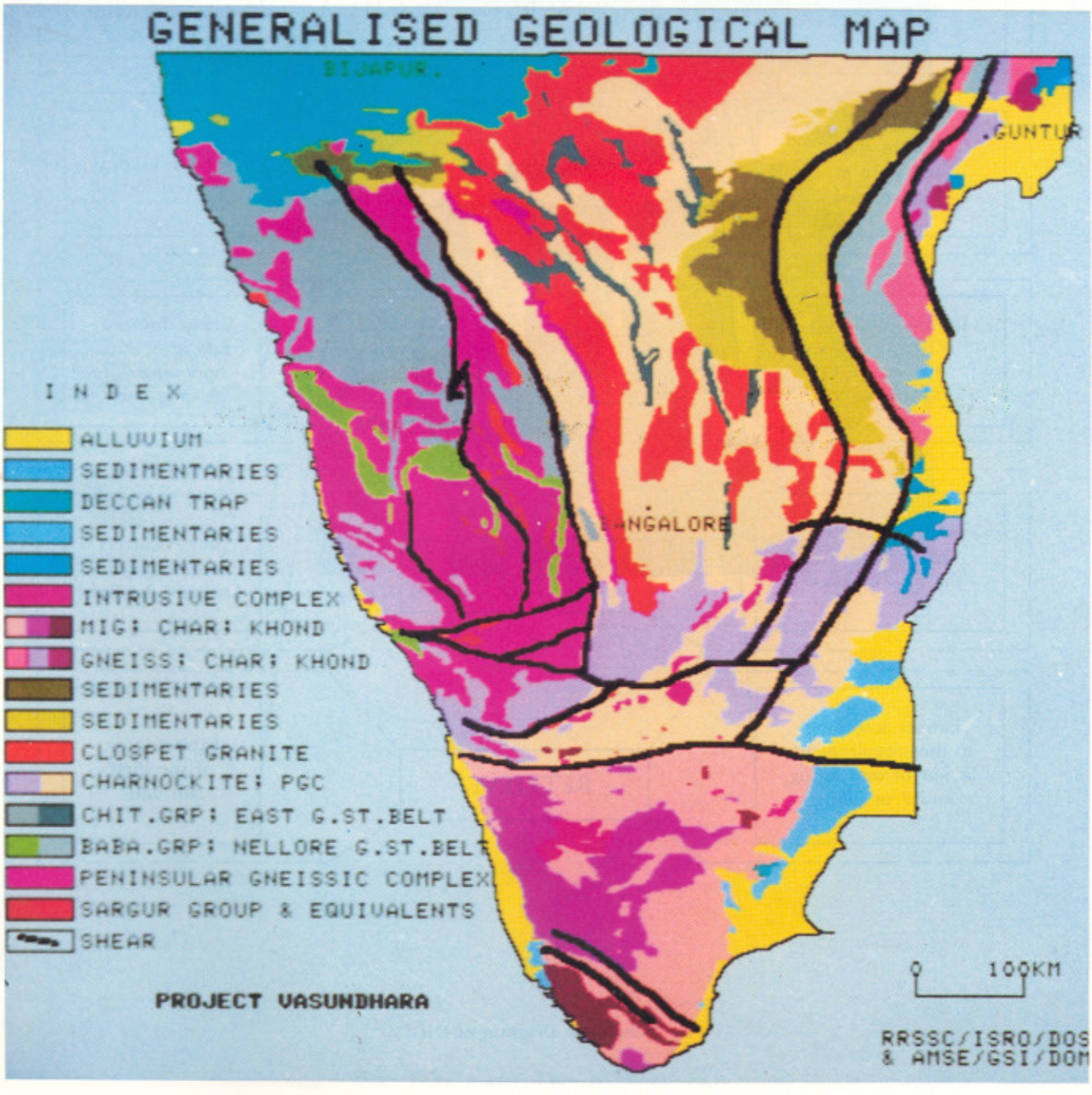
Area selected for Vasundhara Project

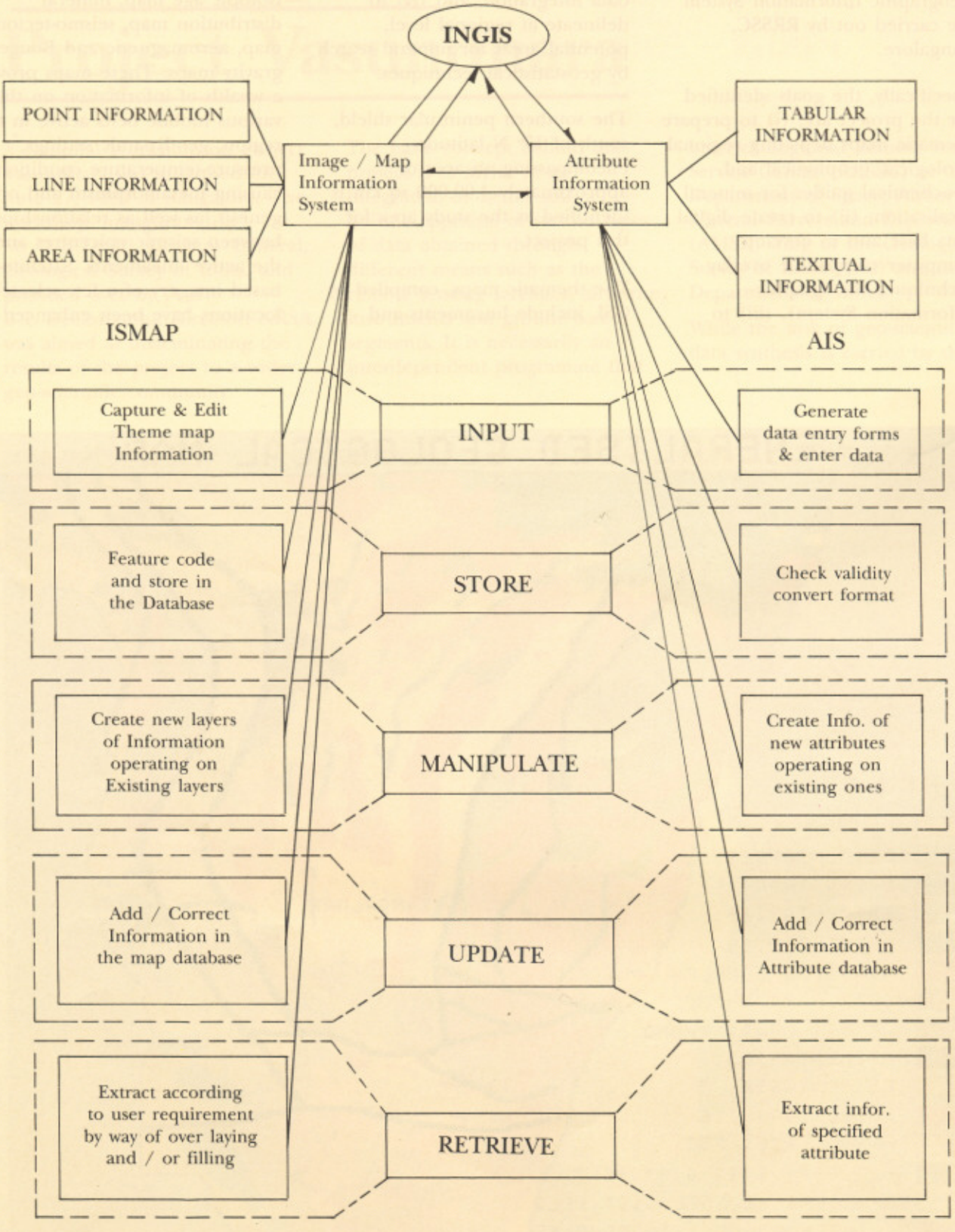
AMSE wing of the GSI, the data base creation and development of Geographic Information System are carried out by RRSSC, Bangalore.

Specifically, the goals identified for the project are: (i) to prepare thematic maps depicting regional geological, geophysical and geochemical guides for mineral localisation, (ii) to create digital data base and to develop computer compatible overlay techniques (Geographic Information System), (iii) to evolve a methodology for multi-level, multi-theme, multi-sensor data integration, and (iv) to delineate at regional level, potential areas for mineral search by geostatistical techniques.

The southern peninsular shield, south of 17° N latitude encompassing an area of approximately 4,00,000 sq km is identified as the study area for this project.

The thematic maps, compiled by GSI, include lineaments and faults, distribution of igneous intrusives, thermobarometric map, isotopic age map, mineral distribution map, seismo-tectonic map, aeromagnetic and Bouger gravity maps. These maps provide a wealth of information on the various mobile belts active in the region, geodynamic settings, pressure-temperature conditions causing metamorphism and ore genesis, as well as relationships between seismic epicentres and the active lineaments. Satellite-based imagery of a few selected locations have been enhanced





Schematic Diagram of INGIS

and studied for possible correlation between mineral localisation and reflectance values. These studies have resulted in identification of nine potential diamondiferous pipe rocks promising zones of ruby and base metal and mineralised zones in certain parts of Andhra Pradesh and Karnataka. Two of the major tasks carried out by the RRSSC of DOS are the development of an information system and creation of data base for the entire area under project Vasundhara. The Indian National Geographic Information System (INGIS), developed specifically for the project, is equipped with functional tools for handling any type of natural resources data. The data base creation included the tasks of digitising the information made available by GSI and making it system compatible and checking its accuracy. Apart from the spatial data, the mineral occurrence details, available in the form of mineral inventory formats, have been codified and included in the data base. The INGIS software package as well as the data base have since been made operational at the Geo-data Centre of AMSE-GSI on a PC-based system. Other efforts include development of geostatistical module such as, for example, those needed for evaluating economic viability of mining projects.

An exhibition, displaying the significant results of the Project Vasundhara, was also organised on the eve of the Workshop. □

Mr D B Dimri, Director General, GSI inaugurating the workshop by lighting the lamp

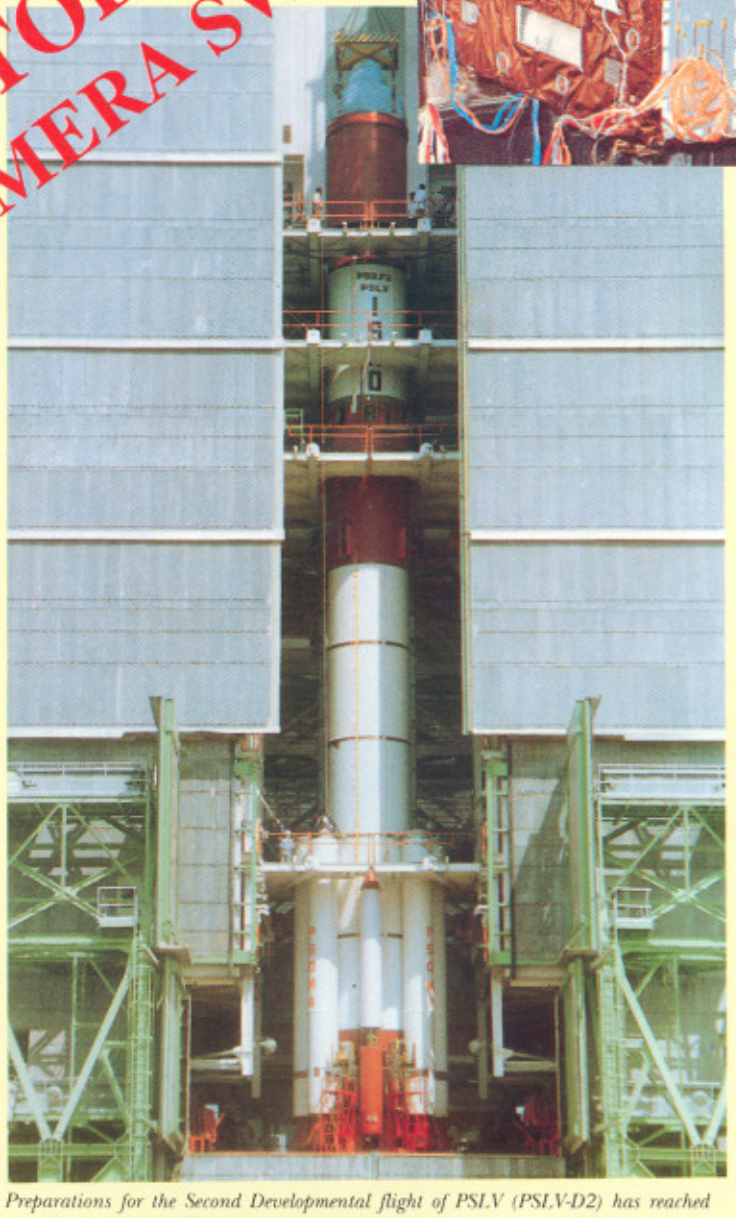
India Signs Two Agreements for Cooperation in Space

The Government of India and the Government of the Russian Federation signed an agreement on June 30, 1994, for cooperation in the exploration and use of outer space for peaceful purposes. Sri Bhuvnesh Chaturvedi, Minister of State, signed the agreement on behalf of the Government of India. This umbrella agreement covers various areas of cooperation including space science, use of space equipment and space technology, space meteorology, monitoring of earth's environment from space, material processing in space, space medicine and biotechnology, remote sensing of the earth, space communication and navigation, research, development and production of spacecraft and systems, research using manned and unmanned spacecraft, manned space flights, etc. ISRO and the Russian Space Agency are the executive organisations for implementation of the agreement. The present agreement replaces an earlier agreement on cooperation in space signed by India and the erstwhile USSR in 1988.

India also signed an umbrella agreement for cooperation in the peaceful uses of outer space with Ukraine on September 16, 1994 at Kiev. The agreement, signed by Dr K Kasturirangan, Secretary, Department of Space, and Chairman, ISRO, and Dr Andrey V Zhalko Titarenko, Acting Director General, Ukrainian National Space Agency, is the culmination of discussions in India earlier and at Kiev, Ukraine, in September 1994. The agreement will provide the basis for establishing cooperation in space research between the two countries in a number of areas which include remote sensing, communication, material processing in space and mutual use of a number of ground facilities in both the countries. Further, this agreement also includes conducting joint space missions involving provision of scientific payloads to be flown in each other's spacecraft. The agreement is also an extension to the cooperative relation between the space research institutions in Ukraine and India established over the last two decades; several scientists belonging to institutions in Ukraine participated in the earlier cooperative satellite programme of ISRO, such as Aryabhata and Bhaskara. □

STOP PRESS

PSLV - D2 SUCCESSFULLY LAUNCHED ON OCTOBER 15, 1994 IRS-P2 CAMERA SWITCHED ON



Preparations for the Second Developmental flight of PSLV (PSLV-D2) has reached an advanced stage. The vehicle integration is now in progress at SHAR centre, PSLV-D2 will launch a Remote Sensing Satellite, IRS-P2 (Inset)

Children of Bal Bhavan inaugurate a special exhibition in Thiruvananthapuram on the occasion of the 75th Birth Anniversary of Dr Vikram Sarabhai.