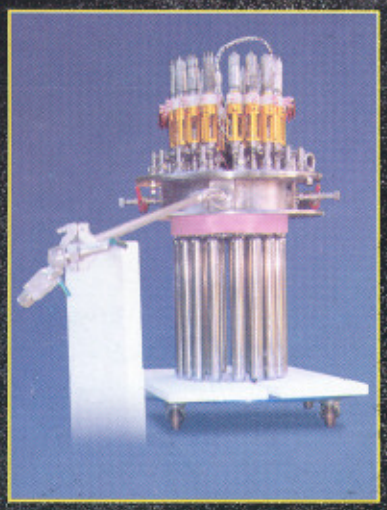
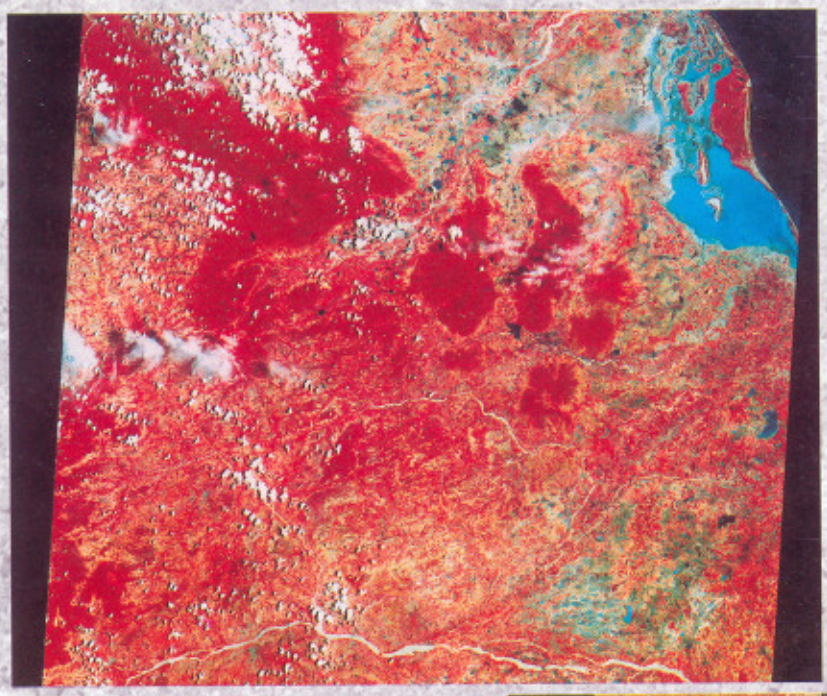
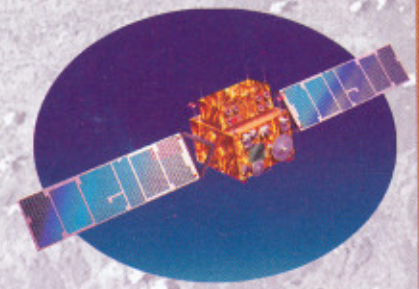
SPACE india

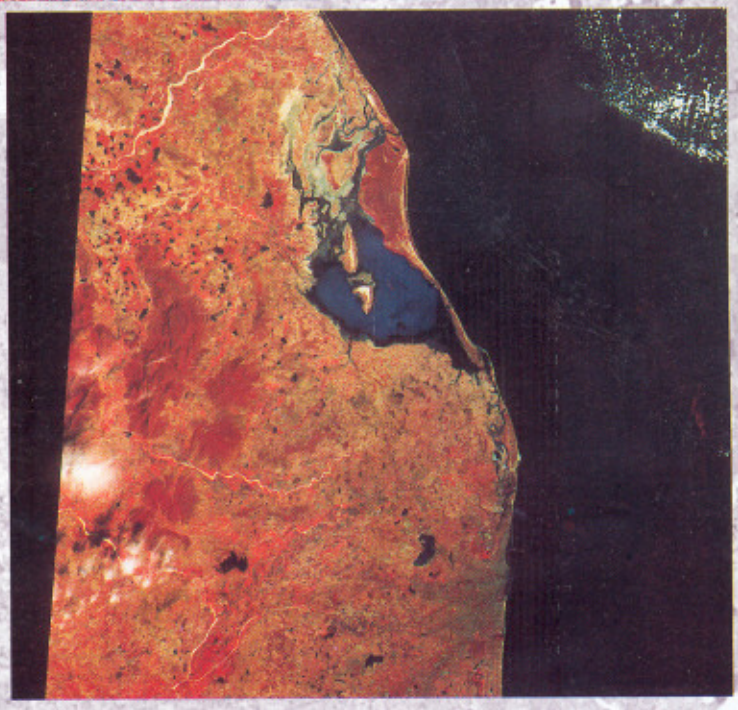
July-September 2001



INDIAN SPACE RESEARCH ORGANISATION



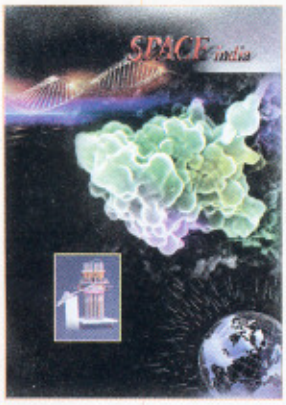




IRS-1B Completes 10 years

The Indian Remote Sensing satellite, IRS-1B, which was launched onboard the RussianVostok launcher on August 29, 1991, has successfully completed10 years of operation. The 990 kg satellite carries two cameras – Linear Imaging Self Scanner(LISS-1) with a spatial resolution of 72.5 m and a ground swath of 148 km and LISS-IIA and LISS-IIB with a spatial resolution of 36.25 m and a composite ground swath of 146 km. The satellite is placed in a polar sun-synchronous orbit at a height of 904 km with an orbital period of 103 minutes. The satellite can image the entire earth once in 22 days.

It is significant that IRS-1B has far outlived its design life of three years. The quality of the imagery has remained same even after 10 years of operation of the satellite as can be seen in the two imageries taken over the same region near Sriharikota island on August 30, 1991 (top) and February 09, 2001(above) respectively. Even though decommissioned now, IRS-1B, is still used for conducting various experiments on the performance of individual subsystems on board.



Cover Page :
Aliens from space ! Electron micrograph showing clumps of putative microorganisms (Inset : The ISRO Cryosampler)

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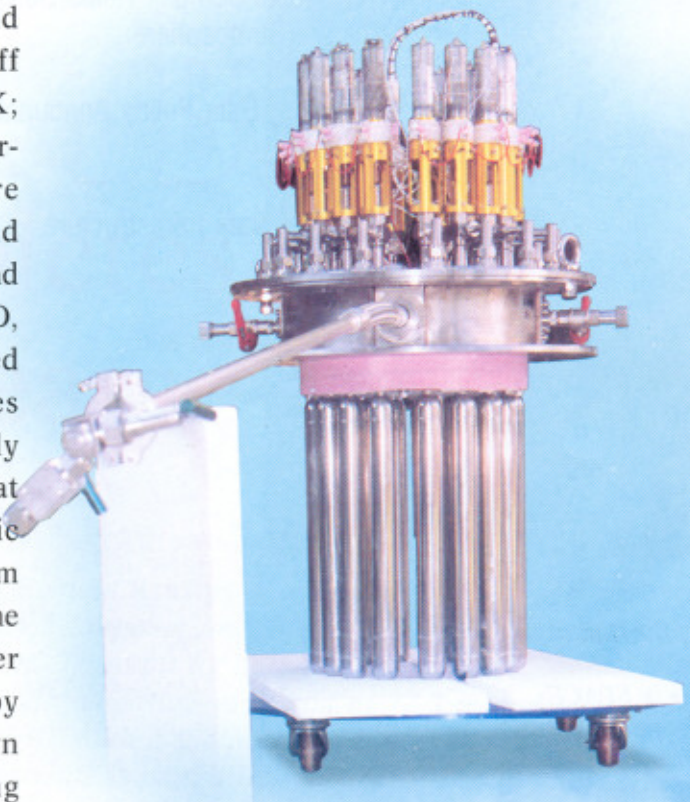
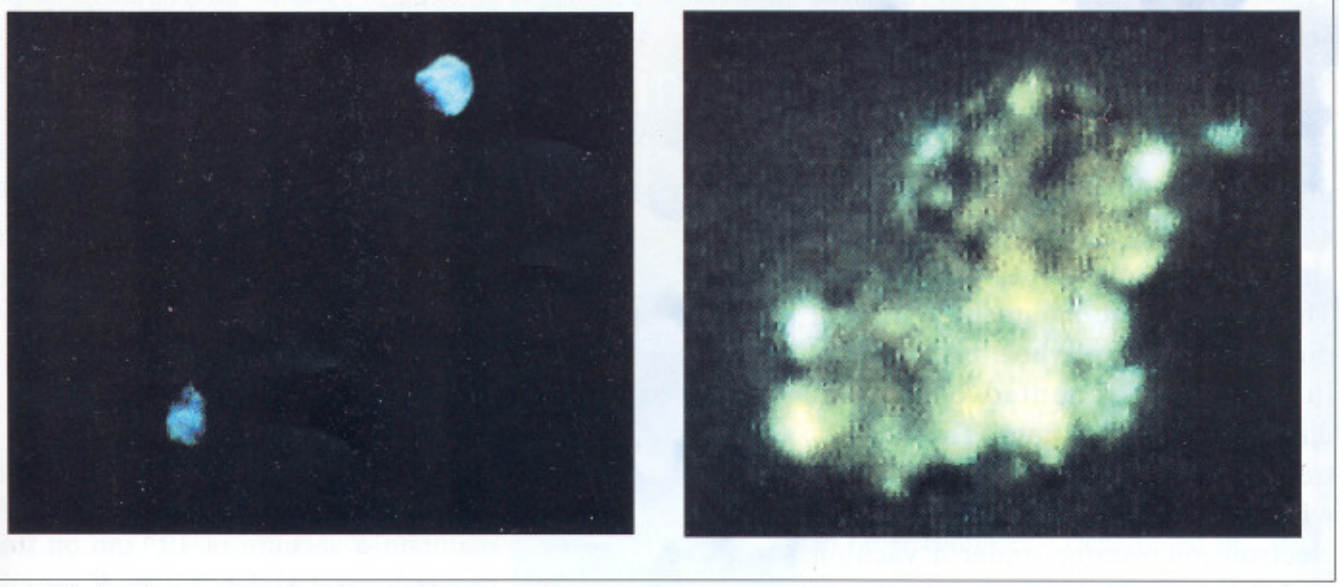
ISRO's Cryogenic Sampler Helps Detect Living Cells *in* Stratosphere

The Cryogenic Sampler, which was developed by ISRO to probe atmospheric chemistry as part of Geosphere-Biosphere Programme (IGBP), has been instrumental in detecting living micro organisms at stratospheric heights upto 41 km. In a scientific paper presented on July 29, 2001 in the Astro Biology Session of the 46th Annual SPIE Conference at San·Diego, California, USA, scientists (Melanie J Harris, N C Wickramasinghe, F Hoyle et.al; David Lloyd of Cardiff University U.K; J V Narlikar of Inter-University Centre for Astronomy and Astrophysics, Pune and P Rajaratnam of ISRO, et.al) have indicated that the air samples collected aseptically over tropical India at various stratospheric altitudes ranging from 20 to 41 km using the ISRO's cryo sampler payload carried by balloons have shown evidence of living microbial cells. Unambiguous evidence of living cells came from examining micro-pore filters on which the samples were recovered with the use of voltage sensitive lipophilic dyes that could detect the presence of active cells. Clumps of viable cells were found at all altitudes using this technique and this conclusion was found to be consistent with images obtained from electron microscopy. Since the sample was collected at 41 km which is well above the local tropopause, a prima facie case for a space incidence of these micro-organisms is established, the scientists have claimed. Further work on culturing, PCR analysis and isotopic analysis is in progress.



Cryosampler manifold in preparation for launch

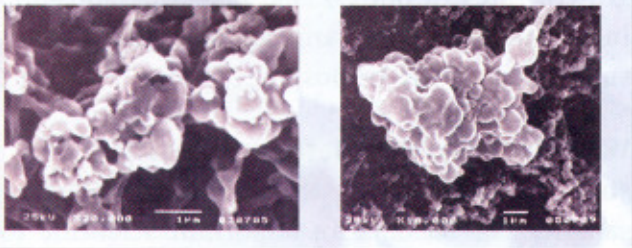
Two of the authors, late Sir Fred Hoyle and N.C. Wickramasinghe, have argued for over two decades that terrestrial life was introduced by comets, which serve both as amplifiers and distributors of life throughout the cosmos. The evidences include the discovery of spectroscopic signatures in astronomical sources over a wide range of wavelengths that are consistent with biology, the presence of microbial life on the earth four billion years ago when the earth suffered an epoch of intense cometary bombardment, and microbiological laboratory studies that have shown extreme survival properties of microorganisms. The contention of the scientists is that if life was



Two of the cluster samples of viable cells flourescing in a cyanine dye

brought to earth by comets four billion years ago, the process of cometary injection of living material must have continued to the present day and should therefore be testable. Over a hundred of tonnes of cometary material enters the earth's upper atmosphere daily and some of this must contain biological material if the idea of cometary panspermia is to be sustained. The results of the present experiment have shown an estimate that a third of a tonne of this cometary matter entering the earth, is micro organisms.

The 200 kg cryo-sampler of ISRO was lifted by the 400,000 cubic-metre balloon in the early hours of January 21, 2001 from the National Scientific Balloon Facility of the Tata Institute of Fundamental Research at Hyderabad. The cryo-sampler was prepared under the most stringent aseptic conditions. The cryo-sampler manifold had fully sterilised and evacuated stainless steel probes, each with a 0.35 litre capacity and capable of withstanding a pressure in the range of 10^{-6} milli bar to 600 bar. The evacuated probes were cooled in liquid neon to produce the cryo-pump action with sterilised valves that were operated at pre-determined heights through telecommand from ground. After the experiment, one half of the probes are being analysed at the Centre for Cellular and Molecular Biology in Hyderabad and the other half at Cardiff University, UK. From each of the probe, representative of a specific altitude, the air sample collected was passed through a sterile system in a laminar flow chamber, first through a 0.45 micrometre micropore filter and then through a 0.22 micro-metre micropore filter.



Electron micrograph showing clumps of putative microorganisms

The microorganisms trapped in the 0.45 μm have been analysed at Cardiff University. Approximately 4 mm squares were aseptically cut from the filters and treated with either a fluorescent cationic carbocyanine or an anionic oxonol dye sensitive to membrane potential. Cationic dyes penetrate the cell membrane of viable cells, but not of dead cells whilst anionic dyes penetrate the membranes only of non-viable cells. Any viable living cells present in a sample would be expected to give rise to flourescent spots when illuminated with ultraviolet light and could be identified under an epifluorescence microscope. Each such spot, depending on resolution would represent either a single cell or a clump of cells.

Isolates, treated with cyanine dye, showed flourescent spots in the form of clumps of 0.3-1 μm sized cells, the clumps themselves measuring 5-15 micrometre across. Electron microscopy on aseptically isolated squares of membrane filters were then carried out by the scientists. The squares were mounted on 12 mm diameter sticky carbon tabs which, in turn, were mounted on 10 mm diameter aluminium tabs. The samples treated in this way were sputter-coated with gold and imaged in a scanning electron microscope under a vacuum of 7×10^{-9} bar. The procedure adopted is suited to imaging bacteria because bacterial cell walls would not collapse or explode under the observing conditions. On each of the micropore isolates examined so far, measuring approximately 2mm x 2 mm, microbial clumps have been found.

The Cryogenic Sampler Payload was developed by ISRO for its Geosphere Biosphere Programme initiated in 1991 as part of the International Geosphere, Biosphere Programme (IGBP). IGBP is aimed at understanding the interactive physical, chemical and biological processes that regulate the total earth system. Even though several sensors such as Modular Opto-electronic Scanner, Wide Field Sensor, Multispectral Microwave Radiometer and Ocean Colour Monitor which have been flown by ISRO on its satellites for atmospheric studies, the need for specific research tools to probe the atmosphere upto about 40 km altitude was felt and development of a cryogenic sampler was therefore initiated.

Preparation of the Cryosampler

The Cryo probes are specialised high vacuum-cum-high pressure vessels which maintain a vacuum of 10^{-6} mb on their upward travel and bring back samples with over 250 bar pressure on their return. They encounter extreme temperatures of - 248°C during the ascent phase and are subject to +40°C when they are recovered. An important feature of these probes is that they have extremely low out-gassing since they are made of special materials as also leak rates better than 4×10^{-9} atm cc/s. The low temperatures in the instrument are achieved by immersing the probes in liquid Neon, a cryo fluid with a very high latent heat.

The ISRO cryo sampler was first flown in April 1994 from National Scientific Balloon Facility, Hyderabad using a high altitude, 150,000 cubic metre balloon to measure vertical distribution of important ozone depleting substances in the stratosphere such as CFC-11, CFC-12, Methyl Bromide and Sulphur Hexafluoride. An improved version of the cryo sampler was flown in April 1998 to study the impact of HCFCs and other replacement gases on global warming phenomena. A cryo sampler flight was also conducted in April 1999 for the scientists of Max Planck Institute for Aeronomy, Germany, to study the trends in the growth rates of both ozone depleting substances in the stratosphere and greenhouse warming substances in the troposphere.

With its use for detecting living cells in stratospheric samples, the ISRO developed cryo sampler has become an important scientific tool of international standing.

Remote Sensing Data Policy Announced in Parliament

The Government of India has approved and adopted a comprehensive Remote Sensing Data Policy (RSDP) for acquisition and distribution of satellite remote sensing data from Indian and foreign satellites for civilian users in India. Ms Vasundhara Raje, Minister of State (Space) made a statement to this effect in the Parliament on August 08, 2001.

Remote Sensing data is an important source of information for managing the nation's natural resources, supporting and monitoring developmental activities at the local level, supporting disaster management activities, ocean state and weather forecasting and environmental monitoring. The Indian Remote Sensing Satellites (IRS) have an immense imaging capability helping a large national and global user community. IRS data is acquired and distributed to government, private organisations and academia for a variety of operational applications and the data is also marketed all over the world.

With the availability of high-resolution (one metre resolution) images from commercial US satellites, images of any part of the world are now available. These images have potential to support local level development and cadastral level applications. India also plans for having such high resolution imaging satellites in the near future.

The high-resolution images also have strategic value and hence a regulated distribution of such high-resolution image is essential to not only take care of the user community requirements but also the national security interests. This aspect has been kept in view in framing the RSDP. It is a policy that sets guidelines for satellite data acquisition and distribution in the country as well as for licensing the IRS capacities to other countries. Department of Space (DOS) will be the nodal agency for implementing the policy.

As per RSDP, permission from the government will be required for operating remote sensing satellite from India and for distribution of satellite images in India. The National Remote Sensing Agency (NRSA), Hyderabad, will be the national acquisition/distribution agency for all satellite data within India and it can enter into agreements for distribution of data from foreign satellites in India. Antrix Corporation, the commercial agency under the Department of Space, will license use of IRS capacities outside India.

RSDP provides for screening out sensitive areas in the images acquired so that national security interests are protected. In particular, the policy streamlines the distribution of high-resolution data to Government users, private users involved in developmental activities with government as well as other private, academic or foreign users.

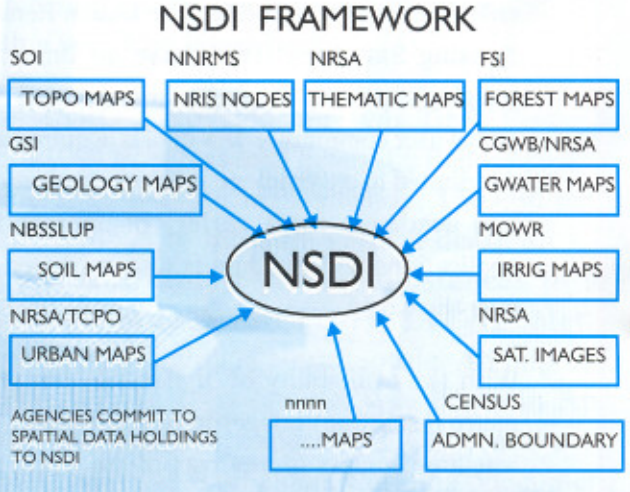
RSDP is an important step towards making transparent, the procedures of satellite data distribution, including those from high-resolution imaging systems. It would help regulate the process of image distribution so that Indian users are not denied access to valuable satellite based imageries, which can be used in the development of natural resources.

National Spatial Data Infr

ISRO and the Survey of India (SOI) have jointly proposed the establishment of a National Spatial Data Infrastructure (NSDI) to provide an organised spatial and non-spatial data on a multi-level information network. NSDI, which is now under discussion, can contribute to local, national and global needs for sustained economic growth, environmental quality and stability as well as social programmes. NSDI assumes significance in the context of India fast becoming an information and knowledge society, with emphasis on Information Technology, e-governance, communication technology and the recent initiatives of the government for private and public investment in IT.

A task force set up by ISRO and SOI, that included the National Remote Sensing Agency of the Department of Space, the National Atlas & Thematic Mapping Organisation, the Geological Survey of India, the Forest Survey of India, the National Bureau of Soil Survey and Land Use Planning and other government agencies, prepared a document setting out the strategy and action plan for the draft NSDI. The NSDI is expected to organise Geographical Information System (GIS) data base and integrate various layers of information in a systematic manner to help decision makers.

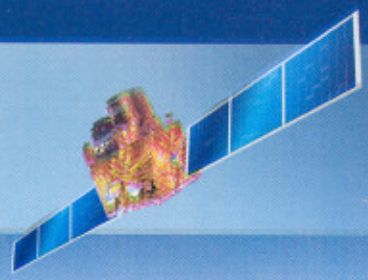
GIS is now used not only for mapping but also for integrated analysis of locale specific plans. India also has a strong repository of spatial data though, mainly in analog and paper-map forms. While traditionally, the spatial information infrastructure has been managed within several government agencies, each of these agencies is expected to contribute to the creation of the NSDI. The major GIS data bases that could contribute to NSDI include National (Natural) Resources Information System (NRIS) for which Department of Space is the nodal agency, Digital Cartographic Data Base (DCDB) of Survey of India and Natural Resources Data Management System (NRDMS) which has Department of Science and Technology as focal point. Other databases evolved by Geological Survey of India National Bureau of Soil Survey and Land Use Planning, Central Water Commission and Forest Survey of India etc, will also be integrated. Thus NSDI will result in a national repository of a digital warehouse of National Mapping Data holding and facilitate sharing and access to digital spatial information.



Once established, NSDI could support planning and development activities especially in the management of natural resources, disaster management, water resources development, watershed management, district and state level planning, land capability analysis and optimal landuse, agricultural development; irrigation planning, infrastructure planning, etc. The government could use NSDI to prepare spatial plans for the whole country such as annual plans, five-year plans, perspective plans, inventory of natural resources and

nstructure (NSDI)

– a proposal



changes, assessment of damages during natural calamities and disasters and monitoring and evaluation of various governmental policies and programmes. NSDI could help in development of infrastructure like roads, telecommunication, water distribution, sewerage management and so on. It will also help in addressing issues related to landuse, environment and land acquisition. It can help use of GIS data bases to further business opportunities and enable spatial data commerce. Universities will utilise the NSDI for undertaking specific research of global and national issues; impart GIS education with case studies and practical hands on training.

NSDI Stakeholders

- Government at local, state and national levels (as both users and data collectors/owners)
- Non Government Organisations (NGOs)
- Community groups
- Aid/development organisations
- Educational organisations and Academia
- Science and environmental community
- Private sector information providers and end-users
- Public sector agencies
- Private citizens

NSDI Contents

- *National coverage of topographical maps on scales of 1:250000, 1:50000 and 1:25000 and any other data of the Survey of India (SOI) toposheets.*
- *National coverage of geological maps on 1:50000 scale and other maps/data of the Geological Survey of India (GSI).*
- *National coverage of soil maps on 1:250000 and 1:50000 scales and other maps/data of the National Bureau of Soil Survey and Landuse Planning (NBSSLUP)*
- *National coverage of forest maps on 1:50000 scale of the Forest Survey of India (FSI)*
- *National coverage of the hydrology maps on all scales of the Central Ground Water Board (CGWB)*
- *National coverage of landuse maps on 1:50000 scale; wasteland maps on 1:50000 scale; urban maps on 1:50000 scale; ground water potential maps on 1:50000 scale and other thematic maps of National Remote Sensing Agency (NRSA);*
- *NRIS Nodes of the NNRMS Programme involving district and State Natural Resources data bases on 1:50000 scales;*
- *Command area maps of Central Water Commission (CWC)*
- *National coverage of coastal landuse maps on 1:50000 and 1:25000 scale of Ministry of Environment and Forest (MoEnF)*
- *Census maps and census data of the Census Department*
- *NATMOs national atlases on 1:1000000 and other scales*
- *National coverage of Satellite images of different resolutions*
- *Hydrographic data of the National Hydrographic Department*
- *India Meteorological Department's weather information and Department of Ocean Development's Ocean information (at smaller scales)*
- *Non-spatial data of the Bureau of Economics and Statistics, National Council for Applied Economic Research, etc*

Concept-demonstration of

Agro-Climatic Planning and Information Bank

A concept-demonstration project on Agro Climatic Planning and InformationBank (APIB), has been implemented by ISRO. The project is supported by the Planning Commission. APIB provides a single window access to all agricultural related information and decision support to users of agricultural and allied sectors. APIB effectively uses the power of information technology to collect scattered information and provide access to any type of information as and when needed.

The demonstration of APIB has been taken up in three districts of Karnataka — Tumkur, Shimoga and Bijapur — which represent three broad agro-climatic zones of India. Inputs from the farmers, financial institutions, agro-based industries and traders, extension officials, researchers, consultants, journalists and state level administration have been used in developing the data bank. The information is available to the users in their regional language for easy understanding.

The information that can be retrieved from this data base include: crops that can be grown with farmers' land and water resources, variety/hybrid selection for principal kharif crops, comprehensive package of practices, financial resources from public and private sources, fertilisers, plant protection, cost of cultivation and market prices, area under cultivation and yield, dairying and insurance. The information is available to the farmers through the Extension Officers of the Departments of Agriculture and Horticulture.

Mr S M Krishna, Chief Minister of Karnataka inaugurating the APIB workshop by lighting the traditional lamp. Dr K Kasturirangan, Chairman ISRO is on his right and Mr T B Jayachandra, Minister for Agriculture, Karnataka is to his left

In order to familiarise the users about the APIB, a workshop was organised at Bangalore on June 25, 2001 which was inaugurated by the Chief Minister of Karnataka, Mr S M Krishna. Dr K Kasturirangan, Chairman, ISRO presided over the function. Mr T B Jayachandra, Hon'ble Minister for Agriculture, Government of Karnataka was also present as the chief guest. Officials from the Agriculture Department and Horticulture Department including Joint Directors, Assistants and a few farmers in the three districts where APIB is being implemented, participated in the one-day workshop. They were appraised of APIB and their feedback was also sought to further tune the system for better utility.

Information Modules in APIB

Crop Selection Module: The module has data on land and water resources potential and recommends a set of possible crops to allow the farmer take the right decision. The soil texture and the average rainfall are taken into account while the recommendation is made.

Package of Practices Module: This module has a vast information base on the package of practices for all the important field crops in different agro-climatic regions of Karnataka. It helps the farmer to cultivate the selected agriculture/ horticulture crop and get optimum yield.

Seeds and Seedlings Module: This module provides data on different varieties/ hybrid seeds produced and supplied by different companies for a variety of agricultural and horticultural crops; characteristics like yield potential, resistance to pests and diseases, quantity of seeds required, crop duration, crop suitability for different regions, etc; packing and price information and; dealers network.

Fertiliser Module: The data available in this module include different types and grades of fertilisers manufactured and supplied by different companies, their nutrient content and utility, trade or brand names, price information, dealer network, district-wise consumption of different fertilisers over the years, fertiliser recommendations list of soil testing laboratories, soil sampling procedure to be followed and the different parameters to be tested.

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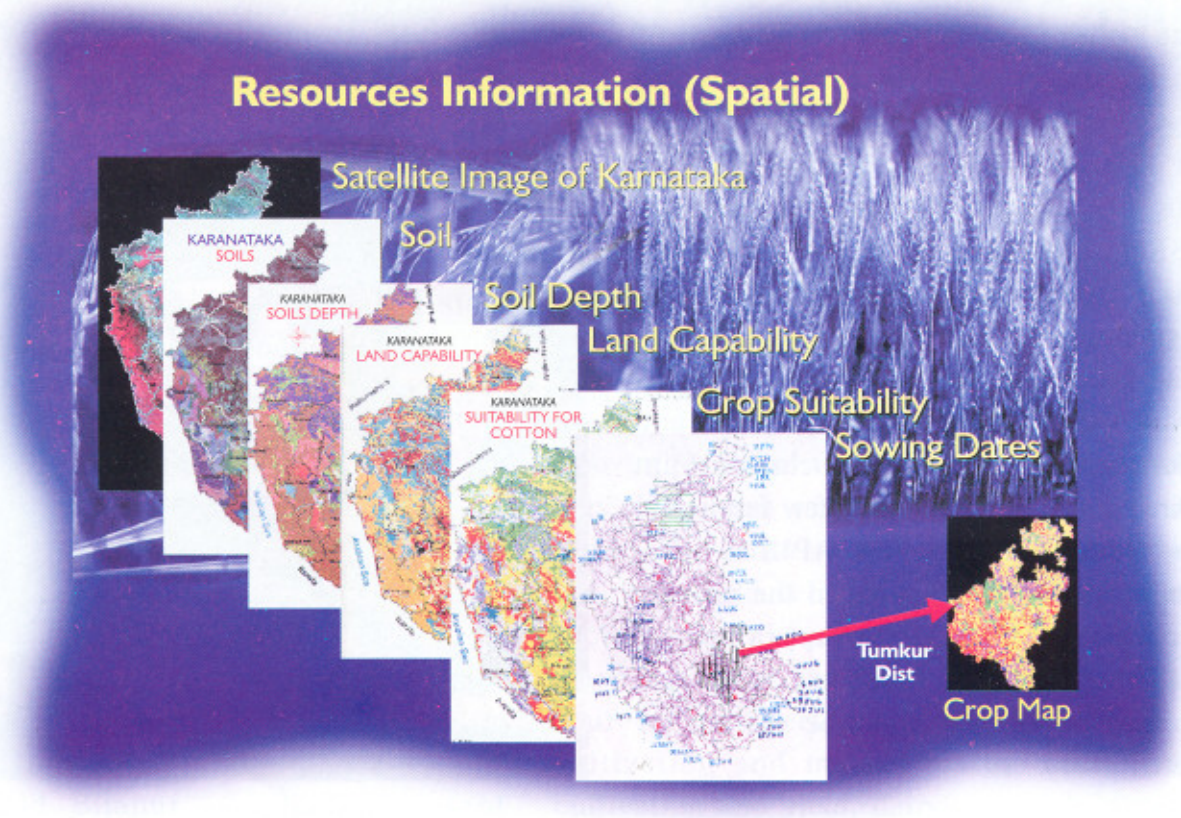

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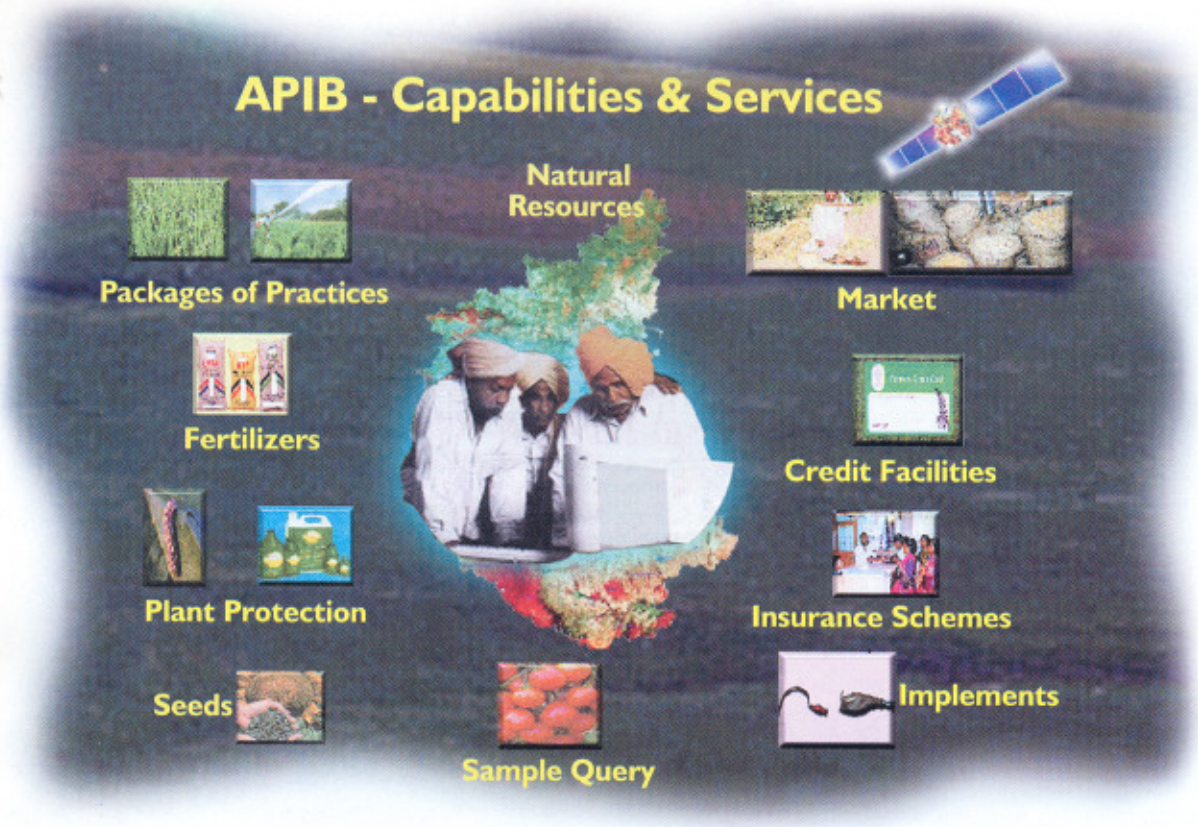
Organic Farming Module: Under this module, the information available include guidelines for total organic farming, different types of organic manures, etc

Plant Protection Module: This module has technical and commercial information on plant protection like list of plant protection chemicals manufactured and supplied by different



APIB

companies, their formulations, trade or brand names, price, pests and diseases which they can control, crops for which applicable and dealers for different pesticides.

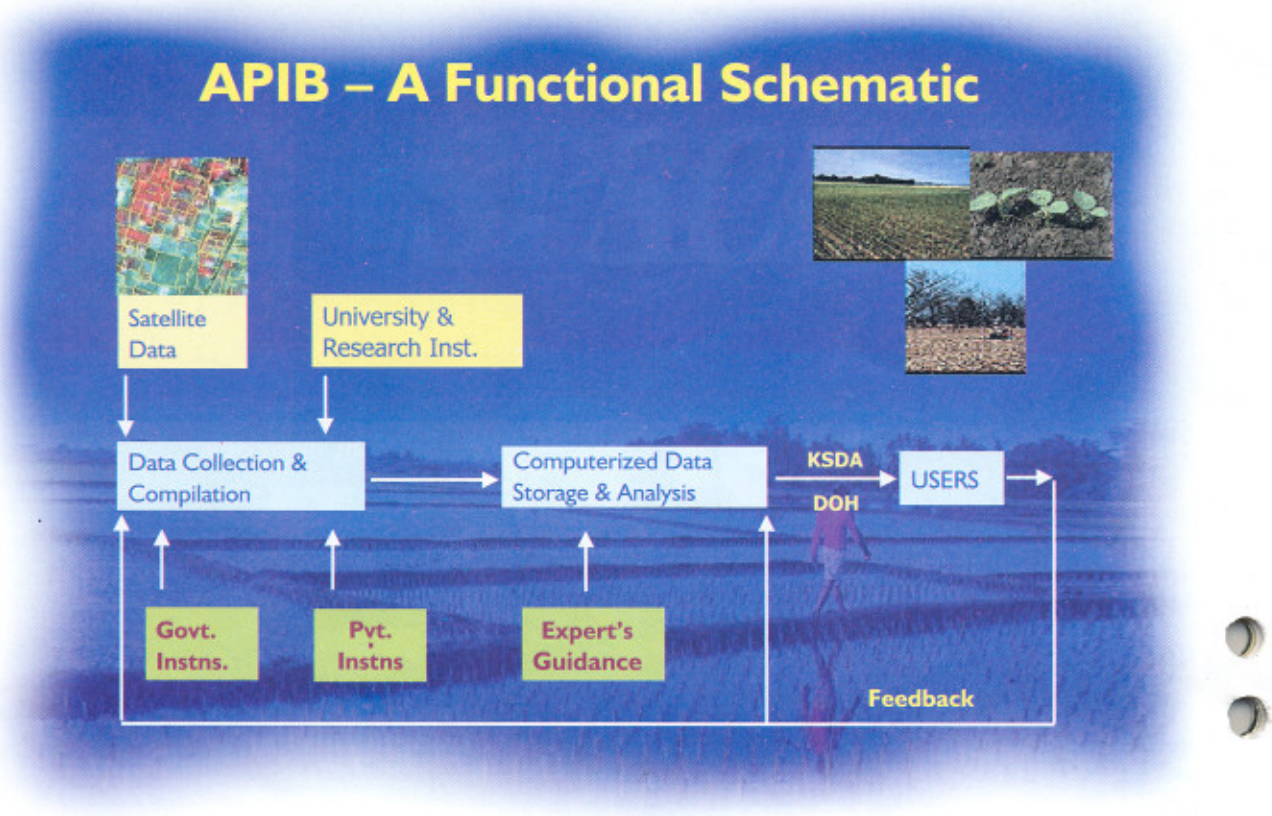
Farm Machinery/Agricultural Implements Module: The information available in this module include different farm machinery/agricultural implements manufactured and supplied by different companies, their trade/brand names, models and types, salient features and approximate price.

Credit and Allied Information Module: In this module information on different credit schemes in agriculture and allied sectors floated by different commercial and rural banks as well as other credit institutions, details of each scheme like interest rates, repayment terms, documents required and other terms and conditions of schemes, addresses of the branches of the different banks and, formats of applications are also made available.

Subsidy Programmes Module: This module contains numerous subsidy schemes that are available from various government departments under different programmes.

Insurance Module: The module gives information on existing insurance schemes for different components of farming,

Training and Development Programmes Module: This module has information on different training and development programmes organised by Government.



Video Library: A video library on different aspects of agriculture and allied sectors is also being developed to provide information on day-to-day farming activities, post-harvest technology, land management, sustainable agriculture, etc.

Market Infrastructure Module: This module has synthesised information on market infrastructure facilities in the district to which the farmer belongs. The module also gives information on market charges, godowns and storage facilities available and their charges. Prices of major commodities in the various markets are also included.

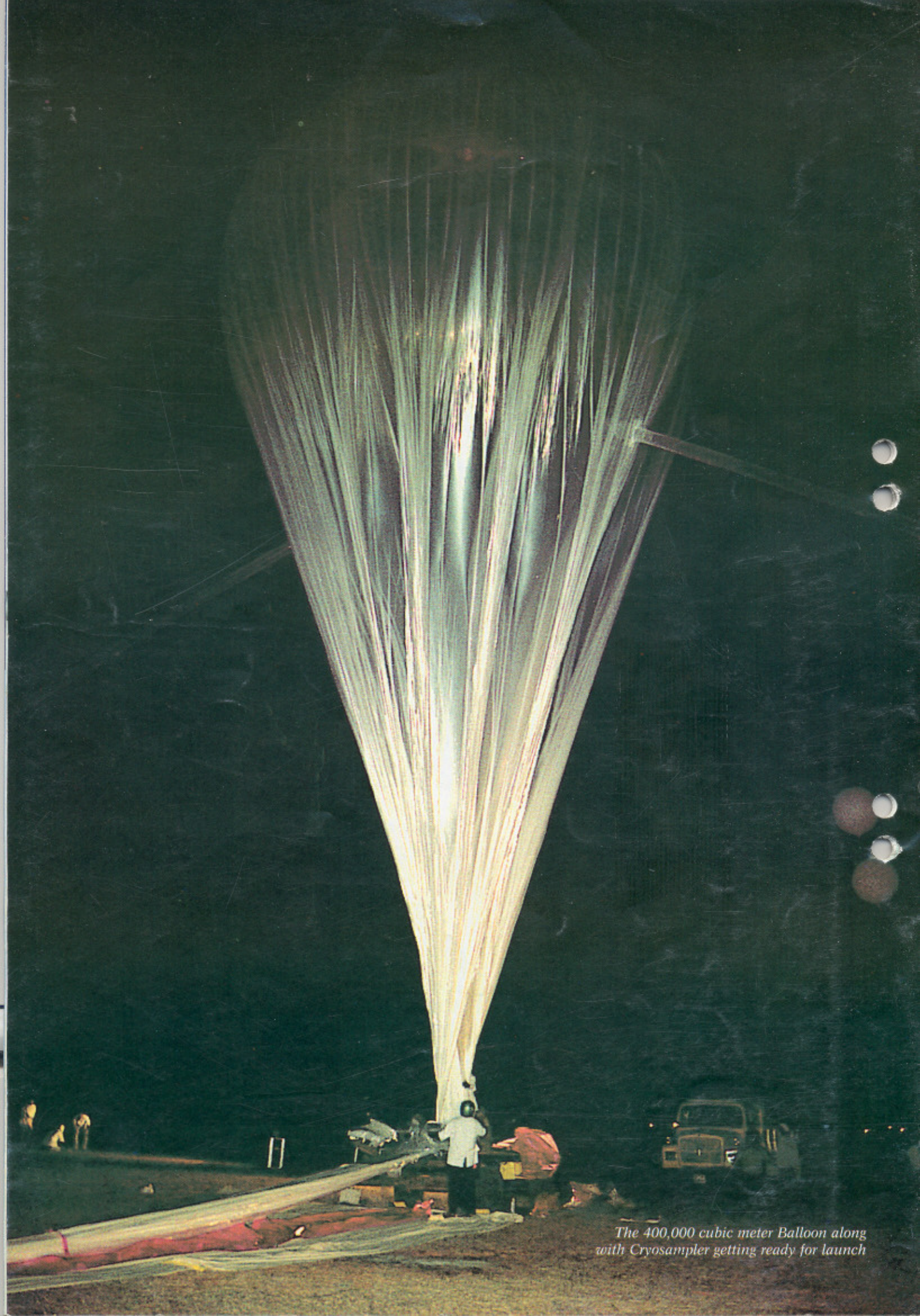
Trade Promotion Information Module: This module has information on export policies, addresses of major exporters and schemes under agriculture and processed food products exports.

Agricultural Weather Information Module: The information in this module includes weekly and monthly historical rainfall data, monthly moving averages of rainfall, weekly probabilities of rainfall and information about the organisations that can provide agricultural weather information.

Spatial Data base Module: A large amount of spatial information generated using satellite remote sensing and other collateral data has been included in this module. The module includes different spatial data base layers like land use/land cover, hydro-geomorphology, soil type, slope, drainage network, transport network, etc. The maps are available either in computerised form or as hard copies. In addition, natural resources information is also available.

PSLV-C3
Launch in October

Preparations for the launch of ISRO's Polar Satellite Launch Vehicle (PSLV-C3) is now in progress and the launch is expected to take place in October 2001. PSLV-C3, which is the sixth flight of PSLV, will launch three satellites — ISRO's Technology Experiment Satellite (TES), the BIRD of Germany and PROBA of Belgium. Both the foreign satellites are being launched under commercial agreements. This is the second time that PSLV is launching multiple satellites; in its previous launch in May 1999, PSLV had launched India's IRS-P4, the German DLR-TUBSAT and Korea's KITSAT-3.



The 400,000 cubic meter Balloon along with Cryosampler getting ready for launch