

# PERANAN INDERAJA DALAM PEMBANGUNAN NASIONAL (TATA RUANG, KELAUTAN) \*

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## ABSTRAK

Teknologi penginderaan jauh diterapkan dalam perencanaan dan pemantauan pembangunan wilayah Indonesia seluas 8 juta kilometer - persegi, 5,9 juta kilometer-persegi di antaranya terdiri dari wilayah lautan.

Penerapan data satelit LANDSAT & SPOT dalam Program Land Resources Evaluation & Planning (LREP) mendukung peningkatan kemampuan perencanaan BAPPEDA di 26 propinsi Indonesia. Perencanaan Land Use dan Pemetaan dilaksanakan oleh BPN di wilayah Kalimantan dan Sumatra, sedangkan penerapan ke-PU-an dilaksanakan pada 14 Kanwil PU dengan didukung data satelit inderaja. Di samping itu, 500 perusahaan HPH menerapkan data SPOT dan LANDSAT dalam pemantauan wilayah konsesi hutan masing-masing. Pemantauan kebakaran hutan Indonesia dilaksanakan dengan didukung satelit NOAA 10,12,14 yang lewat di atas wilayah Indonesia delapan kali sehari.

program Marine Resources Evaluation & Planning (MREP) memanfaatkan data satelit inderaja untuk meningkatkan kemampuan perencanaan wilayah laut dan pantai di 10 propinsi dan 3 Selat Indonesia, termasuk kegiatan survei *base-point* dan survei *sumberdaya laut*. 176 lembar Peta Digital Lingkungan Pantai Indonesia skala 1:50.000 akan dihasilkan proyek MREP. Dalam perencanaan dan pemantauan wilayah laut strategis, seperti proyek gas Natuna, Selat Sunda dan Sipadan-Ligitan, data satelit LANDSAT & SPOT turut dimanfaatkan. Data suhu muka laut hasil rekaman satelit NOAA, khususnya di Samudera Hindia Selatan Jawa, Bali, NTB dan NTT, serta di laut Jawa Selatan P. Sulawesi dipakai untuk membantu kegiatan pencaharian lokasi ikan di laut.

Program penerapan teknologi penginderaan jauh Indonesia di masa datang mencakup Proyek Remote Sensing for Natural Resources Management (SATTIN), Proyek Satellite Rice Assessment for Indonesia, 2nd MREP dan Coral Reef Rehabilitation & Management Program (COREMAP)

Program-program di Indonesia ini dikorelasikan pula dengan program-program Internasional, seperti program Mission to Planet Earth, program satelit radar (ERS, RADARSAT, JERS, ADEOS) dan program satelit resolusi sangat tinggi (Space Imaging, Worldview, Eyeglass).

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REMOTE SENSING TECHNOLOGY AND ITS APPLICATIONS FOR DEVELOPMENT  
PLANNING AND MONITORING IN INDONESIA

By:

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INTRODUCTION:

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Remote sensing technology and its applications are progressing very significantly in Indonesia. Since the inauguration of Indonesia's multimission remote sensing satellite ground receiving station at Parepare, South Sulawesi, September 1993, the country's remote sensing technological activities are spurring very rapidly. The station's operationalization is also strengthen Indonesia's effort in developing a strong in-country's remote sensing services industry, an industry dedicated toward the establishment of four remote sensing components, namely:

- 1) Data acquisition capability,
- 2) Hardware/software processing facilities,
- 3) Consultancy services capabilities,
- 4) Numbers of remote sensing users,

An operational utilization of remote sensing technology in Indonesia is very appropriate. As an equatorial archipelagic country with 17508 islands, stretching 5100 kilometers from East-to-West, and being divided into 27 provincial administrations requires a technology dedicated toward the inventory, explorations and exploitations of its natural resources. Remote sensing technology may answer the needs of such technology. The remoteness and the country's area size requires more than one remote sensing satellite ground receiving station to acquire the satellite data. Currently, one multimission satellite ground receiving station and Six weather and environmental satellites ground receiving stations are in operational status (Figure 1).

THE DATA ACQUISITION CAPABILITIES IN INDONESIA:

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Remote sensing data acquisitions may be conducted from the ground station and from airborne surveys. The multimission satellite ground receiving station located at Parepare, South Sulawesi, and operates by LAPAN - the Indonesian National Institute of Aeronautics and Space - is currently able to receive LANDSAT, SPOT and ERS-1 SAR data. The station, built in cooperation with Canada, is located at the center of the archipelago and capable to receive approximately 97 % of the total Indonesian land and water areas. LAPAN and NASDA of Japan are currently working together to upgrade the station in order to be able to receive JERS-1 data by the end of 1995. Cooperation is also being

SATELLITE GROUND RECEIVING FACILITIES IN INDONESIA

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1. LANDSAT, SPOT, ERS-1, JERS-1, Ground Receiving Station, Parepare, South Sulawesi, operates by LAPAN,
2. NOAA & GMS Ground Receiving station at Jakarta, operates by LAPAN,
3. NOAA & GMS Ground Receiving Station at Biak-Irian Jaya, operates by LAPAN,
4. NOAA & GMS Ground receiving facilities at Central Kalimantan, operates by the Ministry of Forestry,
5. NOAA & GMS Ground Receiving facilities at Jambi, Sumatera, operates by the Ministry of Forestry,
6. NOAA & GMS Ground Receiving facilities at Jakarta, operates by BPPT.
7. NOAA & GMS Ground Receiving Facilities at Jakarta, operates by BMG.

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CURRENT INDONESIA'S REMOTE SENSING AND GIS PROJECTS

- \* Land Use Planning and Mapping, BPN - GTZ, Germany,
- \* 2nd Land Resources Evaluation and Planning, 18 Provinces,
- \* Marine Resources Evaluation and Planning, 10 Provinces, 3 Straits,
- \* Satellite Rice Assessment in Indonesia (SARI), BPPT-CEC-ESA
- \* 2nd Remote Sensing for Agriculture, PU-JICA,
- \* Remote Sensing for Oil and Gas Explorations, JICA-LEMIGAS,
- \* Remote Sensing for Electric Powerplant Assessment,
- \* National Forest Inventory, including cooperation with the UK,
- \* ERS-1 Project, EC-ASEAN-ESA,
- \* JERS-1 Verification Project, NASDA-MITI-INDONESIA,
- \* Satellite Ground Receiving Station Upgrading Project, LAPAN,
- \* On-Line Computer Aided Satellite Photo Interpretation (OCAPI), BPPIT,
- \* SPOT for Road Planning & Design in Indonesia, PU-SCOT,
- \* Remote Sensing Technology for Natural Resources Management, BPPT - ADB,
- \* Satellite Data for Shallow Water Mapping in Indonesia, Indonesia - Australia,
- \* Laser Airborne Depth Sounder (LADS), Indonesia - Australia,
- \* Remote Sensing for the Mamberamo River Basin, Irian Jaya Regional Development Program, BPPT - Australia.
- \* Weather and Environmental Satellite Data for Drought Monitoring and Forest Fire Assessment,
- \* Remote Sensing & GIS for Batam-Rempang-Galang Industrial Area Development Project,
- \* Land Use & Land Cover Change Study Over Citarum Watershed, SACRS Program (International Geosphere & Biosphere Program).
- \* Remote Sensing & GIS for Natuna Island Development,

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established with the AUSLIG-ACRES of Australia in the field of ground station and data dissemination managements. Through the coming SATTIN Project, will be started in 1996, the Parepare ground station capabilities will be strengthened, particularly for SPOT data acquisition, distribution and services. In anticipating toward the launching of RADARSAT-Canada at the end of 1995, negotiation is currently underway for possibilities of receiving RADARSAT from this station. In another front, discussions are also being intensified between the Indonesian parties and LOCKHEED - E-SYSTEM - RAYTHEON of the USA, and MATRA of France in relation to the future utilizations of high resolution satellites, such as: Space Imaging, Eye Glass, World View and Helios.

Six weather and environmental satellite ground receiving stations are currently also in operational status. LAPAN operates two NOAA and GMS stations, one in Jakarta and the other one in Biak, Irian Jaya in the eastern part of Indonesia. Cooperations with NOAA-USA and NASDA-Japan in this field are also being established.

Two other weather and environmental satellite ground receiving stations are located in Central Kalimantan and in East Sumatra. These two stations, constructed in cooperation with the Government of the United Kingdom, are being operated by the Indonesian Ministry of Forestry and dedicated toward forest monitoring, particularly in the field of forest fire mitigation and monitoring. The Government of Indonesia's Agency for the Assessment and Application of Technology (BPPT) operates one NOAA satellite ground receiving station located in Jakarta and dedicated toward supporting the prototype applications for Forest fire monitoring, rice paddy yield prediction, watershed management and the marine productivity assessment. The Indonesian Meteorological and Geophysical Agency (BMG) also operates one NOAA ground station and being utilized for weather assessment and cloud predictions. These two later NOAA ground receiving stations were established under the Environmental Monitoring Joint Cooperation Program between BPPT and The Natural Resources Institute (NRI) of the United Kingdom.

The airborne remote sensing program in Indonesia are wide ranging from the standard aerial photography into more sophisticated one, such as airborne magnetic and airborne gravity surveys (Carson, USA), airborne radar program (INTERA, LORAL, DORNIER, EUROCOPTER), the airborne laser program (Laser Airborne Depth Sounder - LADS, Light Detection and Ranging - LIDAR), and the airborne thermal infrared surveys (DAEDALUS, AGEMA, NDVLR). Indonesia is in the progress of discussing its possible participation in the Pacific AIRSAR Campaign in 1996 utilizing the NASA's DC-8 AIRSAR Laboratory.

The above mentioned airborne and satellite, data acquisition facilities provide continuous data in daily basis. The data acquired should be processed and analyzed at various data processing centers available throughout Indonesia. The Indonesian remote sensing experts convert the data into information and assist the users to

implement the data for Indonesia's development. For that reason, a strong in-country satellite data user community is a top priority currently being developed. Only through this user community that remote sensing technology can have impacts to the country's economy.

#### INDONESIA'S REMOTE SENSING USER DEVELOPMENT:

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The current trend of remote sensing data utilization in Indonesia is very much related to the operational applications of the data. There should be an appropriate numbers of user community which are beneficial on utilizing the data. The Indonesia's current remote sensing user community is being expanded by the introduction of various national scope remote sensing application projects with three main objectives, namely:

- strengthening the manpower and hardware/software capabilities in each sectoral agencies for satellite data utilization,
- putting remote sensing technology in operational stage,
- expanding the remote sensing applications into various new sectors by introducing application prototypes.

Efforts to strengthen the manpower and hardware/software facilities are being flourished through the development of various remote sensing application projects, national in scope. Figure 2 shows the list of current government of Indonesia's remote sensing projects. The above mentioned projects also spurred the establishment of 128 remote sensing data processing centers throughout Indonesia, 102 of those are equipped with digital image processing facilities, from the very inexpensive one, such as PC-computer type system, to the very sophisticated one, like the IBM 3090/600S supercomputer (Figure 3).

Data assessed by the Indonesian Society for Remote Sensing (MAPIN) showed that as of February 1994, the numbers of Indonesian remote sensing experts are reaching 877 persons (Soesilo, 1994).

Progress on the development of remote sensing user community may also be assessed by the numbers and types of data utilizations throughout the country. Since the operationalization of Parepare ground station, the numbers of satellite data are start accumulating. As of June 1994, there are 846 Landsat scenes and 3156 SPOT scenes have been recorded and archived from Parepare station (KOMPAS, August 3, 1994). On September 1995, LAPAN Data Bank reported additional ERS-1, SPOT and LANDSAT TM data recorded from Parepare station during 1994-95. The increase on the number of satellite data utilizations in Indonesia is also indicated by the numbers of Indonesian satellite data acquired from LAPAN station and from various data center, as for example:

- 1) LANDSAT, SPOT, ERS-1 Satellite data distributed from LAPAN during May 1994 to May 1995 have improved significantly, with

**INSTITUTIONS IN INDONESIA WITH DIGITAL IMAGE  
PROCESSING SYSTEM AND  
GEOGRAPHIC INFORMATION SYSTEM FACILITIES:**

**Government Agencies:**

BPP TEKNOLOGI,  
LAPAN,  
BAKOSURTANAL,  
Badan Pertanahan Nasional - Jakarta,  
Badan Pertanahan Nasional - Samarinda,  
Badan Pertanahan Nasional - Pontianak,  
Pusdata, Dept. of Public Works,  
Public Work Regional Office in Medan,  
Public Work Regional Office in Pekanbaru,  
Public Work Regional Office in Padang,  
Public Work Regional Office in Palembang,  
Public Work Regional Office in Bandung,  
Public Work Regional Office in Semarang,  
Public Work Regional Office in Surabaya,  
Public Work Regional Office in Manado,  
Public Work Regional Office in Ujung Pandang,  
Public Work Regional Office in Samarinda,  
Public Work Regional Office in Denpasar,  
DG Human Settlement, Dept. of Public Works,  
DG Road Planning & Construction,  
Dept. of Public Works,  
DG INTAG, Dep. of Forestry,  
DG RRL, Dep. of Forestry,  
Directorate of Preparation of Forest Exploitation,  
Dep. of Forestry,  
Directorate of Program Management,  
Dep. of Forestry,  
Directorate of Forest Protection, Dep. of Forestry,  
Directorate for Inventory of Forest Confirmation & Mapping,  
Dep. of Forestry,  
DG Geology & Mineral Resources,  
Dep. Mines & Energy,  
Directorate of Peat & Coal,  
Dept. Mines & Energy,  
PPGL, Dep. Mines & Energy,  
Mineral Technology Development Center,  
Dep. Mines & Energy,  
Directorate of Environmental Geology,  
Dep. Mines & Energy,  
Directorate of Volcanology/Volcanological Survey,  
Dep. Mines & Energy,  
Directorate of Geological Research and Development Center,

Dep. Mines & Energy,  
Marine Geology Development Center,  
Dep. Mines & Energy,  
R & D Center for Oil and Gas Technology "LEMIGAS",  
Dep. Mines & Energy,  
PLN Electricity, Dep. Mines & Energy,  
DG Regional Development,  
Dept. of Home Affairs,  
Puslitanag, Dept. of Agriculture,  
Pusdatatan, Dept. of Agriculture,  
Directorate of Fish Biological Resources Management,  
Dept. of Agriculture,  
Soil Research & Agro-Climatology Center,  
Dept. of Agriculture,  
Ministry of State for Environment,  
Puslitbang Geoteknologi - LIPI,  
Puslitbang Oseanologi - LIPI,  
IDMC, Dept. of Social Affairs,  
PUSSURTA ABRI,  
Dit. Aerial Survey, Indonesian Air Force,  
BPPIT, Dep. of Defense & Security,  
Indonesian National Police Head quarter,  
DG Pankim, Dep. of Transmigration,  
Directorate of Program Management,  
Dep. of Transmigration  
Bappeda Aceh,  
Bappeda North Sumatra,  
Bappeda West Sumatra,  
Bappeda Riau,  
Bappeda Bengkulu  
Bappeda Lampung,  
Bappeda South Sumatra,  
Bappeda Jambi,  
Bappeda Directorate, DKI-Jakarta,  
Bappeda West Java,  
Bappeda Central Java,  
Bappeda East Java,  
Bappeda Bali,  
Bappeda South Sulawesi,  
Bappeda North Sulawesi,  
Bappeda Irian Jaya,  
Bappeda Yogyakarta,  
- Army Topographic Section, Kodam Trikora,

#### Universities:

Computer Center, University of Indonesia,  
Electrical Engineering Dept. University of Indonesia,  
Dept. of Geodesy, ITB-Bandung,  
Dept. of Electrical Engineering, ITB-Bandung,  
UPT-Komputer PIKSI, ITB-Bandung,  
Dept. of Geology, ITB-Bandung,  
Dept. of Urban & Regional Planning,  
ITB-Bandung,  
Faculty of Geological Engineering,  
Trisakti University,  
PUSPIC, University of Gadjah Mada,  
Electrical Engineering, University of Gadjah Mada,  
UPN "Veteran" Yogyakarta,  
Remote Sensing Laboratory, IPB-Bogor,  
University of Pattimura, Ambon,  
University of Hassanuddin, Ujung Pandang,

Dian Desa Foundation - Yogyakarta,  
PN. Pertamina Oil Company,  
PLN - State Electrical Power Company,  
Caltex Pasific Indonesia,  
Vico Corporation,  
Perum PERHUTANI,  
PT. Indica Dharma  
PT. Mursinsay  
PT. Amythas  
PT. Binareka Alamlestari  
Djayanti Group  
PT. Bukit Gemah Ripah  
PT. Sumber Windu Kencana  
PT. Rio Tinto Indonesia  
PT. Freeport Indonesia Company  
Advanced Planning Inc.

#### State & Private Companies:

Intersys Corp.,  
Geosys Corp.,  
Nusantara System International Corp.,  
PT. Kayu Lapis,  
PT. Kayu Mas,  
PT. Barito Timber,  
PT. Aryamas Asianusa,  
PT. Kompusindo Prima Internusa,  
PT. Multimatra Prakarsa,  
PT. Soedarpo Corporation,  
PT. Tripatra Engineering,  
PT. Geoservices,  
PT. ASCII,  
PT. Geojaya Teknik,  
PT. Geode Pataka Alam,  
PT. Geosys Intipiranti  
PT. Geoinfo  
PT. Indo Georeka Nusantara,  
PT. Metrodata  
PT. SIEMENS Indonesia,  
PT. Prabanugraha Technology,  
PT. USI-Jaya,  
PT. Elmsat Indonesia,  
PT. Elnusa,  
PT. Sarana Putera Makmur,  
PT. Mapindo Parama,  
PT. EXSA International,



the application areas are as follow: Forestry (68%), R & D (16%) Agriculture (8%), Geology/Soil (8 %). Most of the users order Landsat TM data (84.40%), followed by ERS-1 data (12.6 %) and SPOT data (3 %). To expand the number of domestic users, 15 local distributors have been assigned to provide LAPAN's Parepare ground station data products (Figure.4.).

- 2) ACRES-Australia reported on the number of data sales for Indonesia reaching A\$125.000 in 1993 (ACRES Oral Communication,1994),
- 2) Data sales over the Indonesian region from Bangkok station increases 150% in 1993 (Oral Communnication with Dr.Suvit of NRCT-Thailand,1994),
- 3) The total numbers of satellite data distributed by the SPOT Distributor in Indonesia, PT.Bhumi Prasaja, during the period of 1987-1993 reached 1100 SPOT scenes. In 1995, PT.Bhumi Prasaja reported that the SPOT applications in Indonesia are covering: forestry (48.3 %), Mapping (16.3 %), Public Works (15,6 %), geology & explorations (8.7 %), Land Use & City Planning (8.0 %), Others (3.0 %).
- 4) Anticipating the launching of RADARSAT, at the end of 1995, PT.Mapindo Parama of Indonesia signed a \$ 2 million - contract with the RADARSAT International of Canada, for the provisions of 450 RADARSAT images to be delivered in 1996.

The types of SPOT satellite data distributed in Indonesia (1995) are as follow:

- Film Products	: 37,2 %,
- Computer Compatible Tapes:	25, 4 %,
- Paper Prints	: 37.4 %.

The sophstication level of data analysis is being indicated by the numbers of computer tapes being utilized. Users just started implementing remote sensing satellite data are usually applying the paper print products, and by the advancement of their analytical capabilities, the users shift their data selection more into the Computer Compatible Tapes (CCT) rather than the standard film products and paper prints. LAPAN is currently also providing the Indonesian remote sensing users with data in CD-ROM package.

The applications of NOAA satellite data are also being intensified in Indonesia. This type of data, which are low resolution but very inexpensive, are being tested for rice yield predictions, watershed management, ocean productivity assessment and forest fire detections. The ultimate objective of NOAA satellite data utilizations in Indonesia is its "real time" application, while the free data is still current, and also considering that the ground station facility itself may be constructed at low cost.

In order to put remote sensing technology into operational stage and, at the same time, expand its applications into various new sectoral development areas, two approaches are being established:

- a) The development of various application projects in many government agencies, as shown in the previous Figure 2. Considering the needs of continued assessing of this advanced technology, Indonesian agencies cooperate with various foreign agencies in the assessment and application of remote sensing technology, including with:

USA : NASA, NOAA, USGS, EOSAT, Texas A & M University, Houston Advanced Research Center, EOSAT, University of New Hampshire, Lamont-Doherty Earth Observatory-USA,  
Japan : NASDA, ERSDAC, RESTEC, JAMSTEC, STA, JICA,  
France : SPOT Image, IGN Espace, SCOT Conseil, CNES, GDTA, MATRA, IFREMER,  
Germany : Ministry of Bavaria, NLF, EUROCOPTER,  
The Netherland: ITC, Delf Hydraulic, NLR-Netherland,  
Canada : MDA, CRST, Radarsat International,  
Thailand : NRCT, AIT-Thailand,  
Australia : AUSLIG-ACRES, AMSAT, CSIRO, South Australia Center for Remote Sensing, AGSO, NRIC, Univ.of New Southwales, Univ.of Adelaide,  
Multilateral Agencies: European Space Agency, Consortium of European Communities, SACRS, The Asian Development Bank, The United Nations, The World Bank.

- b) The establishment of regulations to encourage Indonesian private sectors to use remote sensing satellite data, such as:

- To encourage the Indonesian private sectors of utilizing satellite data received from Indonesian stations,
- The Minister of Forestry Decree for approximately 500 Indonesian forest concession companies to use satellite data for their forest management tasks.
- To encourage the private consultancy firms to use satellite data for their environmental impact assessment studies.
- The encouragement of mineral, oil and gas industries to acquire and process their remote sensing satellite data in Indonesia.

These remote sensing user development drives are start showing results. The SPOT Distributor in Indonesia, PT. Bhumi Prasaja, reported in 1995 on the sources of funding allocated to acquire satellite data, as follow:

* Domestic Private Companies	: 41.8 % ,
* Foreign Buyers	: 33.3 % ,
* Government Funding	: 11.3 % ,
* Domestic State Companies	: 8,6 % ,
* Foreign Private Companies	: 5.0 % ,

As shown above, 80 % of the funds allocated to acquire satellite data are coming from the private sectors. This is exemplified that the Indonesian remote sensing services industry is growing, and seeing the Project Proposals in the 1995 BAPPENAS Blue Book (Figure.5.), many of these projects have remote sensing application potentials, making the growing trends of the remote sensing applications in Indonesia, in the coming years, will always be positive.

#### ASSESSMENT ON RADAR SATELLITE DATA UTILIZATIONS IN INDONESIA:

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Indonesia's equatorial location, with its tropical weather and cloud conditions, often hindered the data acquisitional tasks using optical remote sensing satellites. An active imaging sensor system, known as the imaging radar technology, is the answer to overcome the above mentioned constraint in conducting remote sensing surveys in such tropical areas, like Indonesia.

Indonesia's interest and participation in remote sensing spaceborne radar activities, started since the Shuttle Imaging Radar (SIR) missions during 1981 and 1984. Three paths of SIR-A coverage over the Indonesian region (West Kalimantan-West Java, West Nusa Tenggara and Irian Jaya,) and one path of SIR-B coverage over Sumatra were acquired and tested for structural geological explorations and forest inventory (Sabins, 1983, Soesilo, 1986, 1991, Ford, 1991) (Figure 4). The radar cloud penetration capabilities were tested and, at the same time, the radar interpretation techniques were introduced.

The successfully launched of ESA's European Remote Sensing Satellite-1 (ERS-1) in 1991 and the Japanese Earth Resources Satellite-1 (JERS-1) in 1992 has brought Indonesia into the world of satellite imaging radar technology and applications. A satellite imaging radar interpretation technique was first introduced during the Annual SPOT Satellite Training Course-1991 in Jakarta, while a Seminar on ERS-1 was organized in Jakarta in 1993. Following the training course and the seminar, various radar application projects are being conducted in Indonesia, including:

- a) The ERS-1 Data Applications for Land Use Change Study, Urban and Regional Planning Studies, under EC-ASEAN Project,
- b) The JERS-1 Verification Program in the field of geological explorations, irrigation study, land use and land mapping, under the Government of Indonesia-NASDA-MITI Program,
- c) Satellite Rice Assessment for Indonesia (SARI) under BPPT - CNES - CEC - ESA Project.

LIST OF PROJECT DEVELOPMENT PROPOSALS IN THE BAPPENAS BLUE BOOK 1995  
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 WHICH HAVE REMOTE SENSING APPLICATION POTENTIALS  
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PROJECT CODE	PROJECT TITLE	PROJECT COST
940185	Coral Reef Rehabilitation and Management Project	\$ 120.000.000
940104	Remote Sensing Technology Appl. for Natural Resources Management	\$ 20.000.000
950314	Digital Marine Resource Mapping of Indonesian Water	\$ 81.000.000
940430	Urban & Landuse Database Development.	\$ 10.900.000
950178	Airborne Geophysical Survey in Kalimantan & Sulawesi	\$ 80.400.000
940524	Western Flores Integrated Area Development Project	\$ 15.000.000
950225	Maluku Island Regional Development Project.	\$ 43.000.000
950229	Central Sumatra Forest Rehabilitation Project.	\$ 30.000.000
941023	Metro Bandung Urban Development Project.	\$ 150.000.000
941024	Metro Medan Urban Development Project.	\$ 150.000.000
941043	Banda Aceh Urban Drainage Project	\$ 6.400.000
941114	Sumatra East Coast Highway Project	\$ 83.500.000
950626	Sumatra Irrigation Improvement & Water Resources Management	\$ 200.000.000
950631	North Java Flood Control Project	\$ 72.000.000
950636	Sulawesi Irrigation Improvement and Water Resources Management	\$ 140.000.000
950639	Segara Anakan Conservation and Development Project.	\$ 57.000.000
950644	Volcanic Disaster Urgent Counter Measures (Mt. Merapi & Mt. Semeru)	\$ 49.000.000
950754	Sustainable Ground Water Development for Irrigation in Indonesia	\$ 14.000.000
950756	Eastern Indonesia Integrated Water Resources Development.	\$ 77.000.000
940732	Sustainable Coastal Resources Development & Management Project	\$ 11.282.000
950454	The Sustainable Management of Protection Forest.	\$ 6.280.000

LIST OF TECHNICAL ASSISTANCE PROPOSALS IN THE BAPPENAS BLUE BOOK-1995

WHICH HAVE REMOTE SENSING APPLICATION POTENTIALS

PROJECT CODE	PROJECT TITLE	PROJECT COST
950411	Integrated Lake Management	\$ 4.025.000
950313	Pekayon Satellite Remote Sensing Ground Station Upgrading for RADARSAT Data Acquisition & Processing.	\$ 2.500.000
941238	Coral Reef Rehabilitation and Management.	\$ 2.500.000
950531	Regional Development Study for the Northern Part of Sumatra, in conjunction with Indonesia-Malaysia-Thailand Growth Triangle	\$ 2.500.000
941255	Permanent Monitoring of Rice Growing Areas By Satellite Remote Sensing & GIS in Indonesia	\$ 3.845.000
941258	Mamberamo Regional Development Planning.	\$ 5.000.000
950015	Integrated Catchment Management Land Use and Coastal Area Dev.	\$ 3.850.000
950032	Development of Airborne Synthetic Aperture Radar for Indonesia.	\$ 494.000
950353	Forest Fire Impact on the Environment.	\$ 1.250.000
950224	Merauke Integrated Area Development Study.	\$ 1.800.000
950078	Feasibility Study for Integrated Agriculture Development and Conservation Project in Irian Jaya	\$ 600.000
940992	Study On Landslide Mitigation and Hazard Mapping in Java.	\$ 2.150.000
940993	Rare Metal & Rare Earth Metal Explorations.	\$ 4.000.000
940998	Seismic Investigation for Coal Deposits.	\$ 460.000
950664	Master Plan Study on Kapuas River Basin Development.	\$ 1.650.000
950668	Feasibility Study for Road Development of West Coast of Sumatera	\$ 2.300.000
950670	Feasibility Study for the Bandung - Cirebon Road Improvement Project	\$ 1.450.000
950678	Assistance for Land Acquisition and Resettlement Program.	\$ 100.000

950456	Management Plan of Teluk Kupang, Megamendung and Teluk Yotefa Natural Recreational Parks.	\$ 1.650.000
950458	Ecotourism Development in Five National Parks.	\$ 1.000.000
950459	Biodiversity Conservation in Bukit Barisan Selatan Nat'l Park	\$ 1.000.000
940587	Real-Time Management of Flood Damage Protection.	\$ 692.000
940588	Environment-Oriented Groundwater Management.	\$ 2.385.000
941038	Study of Biak Area Development	\$ 1.300.000
941082	Geographic Information Center Project for Integrated Planning and Monitoring of Agricultural Land Preparation and Development	\$ 6.000.000
941124	The Road Network Development Study In Lombok Island.	\$ 1.000.000
941127	Road Network Study in Central and Southeast Sulawesi.	\$ 1.630.000
950635	Eastern Indonesia Integrated Water Resources Development	\$ 600.000
950646	Feasibility Study on Integrated Water Resources Development in Mamberamo River Basin.	\$ 2.430.000
950652	Masterplan & Feasibility Study For Development of Digul-Bikuma River Basin.	\$ 1.650.000
950655	Batang Hari River Integrated Basin Development Study.	\$ 1.710.000
950656	Master Plan for Study Peusangan River Basin Development.	\$ 1.650.000
950658	Modernized Integrated Low Land Development Study	\$ 1.800.000
950659	Feasibility Study for Lower Negara Agricultural Development.	\$ 2.080.000
950663	Sustainable Water Management in Low Lying Water Logged Lands.	\$ 1.917.000
950680	Feasibility Study Jawa-Bali Crossing Project.	\$ 1.500.000
950766	Development of Digital Mapping as a Tool for Integrated Planning of Infrastructure.	\$ 2.268.000
950807	Urban Development Program Preparation.	\$ 2.500.000

- d) The applications of satellite imaging radar technology for Natural Resources Management (interferometry, natural resource conversion, hazard mitigation, landuse planning) under ADB grant project TA-1901 INO.

At same time, the Parepare ground receiving station, which is already capable of receiving ERS-1 data, is being upgraded to receive JERS-1 data, while the possibilities of applying RADARSAT are also being assessed. In the meantime, the Indonesian private firm, PT. Mapindo Parama, has already signed a contract with RADARSAT International - Canada, for the acquisition of 450 RADARSAT imagery over the Indonesian archipelago during 1996.

It is expected that the Indonesian capabilities to acquire, process and implement imaging radar satellite data will be increasing in two years to come.

#### REMOTE SENSING PRIORITY INTEGRATED RESEARCH IN INDONESIA:

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It has always been realized that a strong industry must be backed up by an intensive research and development activity. Likewise with the remote sensing services industrial development in Indonesia. A strong demand in remote sensing data, hardware & software facilities, consultancies and the increasing number of users require an ever improving research and development activities in the field of remote sensing technology and its applications.

Starting 1994/95 fiscal year, remote sensing is becoming one of the 12 sectoral programs within the Integrated Priority Research Program of the Indonesian National Research Council (Riset Unggulan Terpadu, Dewan Riset Nasional, RUT-DRN). All Indonesian scientists, engineers and technicians involve in remote sensing and the geographic information system are being invited to submit their research proposals for possibilities of receiving research grants. Since July of 1993, the selection is underway, a six-member remote sensing panel of experts is being established by the National Research Council, and 76 research proposals are being evaluated. Research proposals evaluated are being categorized into six topics, namely:

- Digital Image Processing System,
- Remote Sensing Application System Development,
- Geographic Information System,
- Low-Cost Remote Sensing System,
- Integrated Remote Sensing System,
- Image Analysis System Development.

Out of 76 proposal evaluated, 13 proposals reached the final selection to be funded starting 1994/95 fiscal year. Most of the selected research projects will take 2 - 3 year to complete the work, with annual research budget approximately US \$50.000 per-proposal, per-year. Figure 5 shows the list of remote sensing research proposals reached the final selection for 1994/95 fiscal year.

For the 1995/96 RUT-DRN program and beyond, the remote sensing research activities are being concentrated toward environmental monitorings and other environmental related activities.

The remote sensing Integrated Priority Research in Indonesia opens possibilities of linking Indonesian scientists and engineers with their counterparts worldwide. Through this research activity, various Indonesia's remote sensing research program may be expanded toward the inclusion of the latest technologies and models available in international research institutions. The National Science Foundation of the United States, Science and Technology Agency-Japan, Dept. of Industry, Science & Technology - Australia and The European Communities are the International institutions which are already cooperating with BPPT to link the Indonesian remote sensing scientists and experts with their counterparts in the United States, Japan, Australia and Europe.

#### CONCLUSION AND RECOMMENDATIONS:

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The development of remote sensing technology and its applications are progressing significantly in Indonesia. The development of this technology are indicated by the following examples:

- The operational status of one multimission satellite ground receiving station and six satellite weather & environmental ground receiving stations in Indonesia,
- The availability of 128 remote sensing and GIS centers throughout Indonesia, supported by nearly 900 remote sensing experts,
- The existance of various remote sensing & GIS projects, national in scope,
- Close cooperations in this field with experts and institutions from the USA, Japan, Germany, The Netherland, Australia, Thailand, France and EC, ESA and other multilateral agencies,
- Strong research and development activities in this field, including on the assessing of satellite imaging radar technology and its applications in Indonesia.

The above mentioned progress is only the beginning, and a significant result should be monitored in the coming 2 - 3 year period.

It is recommended that in order to achieve a strong remote sensing and GIS services industry in Indonesia, the number of remote sensing user community should be expanded as wide as possible for in-country optimum utilization of this technology fast, efficient, effective and with optimum economic benefits.

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