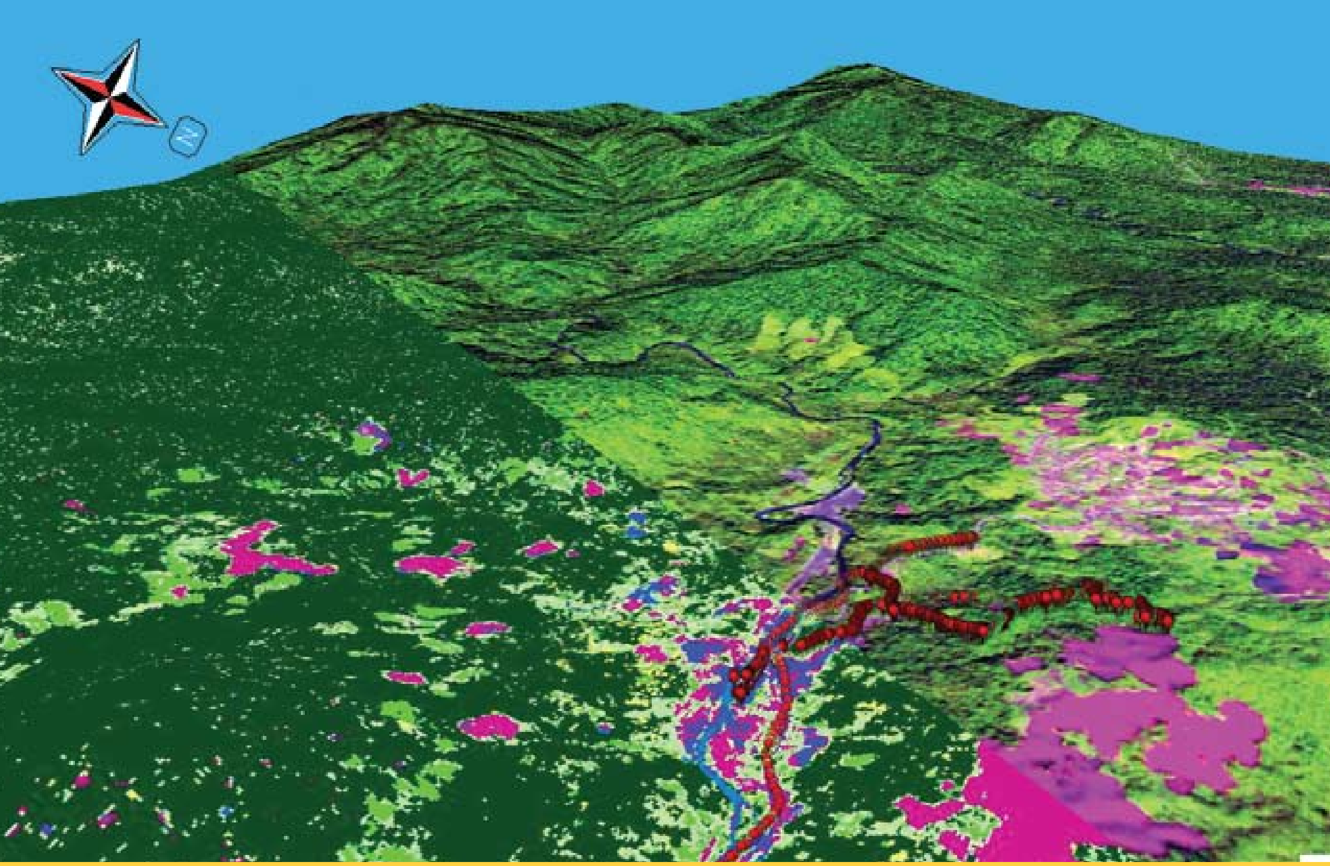

The operational role of remote sensing in forest and landscape management

Focus group discussion proceedings

Editors
Gen Takao
Hari Priyadi
Wim Ikbal Nursal

CIFOR

JAPAN
Official Development Assistance

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Center for International Forestry Research (CIFOR)
CIFOR advances human wellbeing, environmental conservation and equity by conducting research to inform policies and practices that affect forests in developing countries. CIFOR is one of 15 centres within the Consultative Group on International Agricultural Research (CGIAR). CIFOR's headquarters are in Bogor, Indonesia. It also has offices in Asia, Africa and South America.

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Abbreviations

Bappeda	Badan Perencana Pembangunan Daerah (Regional Development Planning Agency)
CI	Conservation International
CIFOR	Center for International Forestry Research
DEM	Digital elevation model
FGD	Focus group discussion
GHNSP	Gunung Halimun Salak National Park
GIS	Geographic information system
ICRAF	World Agroforestry Centre
IPB	Institut Pertanian Bogor (Bogor Agricultural University)
ITC	International Institute for Geo-Information Science and Earth Observation
JICA	Japan International Cooperation Agency
KKI	Komunitas Konservasi Indonesia
MLA	Multidisciplinary landscape assessment
NGO	Nongovernmental organisation
RS	Remote sensing
RADAR	Radio detection and ranging
UNMUL	Universitas Mulawarman
TBI	Tropenbos Indonesia

Foreword

I welcome the participants to CIFOR in Bogor. I am particularly happy to see so many participants from organisations or groups that have actually been involved in landscape or land use management. I am aware that some of the participants have come from national parks and other organisations that already use remote sensing (RS).

I feel that it is very important to share experiences so that participants could prepare themselves to use RS as part of their landscape management activities. I believe that in terms of the evolution of remote sensing, two important aspects stand out.

First, it appears that the concept of sustainable forest management is expanding to cover environmental services that are not traditionally taken into consideration when talking about sustainable forest management. Sustainable forest management is very much about timber, or the sustainability of timber supply, but it is also very much about all the other environmental services and physical systems provided. Furthermore, I believe that everybody is going into this more with the expansion of sustainable forest management, for example through ecosystem services and other products such as non-timber forest products. There are challenges to be faced in planning, managing and monitoring success, and in this respect, the role of RS is becoming increasingly important.

The other aspect relates to negotiations and landscape management, which usually involve multiple stakeholders, with multiple land management objectives. It is important to have appropriate tools for the management and managers of these landscapes. I believe that RS offers many opportunities to improve systems.

I think that the objective of this meeting is very clear. CIFOR wants to learn from the participants and their experience with managing landscapes how to improve the use of RS in landscape management to make it more cost efficient and, hopefully, user friendly.

On behalf of CIFOR, I thank you again for your participation.

Dr. Markku Kanninen
Environmental Services Programme Director, CIFOR
October 2007

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We are grateful for comments on the text and editorial polish by Imogen Badgery Parker, Edith Johnson and Rosie Ounsted. We thank Hasantoha Adnan for his documentation of the discussion and Atie Puntodewo for her support during the event. Various people at CIFOR have helped and assisted at different points in this exercise: Rahadian Danil, Eko Prianto, Yani Saloh and Gideon Suharyanto.

Executive summary

Since it was first introduced, remote sensing (RS) has been assumed to contribute to forest and landscape management. The technology – sensors, processing and analysis – has been the subject of a vast amount of research and development, and studies using RS have improved understanding of the sites studied. At the strategic level of forest planning, or of general planning of forest resource allocation over a wide area, RS has often played an important role in estimating and monitoring the forest cover. However, at the tactical level, for example during planning forest management activity assignments within a forested landscape, RS has not contributed as much as expected. Successful research methods cannot always be applied to operational management. It is recognised that there is a gap between the scientific and the operational uses of RS.

As part of the process to develop an operational RS framework for forest or land management, professional forest managers and RS experts were invited to a focus group discussion (FGD) to discuss their experiences and expectations and the constraints that they have encountered in using RS in their management activities.

The FGD, titled 'The operational role of remote sensing in forest and landscape management', was held at CIFOR in Bogor, Indonesia, on 3 October 2007. Twenty-seven participants were invited, on an arbitrary basis, from 13 organisations, including national parks, local government, private companies, conservation non-governmental organisations (NGOs) and research institutions, all from within Indonesia.

Prior to the discussion, a preliminary questionnaire was distributed to all the organisations invited in order to survey the range of their experiences with and expectations of RS. As part of the event, after some participants gave presentations, all participants joined in plenary and smaller group discussions to discuss and prioritise the major expectations of and constraints on the use of RS in forest management practices.

The discussions revealed that, despite the wide range of experiences with and expectations about the application of RS to forest and land management, and a shared view that RS was the only means for monitoring large areas, several constraints hinder the implementation of the technology. Many of these constraints were institutional rather than technical and had already been identified by expert practitioners; nevertheless, they remain unresolved.

The majority of the participants shared three concerns:

1. the high costs of RS
2. the need for capacity building
3. the need for information sharing.

Many participants mentioned that the costs of RS – especially the cost of images, software and ground truthing – could be reduced. Capacity building is necessary to ensure the confident use of the technology.

Information sharing arose as a key factor for addressing these constraints. Participants noted that data sharing could help avoid duplicate investment, and knowledge sharing could improve users' capabilities. Sharing maps produced using RS should be the first step, but this will be effective only when all the maps apply the same land cover/use definitions. Sharing raw satellite images would be a direct means of reducing costs, and sharing ground-truthing data would not only contribute to reducing costs but also make cooperation among the institutions more flexible and interactive.

Above all, sharing the value of RS and GIS is important, and one of our expectations of RS experts is that they will facilitate such sharing. As a good example, one participant described a local GIS/RS forum that called on local officials from different departments and sectors to share their information on RS and GIS and coordinate a data platform.

Managers are interested in image interpretation, particularly of high-resolution images, as this is something that they can do intuitively by projecting onto the image their abundant empirical knowledge of the land that they manage. Such empirical knowledge is exclusive to those who are familiar with the land, but it is not accessible for outsiders. Consequently, such knowledge should be applied for image analysis both proactively and repeatedly.

The low accuracy of RS data was identified as a potential constraint for operational use by only two participants, both of who were from forestry companies that wanted to replace some of their forest inventory with RS. As quantitative accuracy in a given compartment is very important for such companies, the monitoring system that they use should be carefully designed to meet their demands as far as possible. Some other participants seemed less interested in the accuracy of the products although the accuracy assessment was indispensable; it may be that a lower level of accuracy is sufficient. For RS to be implemented reliably as an aspect of operational management, an objective and systematic assessment system with adequate ground truthing is required.

Capacity building should be the most important process for disseminating RS for use in operational management. Despite their limited resources, the participants preferred to build their own capacity rather than outsource analyses because they felt that it was important to be able to monitor their own land. To respond to user requirements, RS experts should develop technology that is as simple and inexpensive as possible, and not only transfer the technology but also consult with users to tailor an effective system through interactive learning.

To conclude the FGD, the most important issues identified for implementing RS in forest management were summarised as follows:

1. bridging the gap between RS users and RS experts
2. promoting collaboration between institutions
3. identifying/adjusting boundaries identified by authorities that do not match the reality on the ground
4. sharing data, information and technology.

The following recommendations arose from the group discussions.

1. The use of high-resolution images for forest management should be encouraged because both RS experts and users can interpret them more easily.
2. To build capacity, it is essential to train the users.
3. Outsourcing of analyses should be the final option because outsourcing does nothing to advance institutional capacity within the forest management organisations.
4. In disseminating the technology, it is important to distribute materials via the Internet or CD rather than via printed media.
5. To reduce costs, data sharing across institutional barriers and the use of open-source software should be promoted.

1
About the focus group discussion

Background

Remote sensing (RS) is both a technology and a science. It is used to observe objects from a distance, especially from above, so as to measure and monitor them in a way that is quite different from taking direct measurements on the ground. The technology has been the subject of a vast amount of research and development, including work on sensors, processing and analysis. Since its introduction, RS has been assumed to contribute to forest and landscape management, and studies made using RS have undoubtedly improved understanding and management of the study sites.

However, RS has not contributed to operational forest and landscape management as fully as expected. Successful research methods cannot always be applied to operational management. It is recognised that there is a gap between the scientific and the operational uses of RS. Reasons scientific results have not been able to be used successfully in operational management include: the methods are expensive and the user requires a certain level of skill; the images cannot always be taken in a regular or scheduled manner; and there is a lack of mutual understanding between managers and RS specialists, among others.

'Sustainable utilisation of diverse forest environmental benefits' is a CIFOR research project, funded by the Government of Japan, that aims to identify and fill gaps in the knowledge and practice of RS and provide a straightforward way of applying RS technology in operational forest and landscape management. An expected output of the project is a set of guidelines for using RS technology in forest and landscape management.

Participants of the focus group discussion

The aims of the project are addressed under two main themes: ‘participatory and interactive processes’ and ‘active manager involvement in image interpretation’. Under the first theme, it is intended to devise a flexible approach to addressing the problems of using RS in practice, and identifying the criteria required to make the best use of the technology and the outputs that are expected to be achievable in order to satisfy managers. Under the second theme, the aim is to fully utilise the knowledge of managers in the image interpretation process so that outputs can be derived intuitively, thereby reducing costs.

At an early stage of the project, a focus group discussion was used to determine problems in forest and landscape management operations that could be resolved by the use of RS.

Purpose and outline of the focus group discussion

The purpose of the focus group discussion was to deepen understanding of operational forest and landscape management and RS techniques, and to determine ‘meeting points’ between the operational demands and the possible solutions offered by RS in forest and landscape management. The discussion was designed as an arena for forest/landscape managers, RS specialists and other stakeholders to share their knowledge and experience and to discuss potential common ground.
The focus group discussion formed a one-day meeting. In the morning, information about the ‘Sustainable utilisation of diverse forest environmental benefits’ project and its expected contribution to operational forest and landscape management was presented. This was followed by presentations by participants from different backgrounds on their experiences and expectations of management and RS. In the afternoon, the participants discussed ways in which RS can contribute to forest and landscape management.

Before the focus group discussion, a questionnaire was sent to the participants asking about their experiences and problems and/or their needs in terms of management and RS. The responses to these questionnaires, which were received before the meeting, were used to guide the discussions.

Output and outcome of the focus group discussion

The output of the focus group discussion is a report that covers the process, conclusions and recommendations coming out of the meeting. The report will be used to guide the implementation of the ‘Sustainable utilisation of diverse forest environmental benefits’ project.

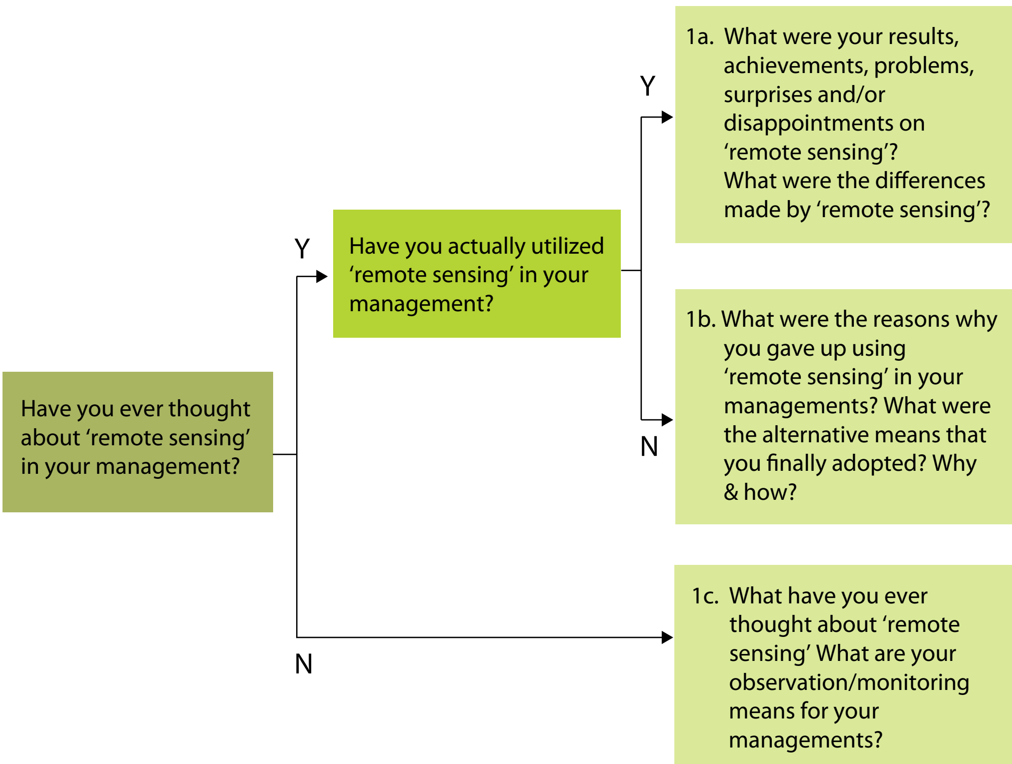
The expected outcome of the focus group discussion is that the participants will increase their knowledge of the importance of RS as a tool in forest and landscape management. The participants will also be able identify the problems with using RS and what might be expected of the technology in the future.

2

Preliminary questionnaire on participants' experiences and expectations of remote sensing

Prior to the focus group discussion, a preliminary questionnaire was sent to each of the 13 participating organisations. It consisted of two questions: 'What are your experiences with remote sensing?' and 'What are your expectations of remote sensing?'.

Q1. What are your experiences with remote sensing?



Q2. What are your expectations of remote sensing?

What are your current interests or problems to which remote sensing might be applied? What are your expectations or hopes for the future of remote sensing? What constraints do you anticipate in applying remote sensing in your operational management? Do you think remote sensing will be more useful to your management in the future?

Of the 13 organisations, seven had experience of using RS (Group 1a), and five had considered RS but did not yet have any experience with it (Group 1b). The remaining organisation did not categorise itself into either group, but presumably had no experience (Group 1c). None of the organisations in Groups 1a or 1b had experience using RS on a regular/operational basis. Some forestry companies (both private and state-owned) classified themselves in Group 1b despite their considerable experimental experience, apparently because they had not used RS in their regular activities. See Table 1 for a summary of the responses.

Sharing experiences in using measurement equipment with project partner in Burgo, Jambi

Table 1. Summary of responses to the preliminary questionnaire

Q1. What are your experiences with remote sensing?	Experiences	1a	Delineation (roads, rivers, illegal logging, shifting cultivation, fires, high conservation value forest), land cover (LC)/land use (LU) classification/interpretation, LC/LU change, assessment (erosion risk, habitat, land capability), regional spatial planning, planning aerial surveys
		1b	Delineation (logging), LC/LU classification/interpretation, management planning (harvesting, replanting), making basic maps for participatory mapping
	Problems confronted	1a	*Cost*, *capacity*, cloud cover, location accuracy, insufficient ground truthing, difficulty of comprehensive cover of large area, subjectivity of interpretation, image quality
		1b	*Cost*, *capacity*, low resolution, cloud cover
Q2. What are your expectations of remote sensing?	Expected uses	1a	Monitoring (deforestation, biomass, habitat, land suitability), LC/LU modelling, Digital Elevation Model (DEM) extraction, background images in GIS, database for regional planning
		1b	Initial harvest planning, forest inventory using high-resolution images, immediate observation and response, classification (forest type, succession stages)
		1c	Initial forest assessment, updating information, forest-type mapping, stand parameters, monitoring (silviculture, damage)
	Possible constraints	1a	*Cost*, *capacity*, long-term consistency, ground truthing, usable results on the ground, insufficient information flow between RS experts and users
		1b	*Cost*, *capacity*, availability of high-resolution images, ground truthing, obtaining reliable information from lower resolution images, timely updating

Note: 1a, 1b and 1c represent classes of respondent experience: highly experienced, less experienced and no experience, respectively. *Cost* and *capacity* (in italics in Table 1) are the two issues that almost all the respondents (12 and 11 of the 13, respectively) identified as either problems or constraints in implementing RS. Other issues are listed in an arbitrary order.

3
Presentations: sharing experiences

This chapter presents a summary of each presentation. See Annex 3 for the slides for each presentation.

Forest/landscape management and remote sensing

Gen Takao, CIFOR

Today there is a great variety of remote sensing data, with a wide range of resolutions and some new types of sensors. Nevertheless, the technology still has not successfully been applied to real forest management at the tactical level. Possible reasons include cost, capacity and institutional problems. Application of RS for forest management should be based on operational knowledge and experience and be embedded in regular management operations; also necessary is a functional relationship between managers and remote sensing experts to overcome the gaps between the technology and the demands.

Comments and responses

Comment 1: Satellite images are very expensive for non-commercial sectors such as ours. We complemented satellite images with aerial patrols and photos from our own ultralight planes for general monitoring. This has been very useful in the operation and management of our national park.

Takao: Using an ultralight plane is a very attractive option, especially if the photographs can be taken in a systematic and statistical manner.

Comment 2: Simpler RS and GIS programmes should be available for managers so that they can learn to work with this technology before more high-tech systems are introduced.

Takao: CIFOR has published guidelines and a textbook for practitioners, and is revising them for free software. Cost reduction can be achieved by sharing the data and the costs of data and equipment with the other interested institutions.

Comment 3: There is a gap between the RS specialist and the user—the lack of shared understanding—and the fact is that RS data are not yet used by decision-makers.

Takao: RS specialists and end-users need to clarify and agree together the required and possible outputs. We need to figure out what administrators or forest managers actually need.

Remote sensing application for forestry and environmental management

Lilik Budi Prasetyo, Faculty of Forestry, Bogor Agricultural University

Remote sensing is being used as an integral research component, for example in determining the source of oil spills and contaminated areas, forest fire mapping, investigating deforestation by oil palm, identifying paddy fields accurately by using RADAR, predicting erosion and landslides in Halimun Salak National Park, and determining Javan gibbon suitability habitat.

Those experiences have shown that RS is very helpful in understanding processes occurring in a landscape, in supporting investigations into environmental problems and in supporting decision-making.

The difficulties with using RS related mainly to data acquisition and the pre-classification process. RS data can be easily used by the users.

Applying remote sensing to support better forest management

Indrawan Suryadi, Tropenbos Indonesia

Tropenbos International is a Dutch NGO. It has been active since 1988 in several countries, including Colombia, Guyana, Suriname, Bolivia, Netherlands, Ivory Coast, Ghana, Cameroon, Vietnam and Indonesia. Its mission in Indonesia is to improve the use and management of forests for a healthy environment, sustainable development and prosperity for the people by generating relevant information; capacity building and training; and strengthening of institutions. Tropenbos has actively used RS in implementing its programme. The first application of RS was in dealing with design and developing a monitoring and certification system of production forest in Indonesia. This programme was run in cooperation with ITC Netherlands and Watershed Management Agency Solo in Berau and Pasir District (East Kalimantan Province). The second application was supporting and providing technical assistance for the development of Spatial Data Infrastructure (GIS-RS Forum) in Pasir District. The third was dealing with a series of GIS and RS training sessions for the GIS-RS Forum and local government agencies. The final activity was biodiversity assessment in Gunung Lumut and Betung Kerihun National Park. The other relevant activity is doing land-cover analysis for all provinces in Kalimantan, as well as erosion hazard analysis for all provinces in Kalimantan.

Tropenbos has ongoing activities related to land cover interpretation for all provinces in Kalimantan, which aim to define the actual land cover and determine remaining forest cover due to support of forest planning and management in Kalimantan.

There is another advanced analysis based on RS data and information, which was to define the critical lands in Kalimantan as base data and information for future rehabilitation activities.

Problems encountered with RS analysis are lack of quality data and lack of coordination amongst institutions. The data do not reflect the reality in the field. The facts are inconsistent or there are unmatched data amongst institutions and lack of coordination in planning decision-making. The solution was the establishment of the GIS-RS Forum for discussions to find solutions together.

Some lessons learned based on Tropenbos' involvement with several projects are as follows.

1. An intensive approach to district governments is needed to have a real influence on spatial planning decisions.
2. Maintaining good personal relations with key persons in the district (particularly the Development Planning Agency) is very important.
3. Support from the heads of all agencies is required.
4. A decree from the district head to formalise the GIS-RS Forum is needed to make it function.
5. The most effective training occurs when classroom training is alternated with field exercises and is followed up by assistance with data analysis 'on the job' after the formal course is over.
6. Peer-to-peer extension is a powerful way of disseminating the concept.

Remote sensing application in spatial planning at the micro level

Damsir Chaniago, KKI Warsi

Komunitas Konservasi Indonesia Warsi or KKI Warsi is a local NGO based in Jambi. In this workshop, I discuss KKI Warsi's experience in remote sensing, especially its application in spatial planning at the community level. Through the participatory mapping approach, working with the community, we determined land use types, such as conservation, agriculture, settlement, etc, as a basis for designing spatial planning on a wider scale.

General issues for the application of RS include cost (data and software) and capacity of human resources (technicians); collaboration, role distribution and commitment between stakeholders could solve those problems.

Remote sensing for management of Gunung Halimun Salak National Park

Werdi Septiana, Gunung Halimun Salak National Park

Gunung Halimun Salak National Park (GHSNP), the largest national park in West Java, is home to a rich biodiversity and a number of local communities. Managing these harmoniously with limited human resources is a big challenge for the park. Remote sensing has been demonstrated to be one of the most useful tools for sustainable planning, zoning, monitoring and updating to support the decisions of the GHSNP management. The park expects to apply the information gained for modelling forest cover change, soil erosion, biomass and habitat changes, etc. Wider use of remote sensing will require appropriate cooperation with researchers and improved skills among park officers. The feasibility of high-resolution images, such as Ikonos and QuickBird, is being evaluated carefully.

Participatory mapping for conservation in Mamberamo

Michael Padmanaba, CIFOR

Multidisciplinary landscape assessment (MLA) is a biodiversity survey tool developed by CIFOR that not only describes biodiversity but also examines its relevance and importance to local people. CIFOR and Conservation International (CI) applied MLA in Mamberamo, Papua, and overlaid the results with remote sensing tools. Participatory mapping was done by plotting important locations for the local communities on a base map provided by the Ministry of Forestry. The locations were then digitised and overlaid on a Landsat image. The product map represented the local priorities and perspectives on how the people manage their land for local livelihoods. Thus the map can be used to promote a key biodiversity area and local government can use it as a source of information for conservation goals in their sustainable spatial planning.

Remote sensing application for managing concession forest: experience of the management unit of PT Suka Jaya Makmur

Gusti Herdiansyah, PT Suka Jaya Makmur

The company PT Suka Jaya Makmur comes under PT Alas Kusuma Group West Kalimantan. The forest consists of 56,700 hectares of primary forest, 4,994 hectares of non-forest area and 109,646 hectares of logged over area. The company used Landsat imagery to support forest-related planning especially in the logged over area, harvesting planning and replanting activities.

We are also conducting vegetation interpretation for a 20-year general working plan, forest delineation and calculation of annual allowable cut. Landsat is used for planning activities such as general harvesting planning, opening the forest and building roads and skid trails.

The use of remote sensing technology is helping us in our implementation of intensive silviculture, such as for identifying degraded land, planting strips, nurseries, rivers and so on. We have validated some images related to monitoring the planted area under intensive silviculture, based on planted years. The major problem is finding a remote sensing specialist. Although the job is very important, it is difficult to retain a skilled person with poor incentives or a low salary.

4
Plenary discussion

Sonya Dewi, ICRAF

The previous presentations provided a great overview of natural resource management. They also introduced some cases of remote sensing used in landscape management, spatial planning issues and inter-organisational coordination and cooperation issues.

During the presentations, three common issues on landscape management arose. The first is the limited resources for management, which means we need planning to set priorities. The second is the trade-off between conservation and development. The third is the existence of many and different stakeholders within a landscape. In general, all management practice follows certain steps, i.e. identification, implementation and monitoring, which are tailored for specific management objectives. Interactions among stakeholders, horizontally and vertically, are the key to successful management.

We will start by making a long list of problems in landscape management in general, regardless of whether they are relevant to remote sensing and/or GIS. Then, we will discuss further what management actually requires of remote sensing. We will use this forum to build a bridge between users and remote sensing experts, who do not actually understand each other, for optimal implementation of the technologies.

Sonya Dewi is facilitating plenary discussion

Indrawan Suryadi, Tropenbos

I'd like to introduce our example of the GIS-Remote Sensing Forum. There are three background problems behind the establishment of the forum. First, subjectivity of interpretation: interpretations made by different interpreters using the same set of information result in different products.

Second, duplication of image data: it is a waste of money to purchase one image data set several times for different purposes/institutions. Rather, they should be shared through a data portal, which we call one portal information management. Third, inter-institutional issues: land management institutions/authorities use their own information types, which differ from each other. For a landscape to be managed as a whole, it is necessary for different institutions' information to be compatible. This issue can be addressed by discussion among GIS/remote sensing staff from different institutions; such discussions would be more effective if the staff can work together on the method and techniques.

The GIS-Remote Sensing Forum is a forum for facilitating discussion and coordination. As an environmental NGO, we can make only technical recommendations. The implementing agencies, e.g. Regional Development Planning Agency (Bappeda), have to apply those recommendations. In the forum, they do the implementation while we support them, and we are trying to make the various agencies' structures compatible.

Sonya Dewi

Different organisations have different purposes for the same data. Thus, the same image data can be interpreted in different ways. How can remote sensing experts help and coordinate the implementing agencies if the data are the same but the purposes or objectives are different?

Indrawan Suryadi, Tropenbos

Our common goal is better forest management in the future. Each of us is trying to fill a piece of a big puzzle. The most important point for us is to be aware of who is doing what and to share with the others what we are doing.

Syahrial Anhar, JICA

We work with national parks and support their management. To achieve management identifying and involving all stakeholders, data sharing is necessary. In the specific case of Gunung Halimun Salak National Park, although there is a will, we have not successfully shared information among the stakeholders to achieve synergies for better management.

Chandra Boer, Mulawarman University

We have an education forest in East Kalimantan. We have tried to demarcate the borders of the education forest together with the provincial government, but we have not been able to finish it. This is because of the lack of synchronisation of land management information among governments and the lack of political will in the governments to resolve the inconsistencies.

Michael Padmanaba, CIFOR

One constraint for data sharing is the authority of data. Although practitioners do want to share the data freely, the permission to release and share the data comes from a higher authority, which requires a prescribed application procedure.

Participant

The right to redistribute images to other parties depends on the image source and the type of licence with the image provider. The results of image interpretation can be released and shared with anyone without permission from the image provider.

Participant

When information is shared, feedback from users is critical. If someone uses our information, finds some defects in it and reports them to us, then we can correct and improve it. That should be the way to refine information at a much lower cost than re-making another set of information.

Participant

Gaps between what the users expect to see with remote sensing and what actually can be seen by remote sensing are another problem. Remote sensing cannot see everything on the ground, but sometimes users cannot understand that. This often results in ambiguity of definition and misunderstanding about the information produced.

Lilik Budi Prasetyo, IPB

I also see that there are misunderstandings about what is remote sensing and what is GIS. For example, remote sensing is strongly expected to find out something apparent on the ground, such as poverty. It seems essential for the project by Dr. Gen Takao for there to be a clear brief on what is actually remote sensing and GIS so that the users do not misuse them.

Sonya Dewi, ICRAF (summary)

From the presentations and the plenary discussion, we have identified two basic issues: data sharing and boundary demarcation. The constraints related to the issues are quite common: technical constraints, governance constraints (authority

and/or legal issues) and different scale requirements. Google Earth (in a previous presentation) is another interesting issue. Given that satellite imagery is expensive, why don't we use a free image source? We need to explore this option in detail.
We need to be cautious about the expectations of remote sensing. Remote sensing and GIS have not been optimally applied in operations, and we should avoid the false belief that remote sensing can solve all problems. Thus, we should clearly distinguish between what can be done by remote sensing and what cannot.

5
Focus group discussions

The participants were divided into three groups for in-depth discussions about how remote sensing can/should be applied in forest management. Each group was assigned a preliminary theme of discussion.

Group 1: Use of high-resolution images

Facilitator: Hari Priyadi (CIFOR)

Members: Andree Ekadinata (ICRAF), Atie Puntodewo (CIFOR), Hadi Haryanto (Inhutani II), Diah Irawati (JICA), Indrawan Suryadi (Tropenbos), Kuswandono (GHSNP)

The group started the discussion with an exercise in identifying ground objects in an example high-resolution image of Bogor Botanical Gardens (Kebun Raya Bogor), an 80 ha area of gardens comprising trees and plants as well as greenhouses, research facilities, ponds and rivers, in the city centre. Members identified settlements, land for conservation area, construction, streams, river, canopy trees, trees, park, streets, railway/railroads, clouds, agricultural areas and so on.

Satellite image of Bogor Botanical Garden

They then discussed their intentions and/or impressions about how they could use such images for their management activities. Suggested activities for application included spatial planning, monitoring, city development planning, hydrological analysis and flood hazards, fauna monitoring, erosion and landslide analysis, counting the number of villages and planning transportation networks. Ideally, they noted, a management body would carrying out all the steps, from purchasing images to analysing them and doing mapping for presentations, but in reality few management bodies have that capacity. Members agreed they needed to consider both capacity building of the staff and outsourcing if appropriate.

The last issue related to the cost and time. The group discussed solutions such as collaborating with data providers (e.g. Eros Data Center) and finding free data sources, such as from China and Brazil.

Report from Group 1

1. The interpretation of high-resolution images
   Based on the information in an example image of Bogor Botanical Gardens, participants noted such information could be used to:
   a. identify land coverage, settlements, vegetation, main rivers and conservation areas, which are useful for spatial planning and monitoring.
   b. identify streams, main rivers, canopy trees, main streets, slopes and land cover for city development planning, hydrological analysis and flood hazards, fauna monitoring, erosion and landslide analysis.
   c. identify objects such as trees, parks, streets, railway/railroads, clouds and agricultural areas for transportation networks.
   d. identify settlements, paddy fields, public buildings, the palace to estimate the number of villages or official buildings.

2. Image accuracy is important. If the image is accurate enough, it can be useful for:
   a. programme design, interpretation guidelines
   b. providing early warning systems for city evacuation plans
   c. developing plans for manageable tourism.

Group 2: Capacity building

Facilitator: Lilik B. Prasetyo (IPB)

Members: Sonya Dewi (ICRAF), Michael Padmanaba (CIFOR), Gusti Herdiansyah (Alas Kusuma), Syahrial Anhar (JICA), Wardi Septiana (GHSNP), Prabani Setiohindrianto (GPNP)

The group discussed ways to improve users' capacity. They also discussed the cost of spatial data.

The question about users' capacity was broken into three parts.

The first question was how to build users' capacity. Members remarked that good manuals/handbooks and well-designed training workshops were indispensable for the users. The workshops would need to cover adequately both the general concepts of the technology and the specific needs of management. Instruction in software-dependent procedures without also covering the principles of the technology would not help users apply the software by themselves. On-the-job training and the training of trainers are important for embedding the capacity on the ground. Some members pointed out that the relocation and/or transfer of trained staff often hinder efforts to build and/or sustain the institutional capacity of a management body.

The second question examined the level to which the capacity of users in a management body needs to be raised to handle spatial data. For regular management operations, usually simple analyses, e.g. overlaying and displaying a set of spatial data, are enough. However, advanced capability, e.g. depicting hazardous areas by modelling, can contribute to a more efficient management. The training should move from the basic to the advanced, with the basic level covering the regular requirements of the management.

In depth discussion during brain storming in the group

The third question was whether the outsourcing of GIS operations was necessary. One member argued that outsourcing would be suitable if the GIS operation was rare and complex. Another member argued, however, that if the operation is rare but still regular in an everlasting forest management it should be done by staff. Another consideration was that outsourcing might be expensive and it would not contribute to the staff's capacity building. Thus, members agreed outsourcing should be cautiously introduced in necessary management tasks.

An additional question was how to obtain spatial data at a minimal cost. Members agreed the key is for multiple concerned institutions to share the costs, which can be achieved by also sharing information among them. Although redistribution of raw satellite images is prohibited by copyright, secondary information created from the images by the users can be disclosed and shared with the public, especially if it concerns public land. Greater cooperation among concerned institutions should be encouraged. In addition, members expect mapping agencies to provide more easily accessible accurate data as data infrastructure.

Report from Group 2

1. Human resource capacity can be enhanced by:
   a. creating and distributing useful manuals using Open Source Software.
   b. general training for special purposes with on-the-job-training and the training-the-trainers approach. The level of training would depend on user requirements, ranging from basic to simple spatial analysis.
2. Outsourcing is needed to compensate for the unavailability of an operator or analyst, but it should be limited because it reduces opportunities to enhance an organisation's internal capacity.
3. The cost of data acquisition can be reduced by:
   a. promoting data sharing and
   b. developing collaboration among multiple concerned institutions, including mapping agencies, to encourage data sharing.

Group 3: Reducing the costs and time of remote sensing operation

Facilitator: Wim Ikbal Nursal (CIFOR)

Members: Agus Salim (CIFOR), Bakhtiar Santri Aji (JICA-GHSNPMP), Rini P. Kirana (PT Komatsu), Chandra Boer (Universitas Mulawarman), Dhamsir Chaniago (WARSI)

The group discussed ways to reduce the costs and time of using RS/GIS, which often compete with each other. The group focused on three aspects: human resources, data, and software and hardware. Recommendations were drawn from the participants' experiences with each aspect.

Human resources. Members agreed that using RS/GIS is challenging because of costs and time; for managers to learn RS/GIS is a difficult and time-consuming process, while training by specialists is costly. Recruitment of external human resources, e.g. RS/GIS operators for data handling and processing or ground-truthing activities, is also expensive. Members also mentioned that knowledge gaps between the forest/land managers and RS/GIS experts, i.e. each side not fully understanding what the other could/wanted to do, hampered efficient image interpretation.

Data. Members felt that accurate images, especially of a high resolution, could help and improve their management, but such images were rarely available for them because of their high prices. Members noted that data processing and maintenance are costly also.

Software and hardware. Members noted that the cost of software and hardware discourages them from keeping them updated. However, members admitted they are reluctant to start using open source/free software because they do not want to waste time learning that software, which tends to have a less user-friendly design, despite their interest in inexpensive software.

Report from Group 3

1. Human resources
    a. Continual and mutual capacity-building programmes between RS/GIS experts and users are recommended. Such programmes would not work as a one-way transfer of RS/GIS skills and knowledge to users, but rather would contribute to both of them mutually understanding the demands of management and the capability and limitations of RS/GIS.
    b. Even if new staff recruitment is limited, employing a few RS/GIS operators with specific skills, such as interpretation, data entry and analysis, would promote the efficiency of RS/GIS operation in the organisation.

2. Data
    a. To share the acquired knowledge with related organisations and avoid duplicate investment, those organisations are encouraged to agree on and promote a data-sharing policy and protocol. Institutional barriers for data sharing, e.g. copyright, authorities or licences, should be appropriately addressed and overcome for overall efficiency.
    b. There is a need to revitalise the role of data centres (such as BAPLAN, BAKOSURTANAL and PIKA) as public data providers.
3. Software and hardware
    a. Practical guidebooks for using RS/GIS software, especially on open source/free software, are desired.
    b. It is worth seeking the use of open source/free software despite its less friendly design, especially for those organisations that cannot afford expensive commercial software.
    c. Careful maintenance and use of hardware would prolong its life.

6
Summary and recommendations

Lilik B. Prasetyo (IPB) and Gen Takao (CIFOR)

Today, we, foresters, government officials, activists, scientists and engineers, gathered at CIFOR to discuss the operational role of remote sensing in landscape and forest management. Our aim was to discuss the theme from the viewpoint of (potential) remote sensing users who had implemented (or wanted to implement) the technique in their own forest/land management. Sharing experiences and expectations for remote sensing during a preliminary questionnaire, presentations and plenary discussion, the participants noted that cooperation among the various actors is quite important, and specifically raised the following issues.

1. It is necessary to bridge the gap between RS users and experts.
2. Collaboration among institutions is key for effective implementation and capacity building of RS users.
3. Reliable official information infrastructure, such as administration boundaries, is indispensable for building meaningful management systems.
4. Costs can be reduced in part by using open/free/shared software/data.

In the focus group discussions, participants were divided into three groups, each of which discussed a different theme.

Group 1. Using high-resolution images
Group 2. Building capacity in remote sensing
Group 3. Reducing the costs of remote sensing

The resulting recommendations are as follows.

1. Users should be empowered to monitor their forest/land using the technology themselves; outsourcing of the monitoring should be seen as a last option.
2. Appropriate capacity building is required for users.
3. Ready-for-use materials, i.e. software and/or data, supplied through the Internet and computer media, e.g. CD-ROM or DVD, are required for dissemination and cooperation among users.
4. To share software and/or data among organisations, different organizations' requirements should be coordinated, and the authority of the software/data should be respected.
5. High-resolution images are an effective tool for monitoring forest and land. Its effective implementation by management depends on how and how much the users and experts can interpret the images appropriately.

7
Considerations and conclusion

Gen Takao, CIFOR

The discussions revealed that, despite a wide range of experiences with and expectations of RS for forest/land management and a shared view that RS was the only means to monitor a wide area, several constraints prevent the implementation of RS. Many of these were institutional rather than technical, and have been already identified by many experts (Wynne *et al.* 1997; Holmgren *et al.* 1998; Franklin 2001). However, they remain unresolved, possibly because RS experts have not taken the institutional constraints into consideration. Taking such institutional constraints into account could result in a new technical framework for satellite monitoring systems.

The biggest concerns shared by the respondents were cost reduction, capacity building and information sharing. The costs include those of images, software and ground truths. Capacity building is necessary so that users can apply the technology with confidence.

Utilising information from remote sensing before going to the field for survey

Information sharing arose as a key issue for solving these constraints. Data sharing could avoid duplicate investment and knowledge sharing could improve users' capacity. Sharing the resultant maps should be the first step, but it would be effective only if the legends are compatible among the sharing institutions. Sharing raw satellite images would be a direct means of reducing costs. Sharing ground truths would not only contribute to reducing costs but also make the cooperation among the institutions more flexible and interactive. Above all, sharing the value of RS and GIS is important, and it is the role of RS experts to facilitate such sharing. One good example is a local GIS/RS forum, introduced by a participant, which called on local officials from different departments and sectors to share their information about RS and GIS and coordinate the data platform.

Managers are interested in image interpretation, particularly of high-resolution images, because they can do it intuitively by projecting their abundant empirical knowledge on the land under their management. Such empirical knowledge is exclusive to those who are familiar with the land and rarely accessible for outsiders. Thus, it should be used for image analysis proactively and repeatedly. Bayesian inference is one way to use such empirical information (for example, Reguzzoni *et al.* 2003; Vaiphasa *et al.* 2006). Such empirical knowledge would also be stored as a likelihood distribution as a function of spectral/geographical/landscape attributes so that the available knowledge can be combined with the user's judgement. Furthermore, any type of existing information, such as the thematic maps of the past, can be combined in the same manner. The accuracy of the results could be evaluated objectively with an independent set of ground truths, as mentioned later.

Low accuracy of RS data was identified as a potential constraint for operational use by only two participants, both of who were from forestry companies that wanted to replace some of their ground inventories with RS. Quantitative accuracy at a given compartment is very important for them; therefore, the monitoring system should be carefully designed to meet their demands as much as possible. For other participants, especially those who wanted to use the resultant maps for land use planning, we wonder if accuracy is out of the question. There have been countless scientific and technical reports on landscape analyses that use land use/land cover maps from satellite images with inappropriate accuracy assessments or without assessment at all. We have found that even RS and/or GIS experts do not always deal with the accuracy assessment properly. For sound RS implementation in operational management, an objective and systematic assessment system with adequate ground truths is required.

Ground truths are indispensable for transparent evaluation but are expensive and time consuming; managers cannot afford the time and money required for this extra task (Sheil 2001). Thus, ground-truth collection should be embedded in their regular activities. The items to be measured should be limited to stand parameters that managers are familiar with (Danielsen *et al.* 2005) and that the satellite can observe from above. Unobservable parameters should be estimated using models independent from RS; otherwise, the estimation and evaluation of such parameters can be applicable to local areas only (Foody *et al.* 2003). Sharing ground truths among stakeholders/neighbours would help reduce the costs. To make it work well, ground-truth plans should be coordinated among them, which should be another role of RS experts.

Capacity building is the most important process for disseminating RS in operational management. The participants indicated a preference to build their own capacity rather than outsource the analyses despite their limited resources, because they wanted their own eyes to keep watching their lands. To respond to their requirements, RS experts should develop technologies that are as simple and inexpensive as possible, and not only transfer the technologies but also consult with users to tailor a system, with experts and users interactively learning from each other.

In conclusion, we identified from the discussion with forest managers and RS experts that cost reduction, capacity building and information sharing were the most important issues to be addressed when disseminating RS for operational forest/land management. RS has been developed as a professional tool that requires special skills by experts. It is clear from the discussion, however, that appropriate technology, or intermediate technology (Schumacher 1973), is also now required for the implementation of RS in operational forest/land management with professional managers.

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Annex 1. List of participants

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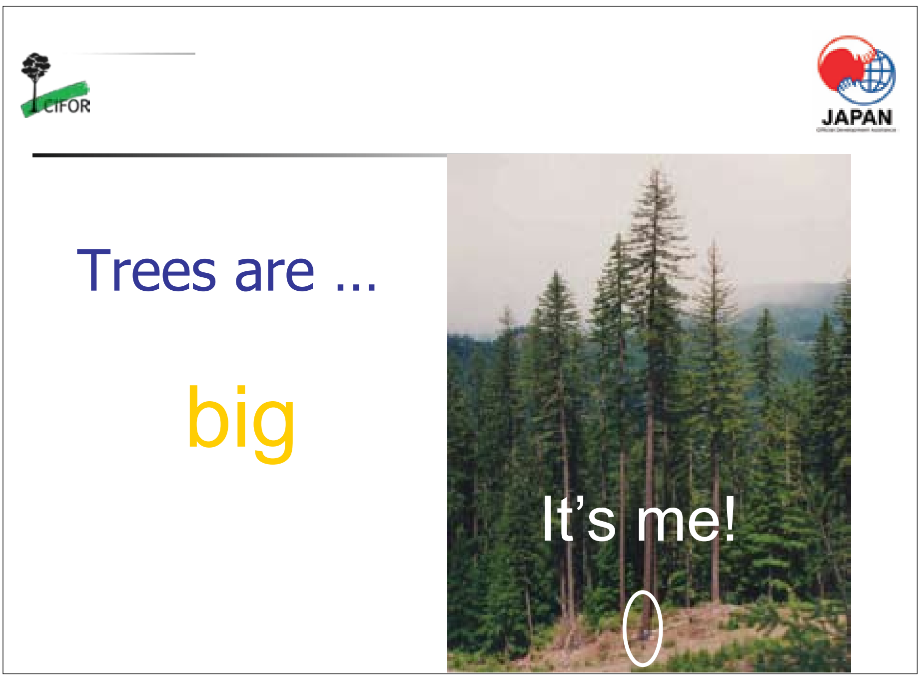
Annex 2. Agenda

Time	Events	
08.30–09.00	Registration	
09.00–09.15	Opening remarks	
	Environmental Services Programme Director, CIFOR	Dr. Markku Kanninen
	Research Project Leader	Dr. Gen Takao
09.15–09.45	Presentation on 'Forest/landscape management & remote sensing' by Dr Gen Takao, CIFOR	Moderator: Atie Puntodewo
09.45–10.00	Discussion	
10.00–10.15	Presentation by Dr. Lilik B. Prasetyo, Faculty of Forestry, IPB	
10.15–10.30	Presentation by Indrawan Suryadi, Tropenbos International	
10.30–10.45	*Coffee break*	
10.45–11.00	Presentation by Damsir Chaniago, WARSI	Moderator: Dr. Chandra Boer
11.00–11.15	Presentation by Wardi Septiana, Gunung Halimun Salak National Park	
11.15–11.30	Presentation by Michael Padmanaba, CIFOR	
11.30–11.45	Presentation on 'Pengalaman IUPHHK SJM dengan Penginderaan Jauh (Citra Landsat)' by Gusti Hardiyansyah, PT Alas Kusuma	
11.45–12.15	Discussion	
12.15–13.30	*Lunch break*	Cafeteria
13.30–13.45	Notes on joint discussion	Dr. Gen Takao
13.45–14.45	Joint discussion: *Monitoring for management*	Facilitators: Dr Sonya Dewi, Dr. Gen Takao
14.45–15.00	*Coffee break*	
15.00–16.00	Group discussion: *Special topics*	Facilitators: Dr. Lilik B. Prasetyo, Hari Priyadi, Wim Ikbal
16.00–16.30	Group presentations	Moderator: Hari Priyadi
16.30–17.00	*Break – GIS Lab Visit (optional)*	Wim Ikbal, Andree, Atie Puntodewo
17.00–17.30	Conclusion and recommendation, Closing	Dr. Lilik B. Prasetyo and Dr. Gen Takao
17.45–18.15	*Buka puasa bersama*	Outside Amazon room
18.15–19.30	*BBQ dinner*	Pool side

Annex 3. Presentations

1. Forest/landscape management and remote sensing

Gen Takao, CIFOR



CIFOR

JAPAN

Measurement is

a hard job

CIFOR

JAPAN

Visibility is

limited

Area is vast

Remote Sensing of Forest

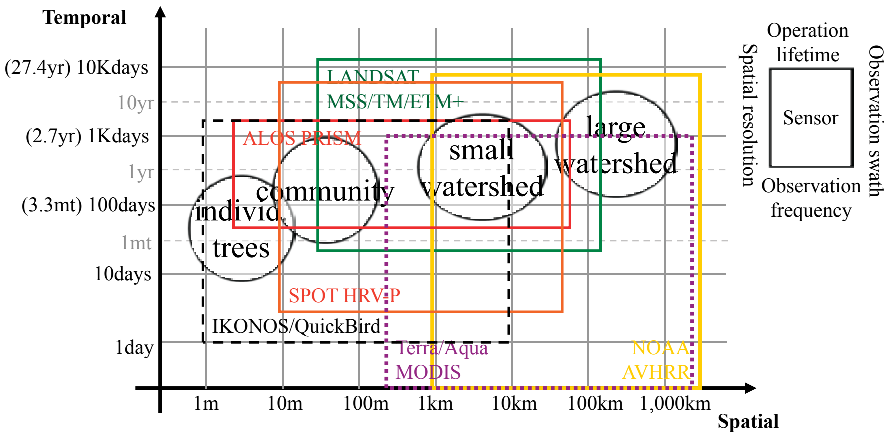
- simultaneity
  - can observe remote area at once
- periodicity
  - can observe repeatedly
- recordability
  - can observe retrospectively

Contents

1. Remote Sensing Today
2. What are the constraints for applying RS to the forest/landscape management?
3. Another approach for the real management
4. Expectation to today's Discussion

1. Remote Sensing Today

Temporal & spatial scales of the sensors



Remote sensing is up!
Inventory & monitoring

- Inventory
  - To describe the current status of forest
    - Landcover / landuse classification
    - Forest structure / functionality estimation
- Monitoring
  - To trace temporal changes of forest
    - Expectable changes: growths, management activities
    - Unexpected changes: disasters, illegal activities

Modern sensors

- Optical (excl. thermal)
  - High spatial resolution
  - Hyperspectral
  - Aerial photo
- Radar (SAR; Synthetic Aperture Radar)
- LiDAR (Light Detection And Ranging)
  - Large footprint
  - Small footprint

Optical – High spatial resolution

- Able to identify individual tree crowns
  - Count trees
  - Measure sizes (from above!!!)
  - Interpret forest structure
  - Accurate locating by GPS

SAR
Synthetic Aperture Radar

- Active sensor using microwaves
- Waves penetrate much smaller objects than their wavelengths
  - Waves can penetrate **rain, clouds**
  - Shorter waves cannot penetrate the surface of forest canopies
    - X band: 3.24 cm ~ small leaves
    - C band: 5.66 cm ~ middle leaves
    - L band: 24.0 cm ~ big leaves, trunks
    - P band: 68.1 cm ~ big trunks
- For forests,
  - Canopy detection
  - Volume estimation

SAR

- Available sensors
  - Space-borne
    - RADARSAT (C)
    - ALOS PALSAR (L)
    - JERS1 SAR (L)
    - TerraSARX (X) (to be launched)

How much are them?

Imagery	Corretion Level/ Product Type	Spatial Resolution	Price (US$)	Notes
QuikBird	Standard	0.6 m	18/km2	min.25 km2
	OrthoStandard	0.6 m	18/km2	min.25 km2
IKONOS	GeoOrthoKit	1.0 m	27.5/km2	min.100 km2
	Orthorectified	1.0 m	36/km2	min.100 km2
SPOT5 HRG	Level1A/1B/2A (Scene)	10m/5m	3900	60x60km
SPOT5 HRG	Ortho	10m/5m	4800	55x55kkm
Landsat 7 ETM+	1G	30m/15m	600	Full Scene 185 km X 172 km
Landsat 5 TM	1G	30m	425	Full Scene 184 km X 172 km
Landsat MSS	system corrected	80m	200	Full Scene 184 km X 172 km
TERRA ASTER	Level 1A/1B/2	15m	75	60 km x 60 km
TERRA ASTER	Ortho	15m	150	60 km x 60 km
TERRA ASTER	Level 1A/1B	15m	98	60 km x 60 km
ALOS PRISM		2.5m	500	35km x 35km
ALOS AVNIR-2		10m	500	70km x 70km
ALOS PALSAR		10 - 100m	500	30km - 350km

2. What are the constraints for applying RS to the forest/ landscape management?

Remote Sensing for the Real World

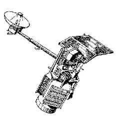
Remote sensing has not yet succeeded in the practical world – the world of application.

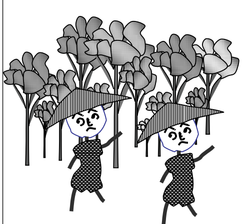
Franklin (2001)
"*Remote Sensing for Sustainable Forest Management*"

- Why?
- How can we overcome?

What do we want from RS data?

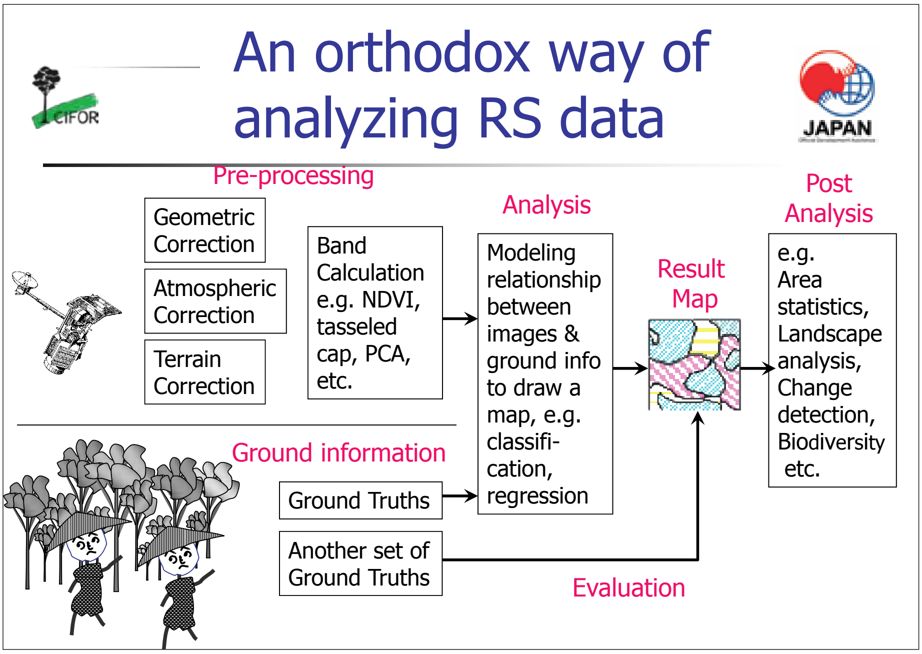
Post Analysis

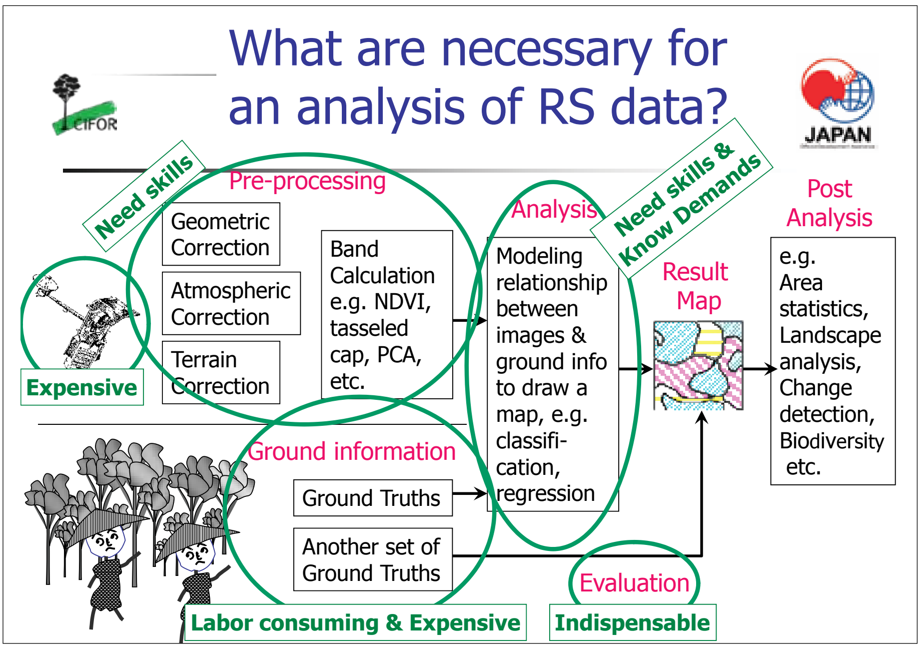


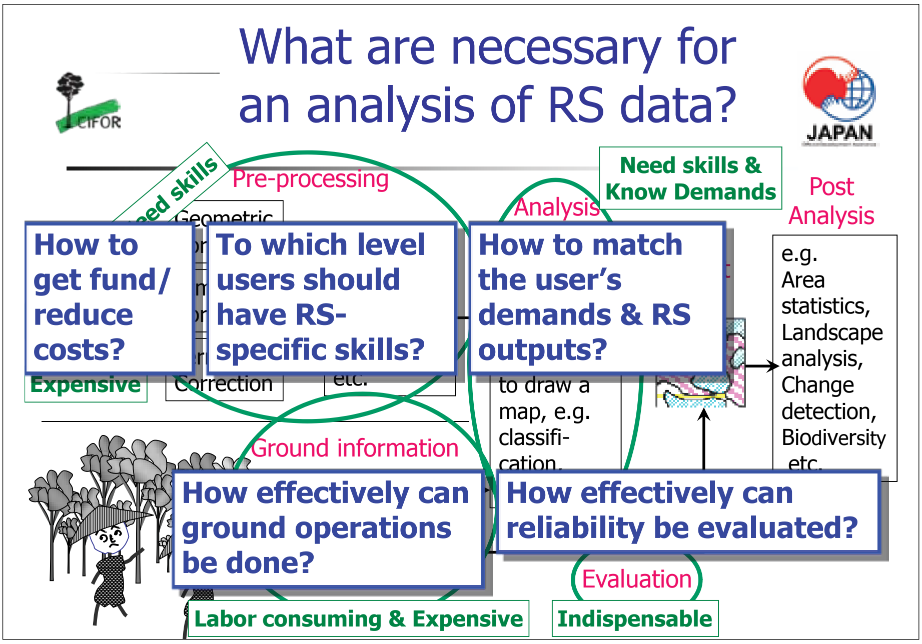


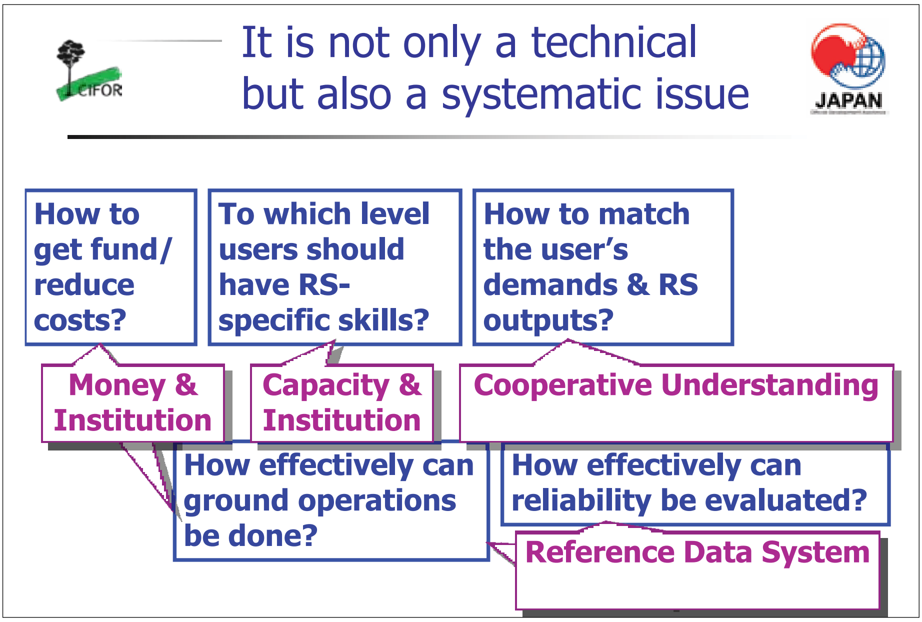
Result Map

e.g.
Area statistics,
Landscape analysis,
Change detection,
Biodiversity
etc.


An orthodox way of analyzing RS data
CIFOR
JAPAN
Pre-processing
Geometric Correction
Atmospheric Correction
Terrain Correction
Band Calculation e.g. NDVI, tasseled cap, PCA, etc.
Analysis
Modeling relationship between images & ground info to draw a map, e.g. classifi-cation, regression
Result Map
Post Analysis
e.g. Area statistics, Landscape analysis, Change detection, Biodiversity etc.
Ground information
Ground Truths
Another set of Ground Truths
Evaluation


What are necessary for an analysis of RS data?
CIFOR
JAPAN
Need skills
Pre-processing
Geometric Correction
Atmospheric Correction
Terrain Correction
Band Calculation e.g. NDVI, tasseled cap, PCA, etc.
Expensive
Analysis
Need skills & Know Demands
Modeling relationship between images & ground info to draw a map, e.g. classifi-cation, regression
Result Map
Post Analysis
e.g. Area statistics, Landscape analysis, Change detection, Biodiversity etc.
Ground information
Ground Truths
Another set of Ground Truths
Evaluation
Labor consuming & Expensive
Indispensable


What are necessary for
an analysis of RS data?
CIFOR
JAPAN
Need skills
Pre-processing
Geometric
Correction
Expensive
Need skills &
Know Demands
Analysis
Post
Analysis
How to
get fund/
reduce
costs?
To which level
users should
have RS-
specific skills?
How to match
the user's
demands & RS
outputs?
e.g.
Area
statistics,
Landscape
analysis,
Change
detection,
Biodiversity
etc.
etc.
to draw a
map, e.g.
classifi-
cation.
Ground information
How effectively can
ground operations
be done?
How effectively can
reliability be evaluated?
Evaluation
Labor consuming & Expensive
Indispensable


It is not only a technical
but also a systematic issue
CIFOR
JAPAN
How to
get fund/
reduce
costs?
To which level
users should
have RS-
specific skills?
How to match
the user's
demands & RS
outputs?
Money &
Institution
Capacity &
Institution
Cooperative Understanding
How effectively can
ground operations
be done?
How effectively can
reliability be evaluated?
Reference Data System

3. Another approach for the real management

Issues to be tackled

- Money & Institution
- Capacity & Institution
- Cooperative Understanding
- Reference Data System
  - for modeling
  - for evaluation

Group Discussion

Landcover translation

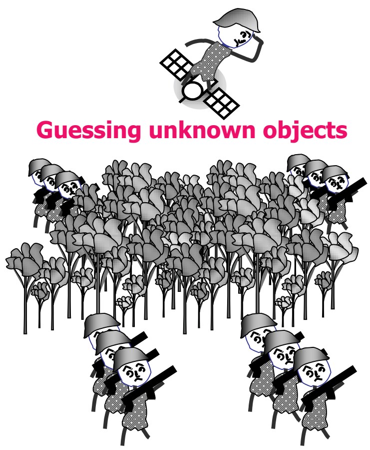
Reflecting knowledge by interpretation

Systematic permanent samples

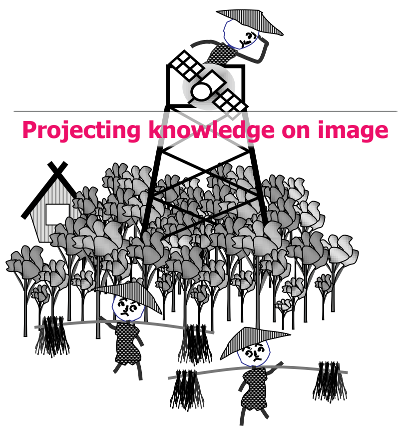
Landcover translation

- Carefully & cooperatively create a table to translate between
  - What can be seen by RS
  - Local classification system
- To limit RS to estimate only what it can see directly.

Reflecting knowledge by interpretation



Orthodox interpretation

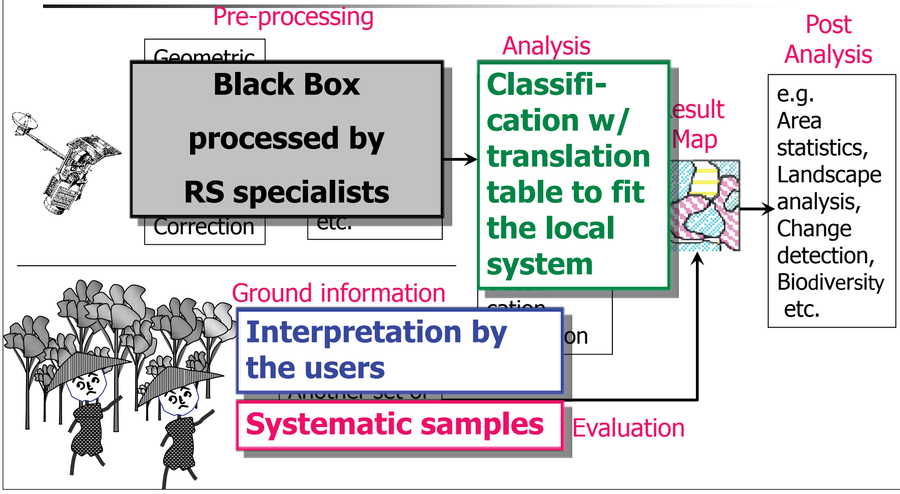


Another interpretation

Systematic permanent samples

- As a basic platform of ground information
  - many small plots scattering over the area
  - regularly measured
    - labor & cost dispersion
- Evaluation is indispensable
  - better combine with regular ground operations
  - Any other good idea?

An orthodox way of analyzing RS data



Possible applications

- Class area estimation
  - Enhanced by evaluation samples
- Carbon balance
  - Stratified sampling with ground info
- Disturbance history
  - Change detection
- Disturbance risk
  - Landscape analyses on GIS
- Succession estimation
  - From discrete estimation to continuous

4. Expectation to today's Discussion

Purpose of the Discussion

- Learn from each other the forest/landscape management & remote sensing
- Figure out the constraints that hamper the dissemination and propose possible solutions

Goal of the Discussion

- Conclusion – management & RS
  - The most urgent issues to be solved by RS
  - The most likely issues to be solved by RS
- Recommendation
  - How to make cooperation among different sectors to solve the problems above?

What I'd like to learn

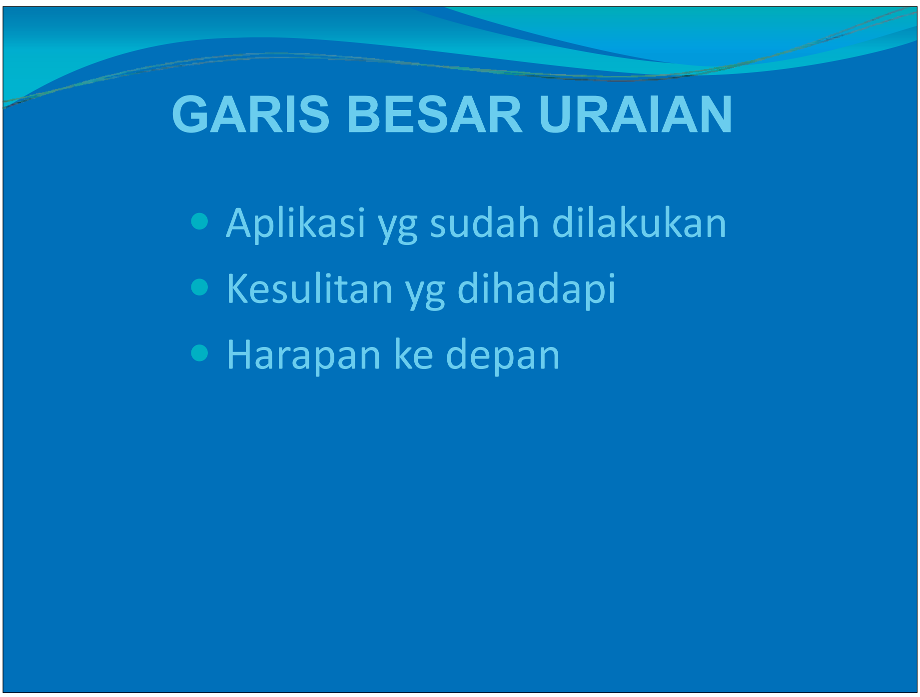
- Management & monitoring issues hot in varied fields of management
- I hope to contribute the ideas of RS

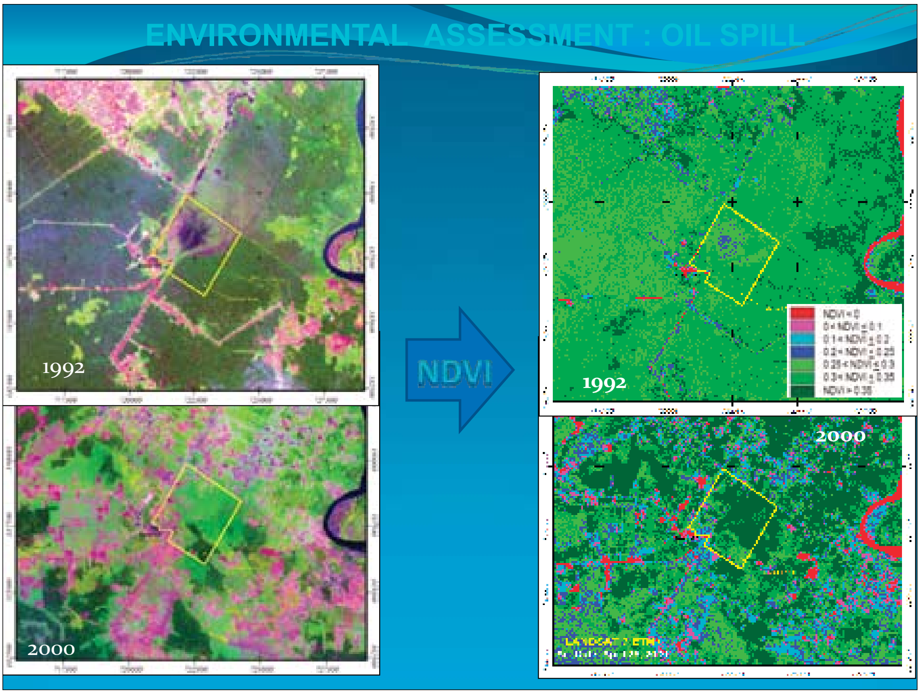
Conclusion

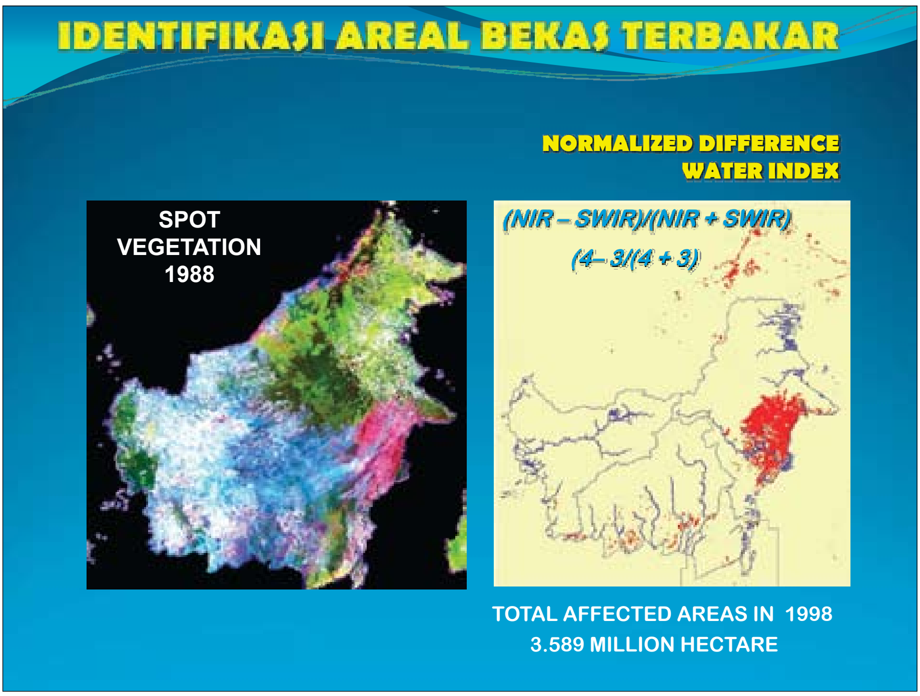
- There have been many tools & methods of remote sensing
- But, they are not actually applied in the real forest/land management, especially in FMU level
- There are not only technical but also system problems
- Today, I'd like to clarify the gaps between the techniques and the demands

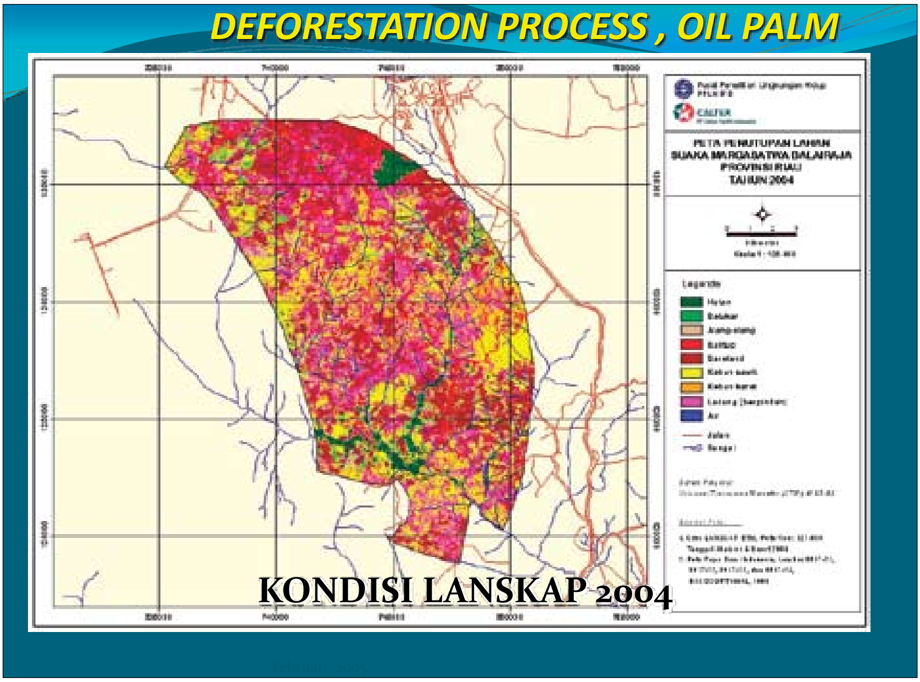
2. Remote sensing application for forestry and environmental management

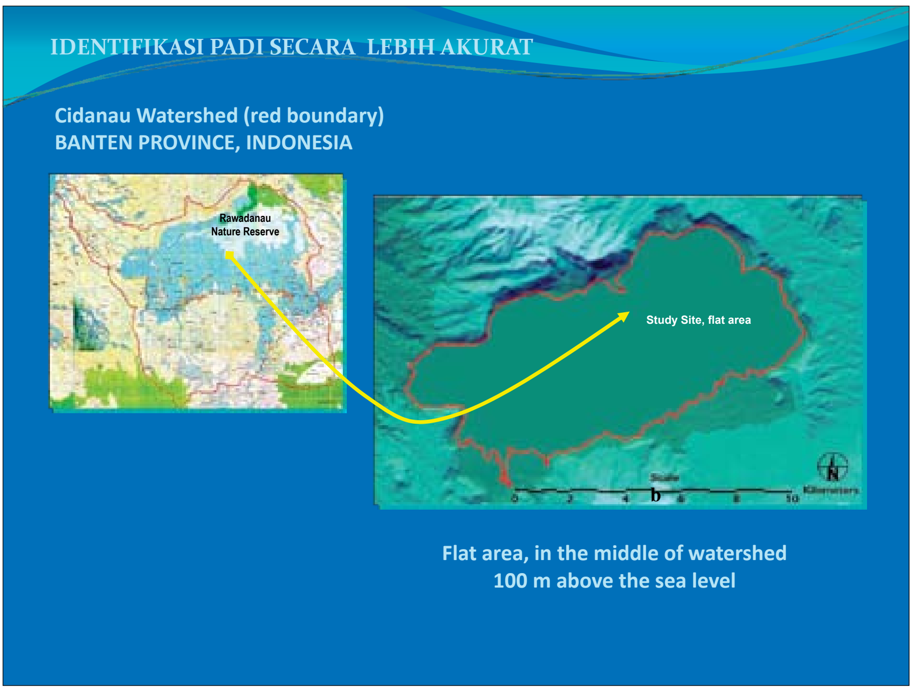
Lilik Budi Prasetyo, Faculty of Forestry, Bogor Agricultural University

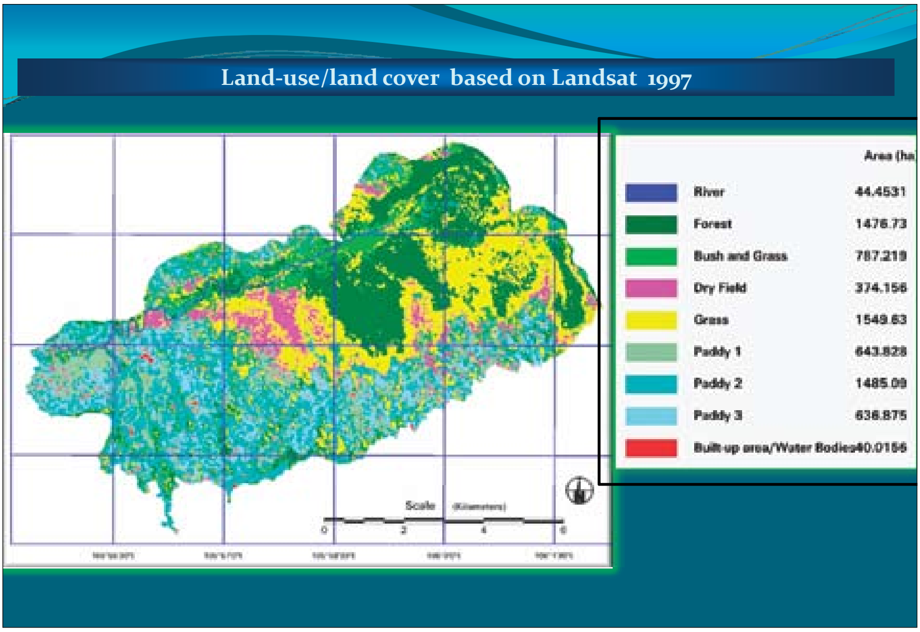


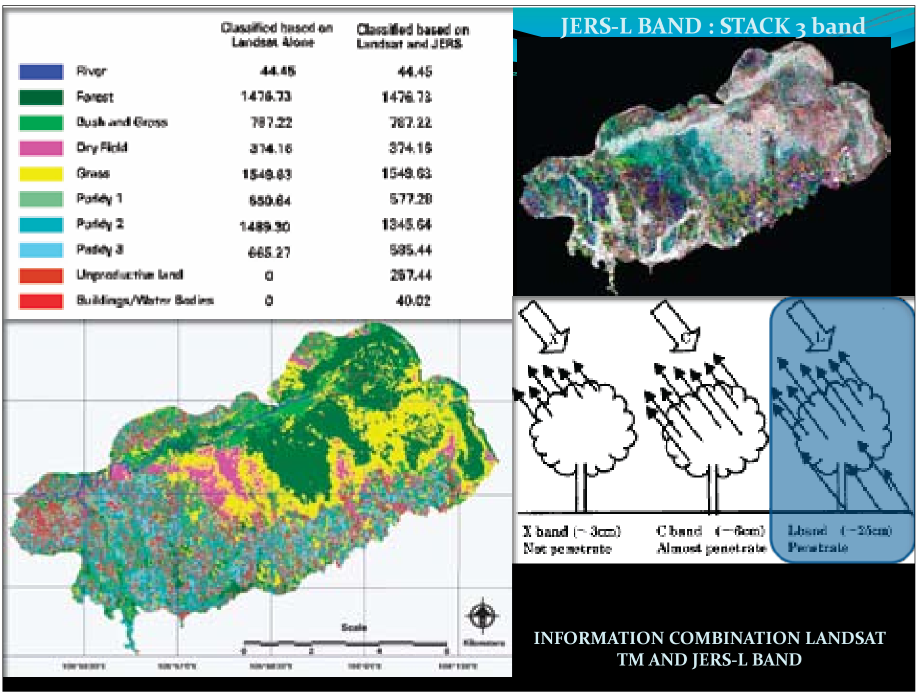

ENVIRONMENTAL ASSESSMENT : OIL SPILL
1992
2000
NDVI
1992
2000

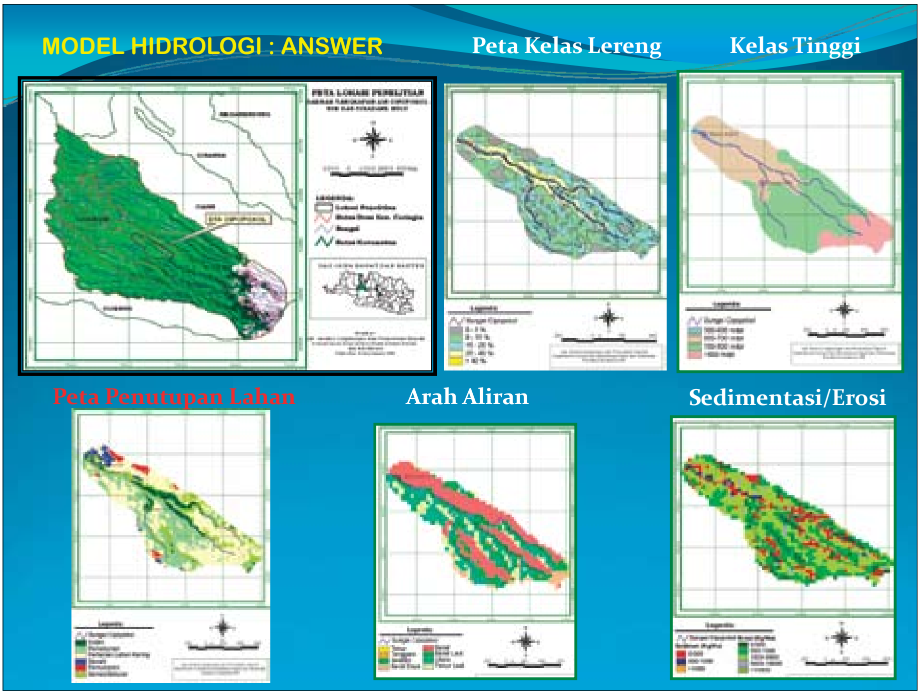

IDENTIFIKASI AREAL BEKAS TERBAKAR
NORMALIZED DIFFERENCE
WATER INDEX
SPOT
VEGETATION
1988
(NIR – SWIR)/(NIR + SWIR)
(4– 3/(4 + 3)
TOTAL AFFECTED AREAS IN 1998
3.589 MILLION HECTARE


DEFORESTATION PROCESS , OIL PALM
KONDISI LANSKAP 2004

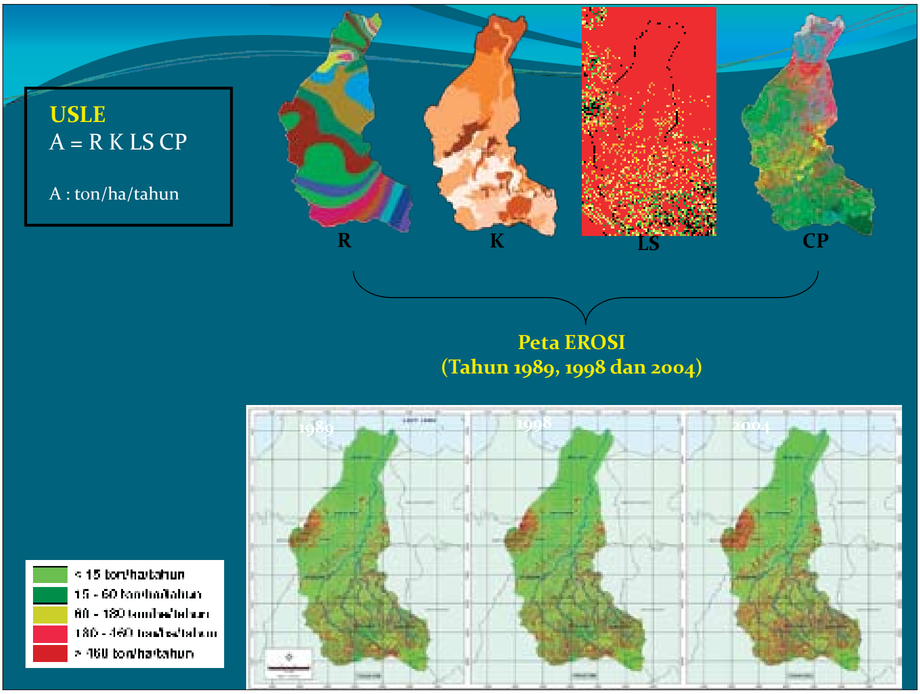

IDENTIFIKASI PADI SECARA LEBIH AKURAT
Cidanau Watershed (red boundary)
BANTEN PROVINCE, INDONESIA
Rawadanau Nature Reserve
Study Site, flat area
Scale
Kilometers
Flat area, in the middle of watershed
100 m above the sea level

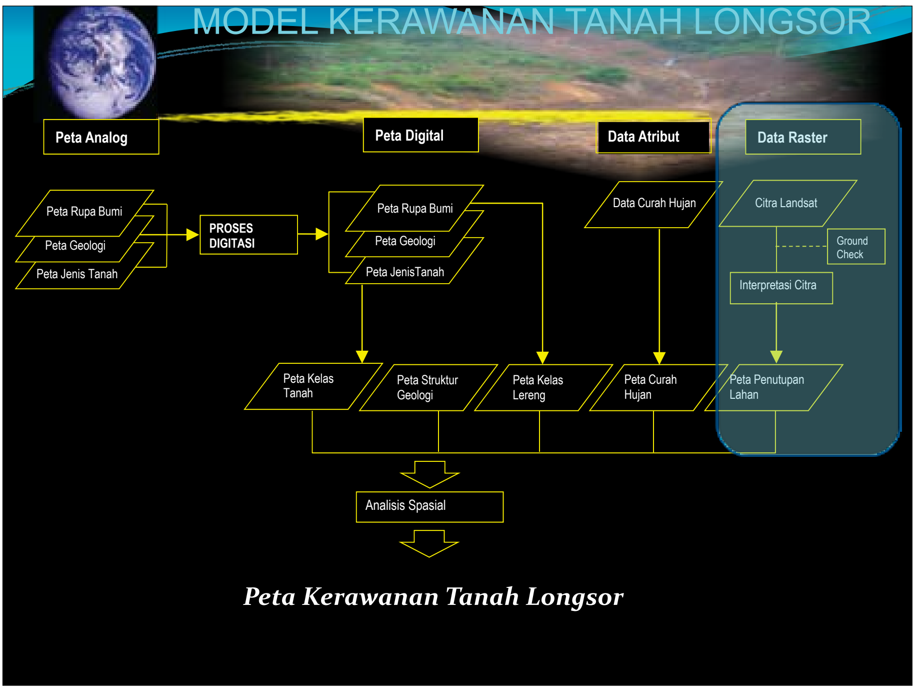

Land-use/land cover based on Landsat 1997
Area (ha
River 44.4531
Forest 1476.73
Bush and Grass 787.219
Dry Field 374.156
Grass 1549.63
Paddy 1 643.828
Paddy 2 1485.09
Paddy 3 636.875
Built-up area/Water Bodies40.0156
Scale (Kilometers)
0 2 4 6

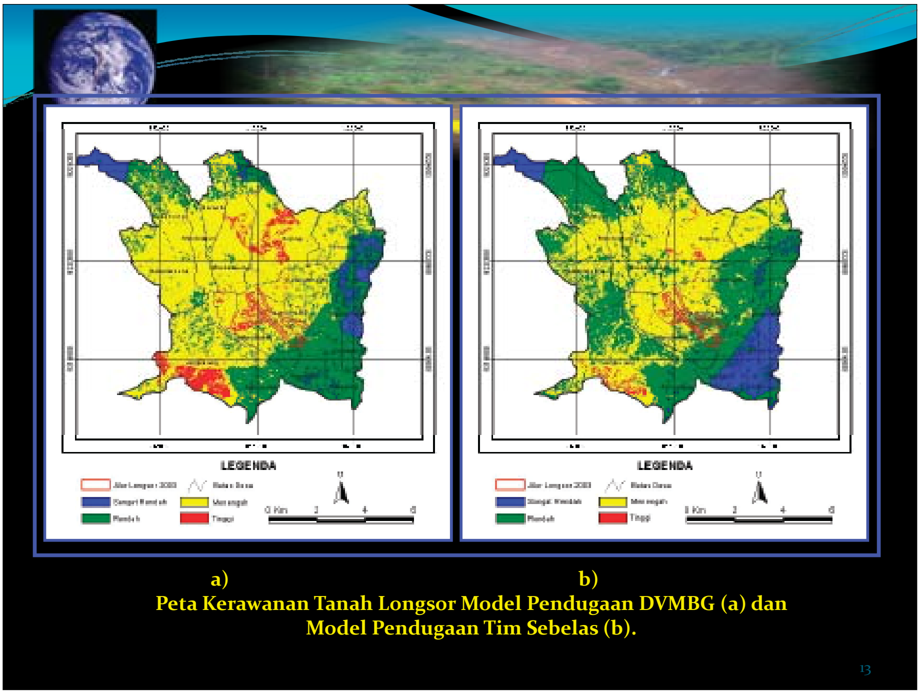

Classified based on Landsat Alone
Classified based on Landsat and JERS
River 44.45 44.45
Forest 1476.73 1476.73
Bush and Grass 787.22 787.22
Dry Field 374.16 374.16
Grass 1549.63 1549.63
Paddy 1 650.64 577.20
Paddy 2 1489.30 1345.64
Paddy 3 665.27 585.44
Unproductive land 0 267.44
Buildings/Water Bodies 0 40.02
JERS-L BAND : STACK 3 band
X band (~3cm) Not penetrate
C band (~6cm) Almost penetrate
L band (~25cm) Penetrate
Scale
INFORMATION COMBINATION LANDSAT TM AND JERS-L BAND

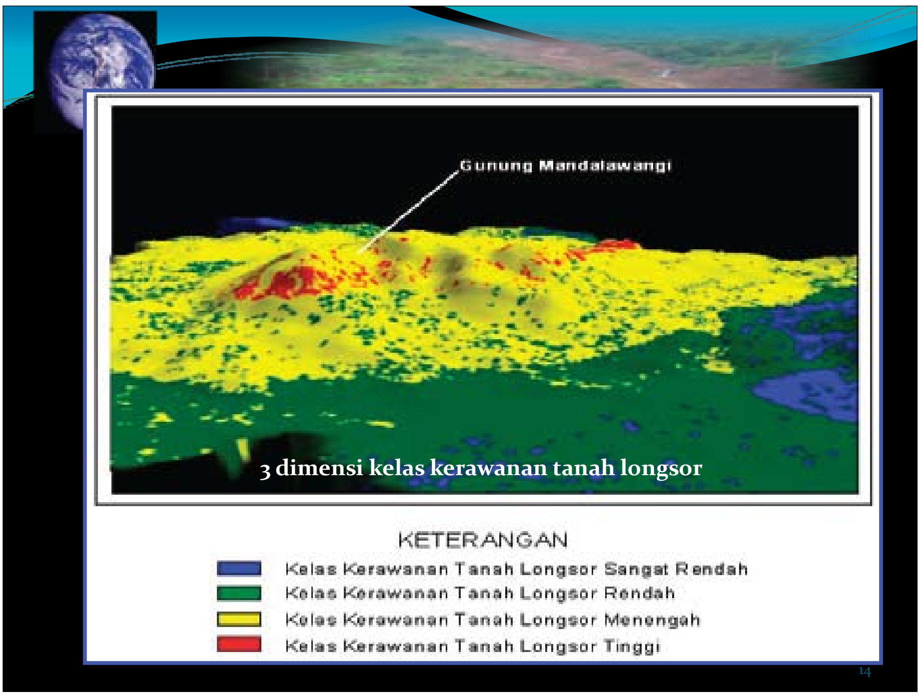

MODEL HIDROLOGI : ANSWER
Peta Kelas Lereng
Kelas Tinggi
Peta Penutupan Lahan
Arah Aliran
Sedimentasi/Erosi

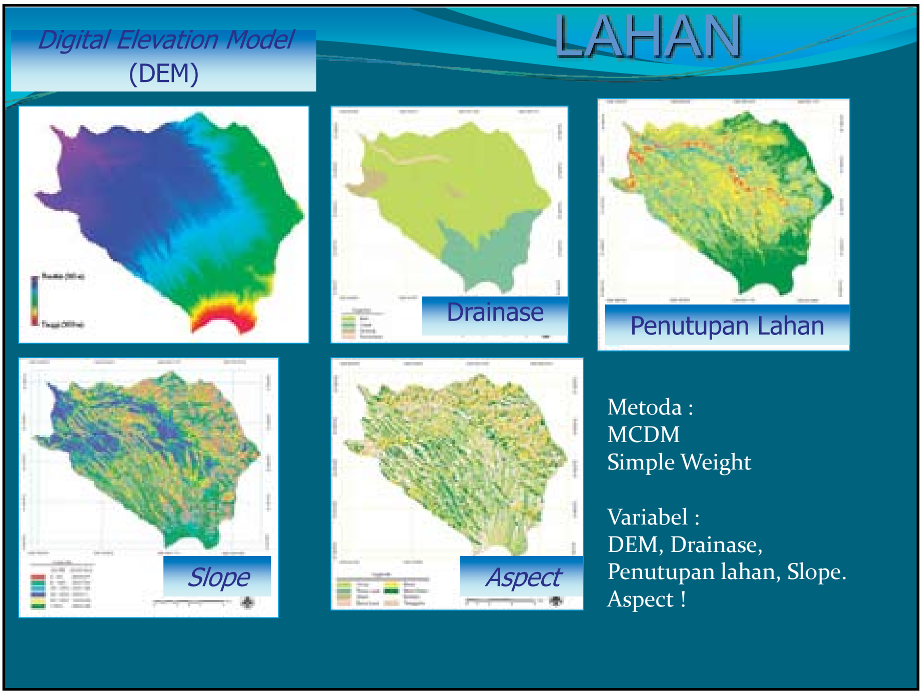

MODEL HIDROLOGI : USLE
DAS Ciujung
Terbagi menjadi 3 Wilayah, yaitu: Wilayah Hulu, Tengah dan Hilir
Di wilayah hulu terdapat 3 sungai besar yang membentuk
3 Sub Das, yaitu:
1. Sub Das Ciberang,
2. Sub Das Cisimeut,
3. Sub Das Ciujung Hulu
Wil. Hilir
Wil. Tengah
Sub Das Ciujung Hulu
Wil. Hulu
Sub Das Cisimeut
Sub Das Ciberang

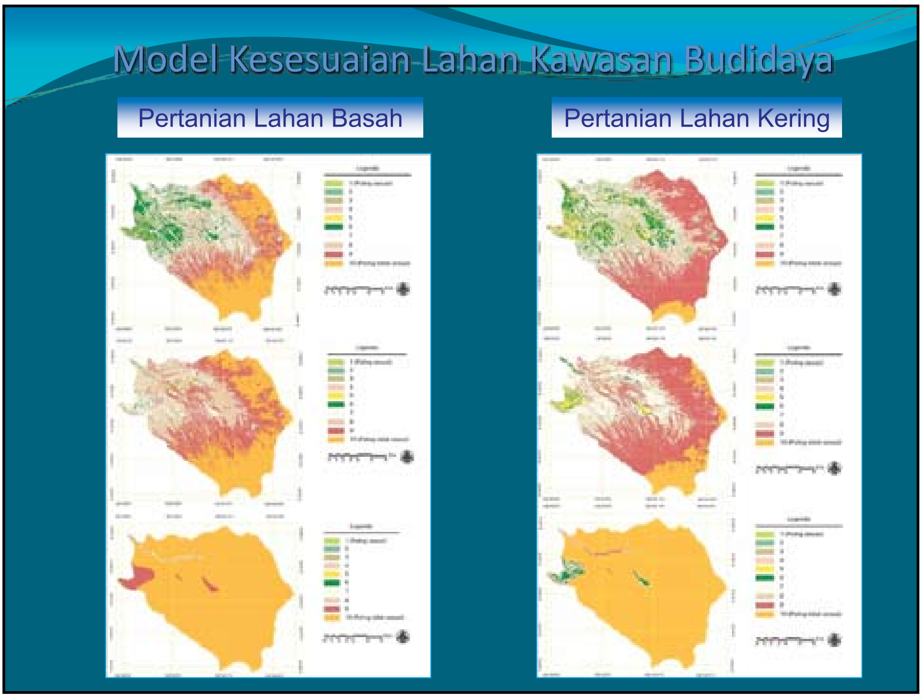

USLE
A = R K LS CP
A : ton/ha/tahun
R
K
LS
CP
Peta EROSI
(Tahun 1989, 1998 dan 2004)
1989
1998
2004
< 15 ton/ha/tahun
15 - 60 ton/ha/tahun
60 - 180 ton/ha/tahun
180 - 460 ton/ha/tahun
> 460 ton/ha/tahun


MODEL KERAWANAN TANAH LONGSOR
Peta Analog
Peta Digital
Data Atribut
Data Raster
Peta Rupa Bumi
Peta Geologi
Peta Jenis Tanah
PROSES DIGITASI
Peta Rupa Bumi
Peta Geologi
Peta JenisTanah
Data Curah Hujan
Citra Landsat
Ground Check
Interpretasi Citra
Peta Kelas Tanah
Peta Struktur Geologi
Peta Kelas Lereng
Peta Curah Hujan
Peta Penutupan Lahan
Analisis Spasial
Peta Kerawanan Tanah Longsor


LEGENDA
LEGENDA
a)
b)
Peta Kerawanan Tanah Longsor Model Pendugaan DVMBG (a) dan
Model Pendugaan Tim Sebelas (b).
13


Gunung Mandalawangi
3 dimensi kelas kerawanan tanah longsor
KETERANGAN
Kelas Kerawanan Tanah Longsor Sangat Rendah
Kelas Kerawanan Tanah Longsor Rendah
Kelas Kerawanan Tanah Longsor Menengah
Kelas Kerawanan Tanah Longsor Tinggi
14


LAHAN
Digital Elevation Model
(DEM)
Drainase
Penutupan Lahan
Slope
Aspect
Metoda :
MCDM
Simple Weight
Variabel :
DEM, Drainase,
Penutupan lahan, Slope.
Aspect !


Model Kesesuaian Lahan Kawasan Budidaya
Pertanian Lahan Basah
Pertanian Lahan Kering

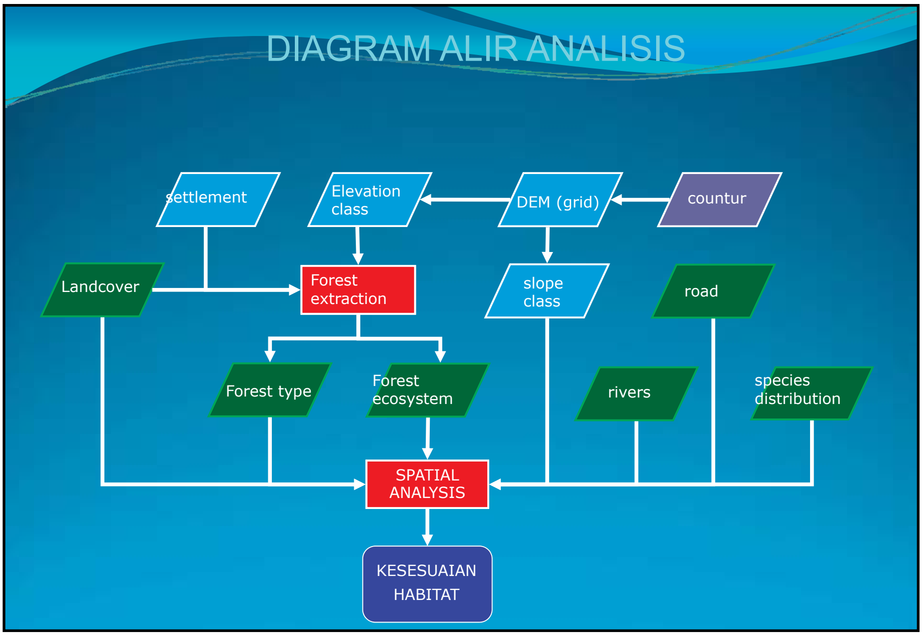
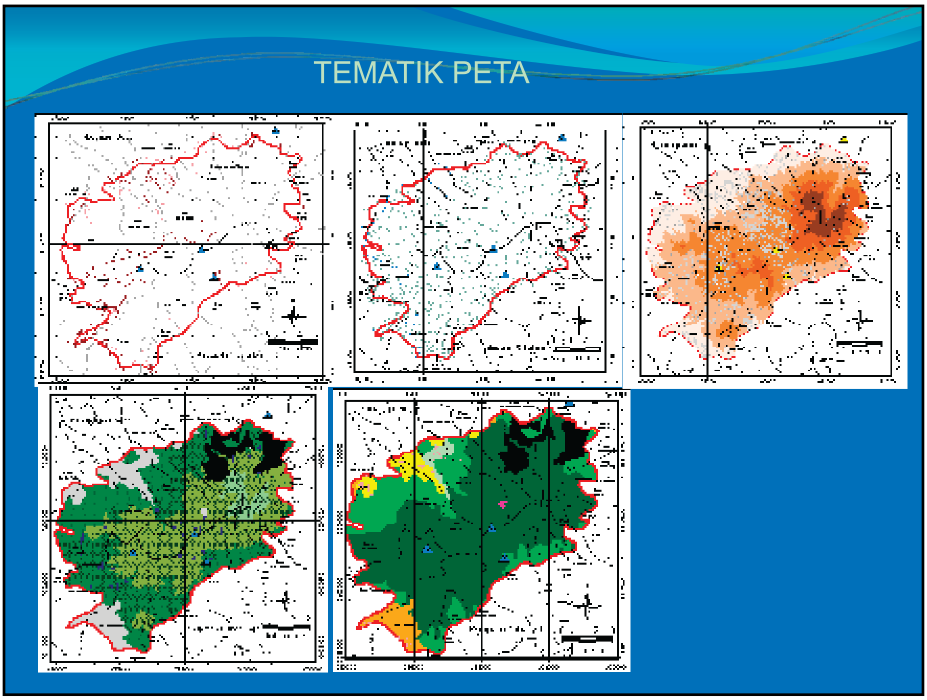
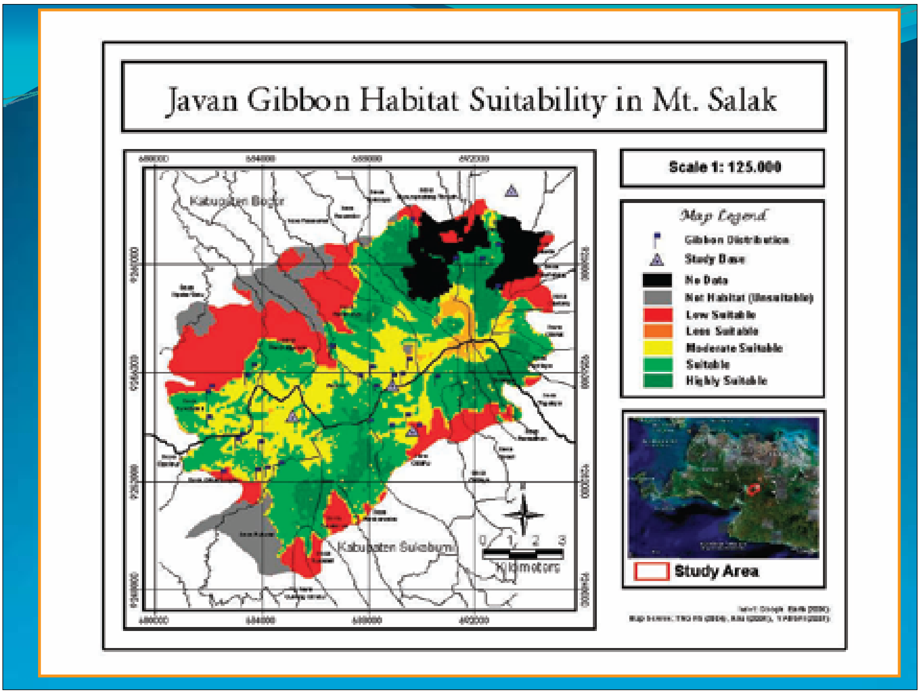


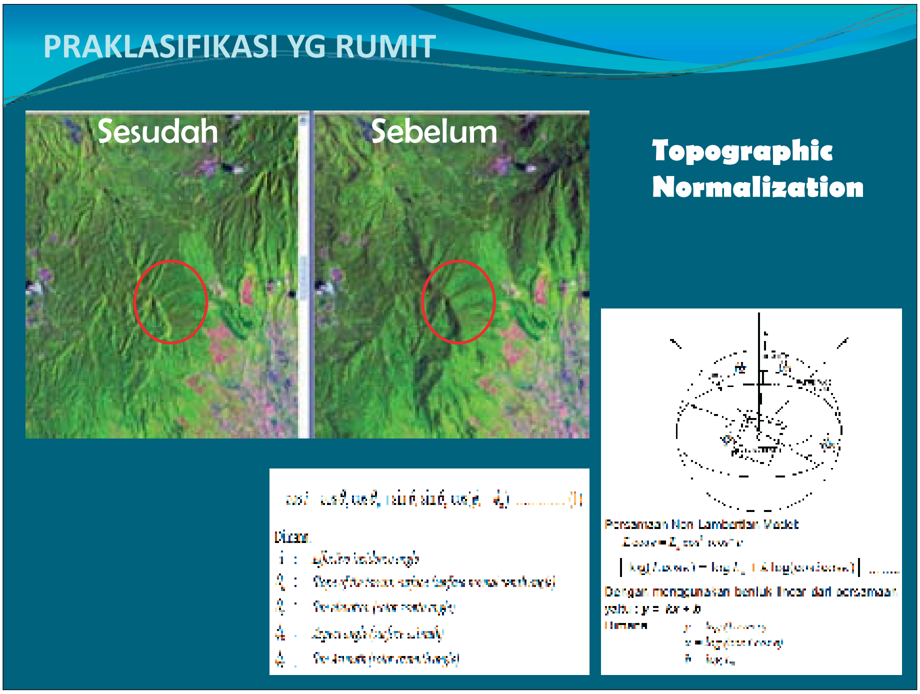
DIAGRAM ALIR ANALISIS
settlement
Elevation class
DEM (grid)
countur
Landcover
Forest extraction
slope class
road
Forest type
Forest ecosystem
rivers
species distribution
SPATIAL ANALYSIS
KESESUAIAN HABITAT

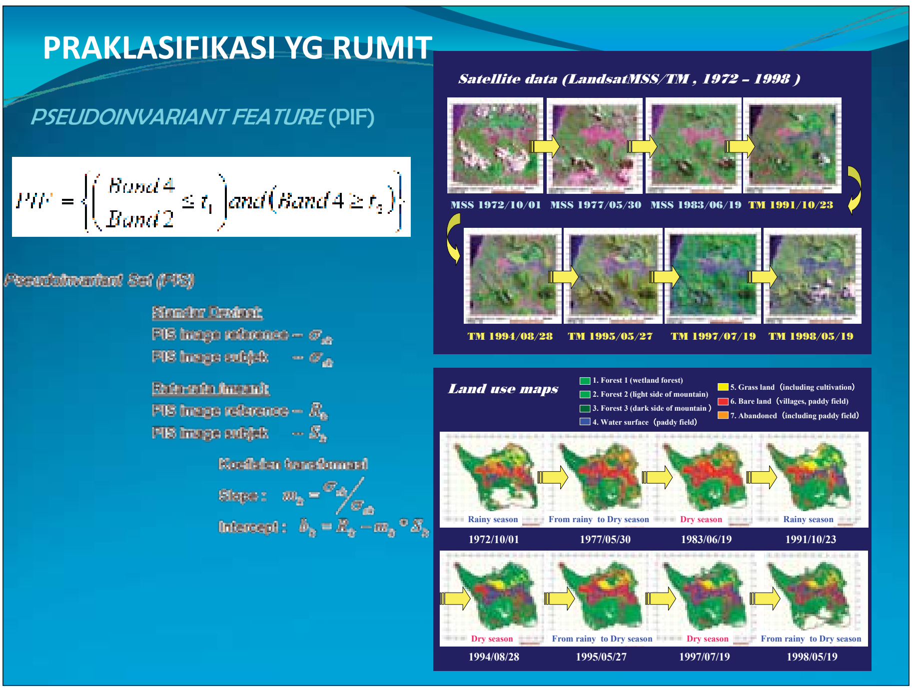

TEMATIK PETA



Problem /Disappointment

- DATA AKUISISI (KADANG TIDAK ADA)
- PROSES PRA KLASIFIKASI YG KADANG SANGAT RUMIT


PRAKLASIFIKASI YG RUMIT
Sesudah
Sebelum
Topographic Normalization
Dimana
Persamaan Non Lambertian Model
Dengan menggunakan bentuk linear dari persamaan
Dimana


PRAKLASIFIKASI YG RUMIT
PSEUDOINVARIANT FEATURE (PIF)
Pseudoinvariant Set (PIS)
Standar Deviasi
PIS image reference
PIS image subjek
Rata-rata invarian
PIS image reference
PIS image subjek
Koefisien transformasi
Slope :
Intercept :
Satellite data (LandsatMSS/TM , 1972 – 1998)
MSS 1972/10/01
MSS 1977/05/30
MSS 1983/06/19
TM 1991/10/23
TM 1994/08/28
TM 1995/05/27
TM 1997/07/19
TM 1998/05/19
Land use maps
1. Forest 1 (wetland forest)
2. Forest 2 (light side of mountain)
3. Forest 3 (dark side of mountain)
4. Water surface (paddy field)
5. Grass land (including cultivation)
6. Bare land (villages, paddy field)
7. Abandoned (including paddy field)
Rainy season
From rainy to Dry season
Dry season
Rainy season
1972/10/01
1977/05/30
1983/06/19
1991/10/23
Dry season
From rainy to Dry season
Dry season
From rainy to Dry season
1994/08/28
1995/05/27
1997/07/19
1998/05/19

KESIMPULAN

A. Capaian (Achievement)

- Remote sensing membantu dalam memahami suatu proses yang terjadi dalam suatu bentang lahan/spasial.
- Remote sensing membantu dalam investigasi permasalahan lingkungan, terutama yg terjadi di masa lampau (*Environmental Forensic*)
- Remote sensing sangat membantu dalam pengambilan keputusan/alokasi lahan.

B. Nilai lebih Remote Sensing *(the difference among others*)

- Data yg konsisten dari waktu ke waktu
- Pertimbangan spasial/tidak hanya besaran tapi juga distribusi

C. Problem

- Data akuisisi
- Pre Klasifikasi yg rumit

D. Ekspektasi

- Problem data akuisisi dan kerumitan Pre klasifikasi dapat di atasi

3. Remote sensing application to support better forest management

Indrawan Suryadi, Tropenbos Indonesia

Remote Sensing Application
to Support Better Forest Management

Lessons learned from Tropenbos International Indonesia Programme

By:

Indrawan Suryadi
GIS Specialist

Tropenbos International – Indonesia Programme
2007

Contents:

1- Tropenbos International – Indonesia and its programmes at a glance

2- Remote Sensing activities within the programmes

3- Lessons learned

1. Tropenbos International – Indonesia Programme at a glance

Tropenbos International

- Dutch Non-Governmental Organization
- Active since 1988 in several countries

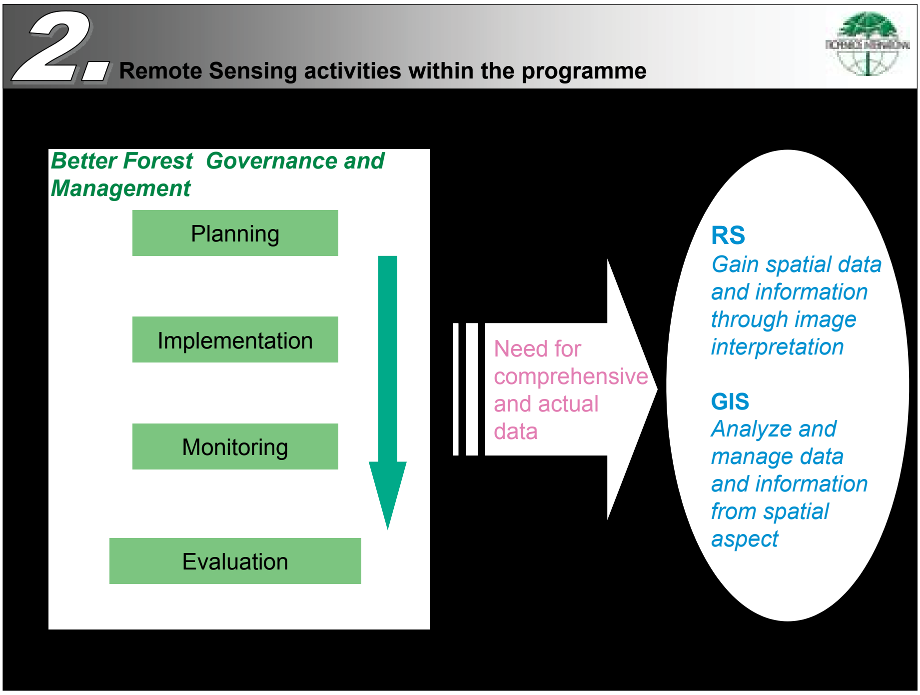
TROPENBOS INTERNATIONAL INDONESIA

- **Mission:**

Improve the use and management of forest for a healthy environment, sustainable development and prosperity for the people

by

Generation of relevant information; capacity building and training; and strengthening of institutions



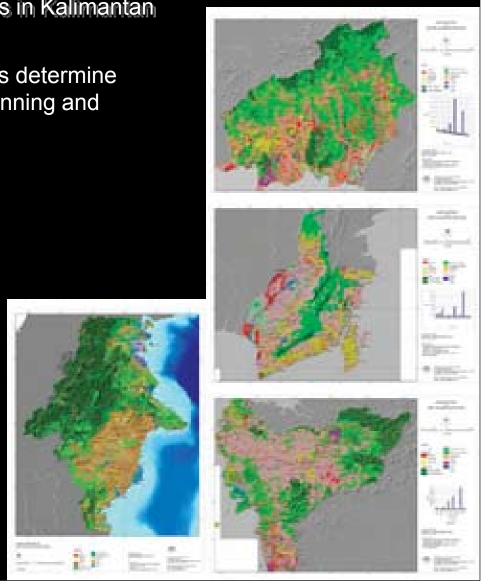
RS RELATED ACTIVITIES

- Design and develop a monitoring and certification system of production forest in Indonesia in cooperation with ITC Netherlands and Watershed Management Agency Solo (BPPTPDAS) in Berau and Pasir District (East Kalimantan Province)
- Support and provide technical assistance for the development of Spatial Data Infrastructure (GIS-RS Forum) in Pasir District
- A series of GIS and Remote Sensing training sessions for GIS-RS Forum and local government agencies
- Biodiversity assessment in Gunung Lumut PF and Betung Kerihun NP
- Land cover analysis for all provinces in Kalimantan
- Erosion hazard analysis for all provinces in Kalimantan
- Critical land analysis for all provinces in Kalimantan
- HCVF assessment in PT. Rea Kaltim and PT. Sumalindo

Land cover interpretation for all provinces in Kalimantan

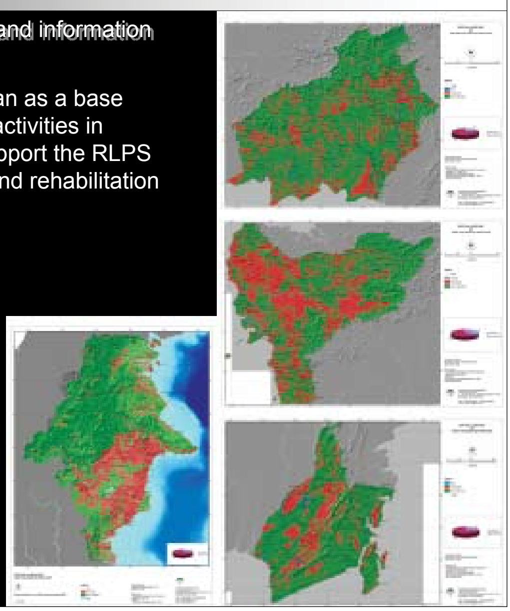
→ Define the actual land cover as well as determine forest cover left due to support forest planning and management in Kalimantan

→ Used by FORDA, Planning Agency of Forest Dept., local government, BKSDA of East Kalimantan, research institutions, NGOs, etc. as a basic data and information for their planning and monitoring process



Advanced analysis based on RS data and information

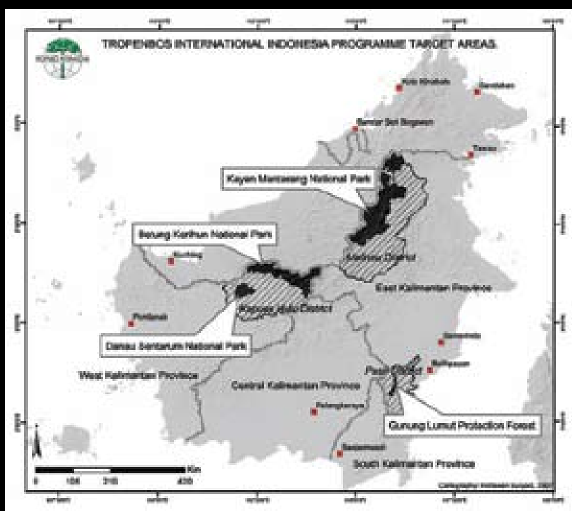
→ Define the critical lands in Kalimantan as a base data and information for rehabilitation activities in Kalimantan. This data was made to support the RLPS and other stakeholder to define their land rehabilitation related activities.

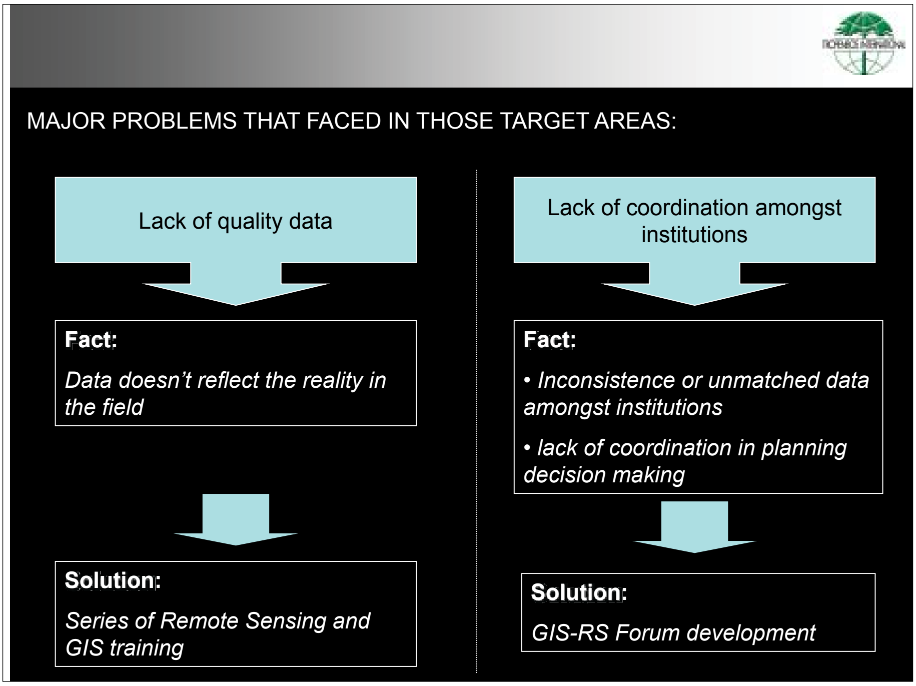


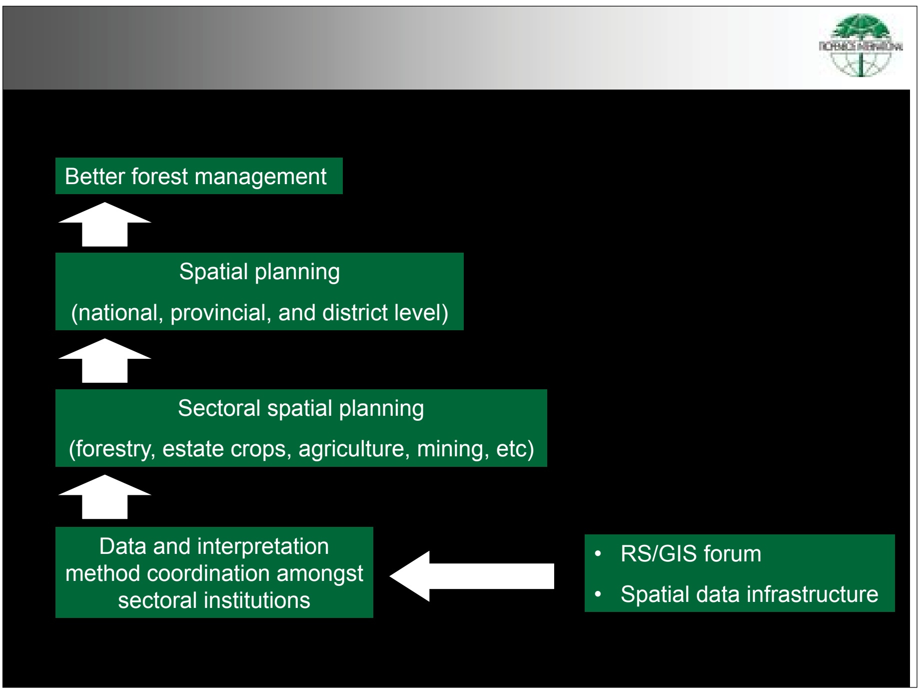
Advanced analysis based on RS data and information (continued)

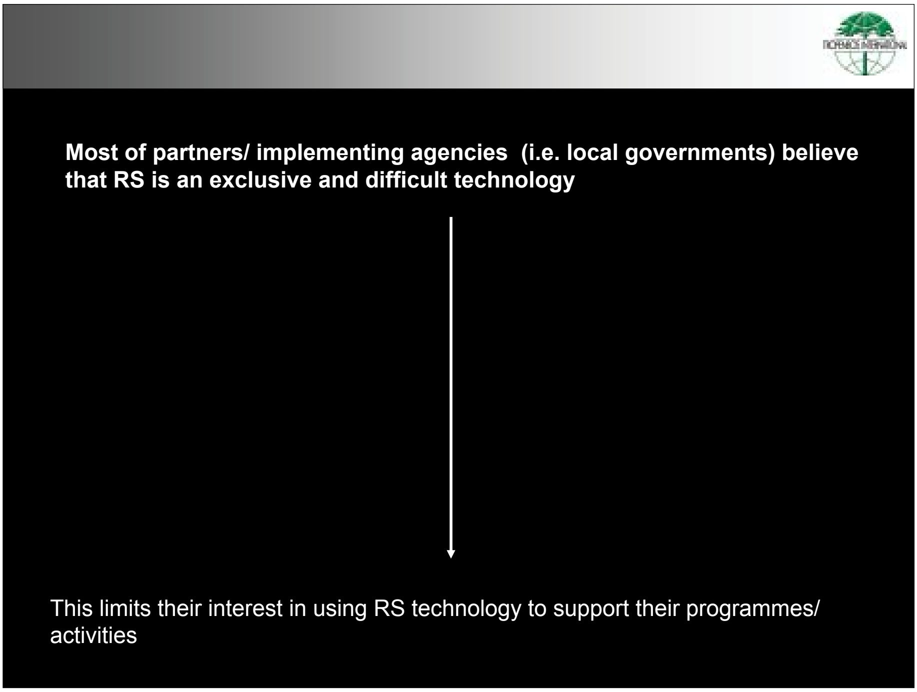
Define the areas with high conservation value in Pasir District due to their conservation district initiation process

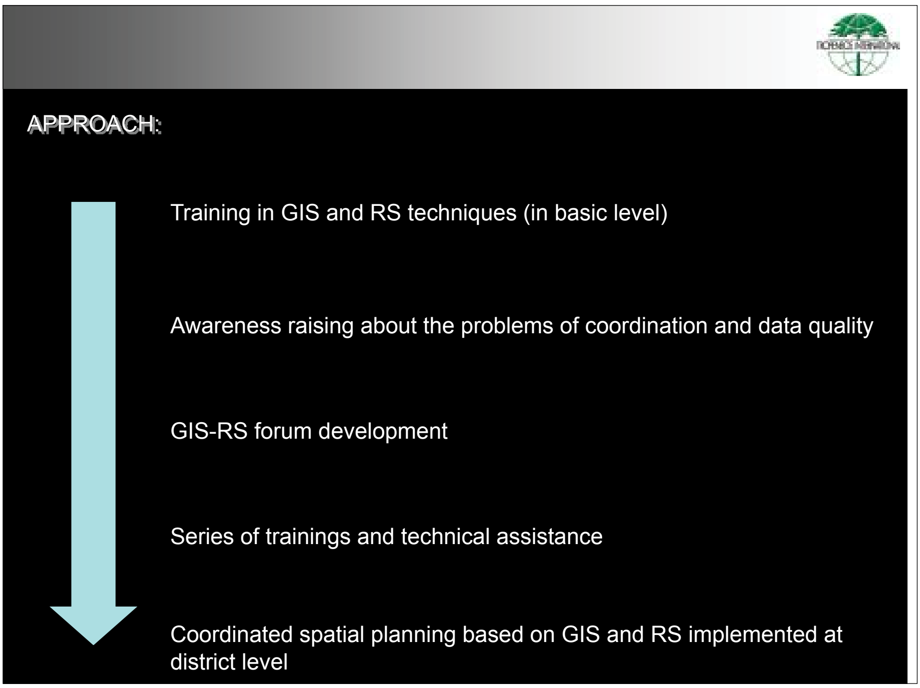
TROPENBOS INTERNATIONAL INDONESIA TARGET AREA

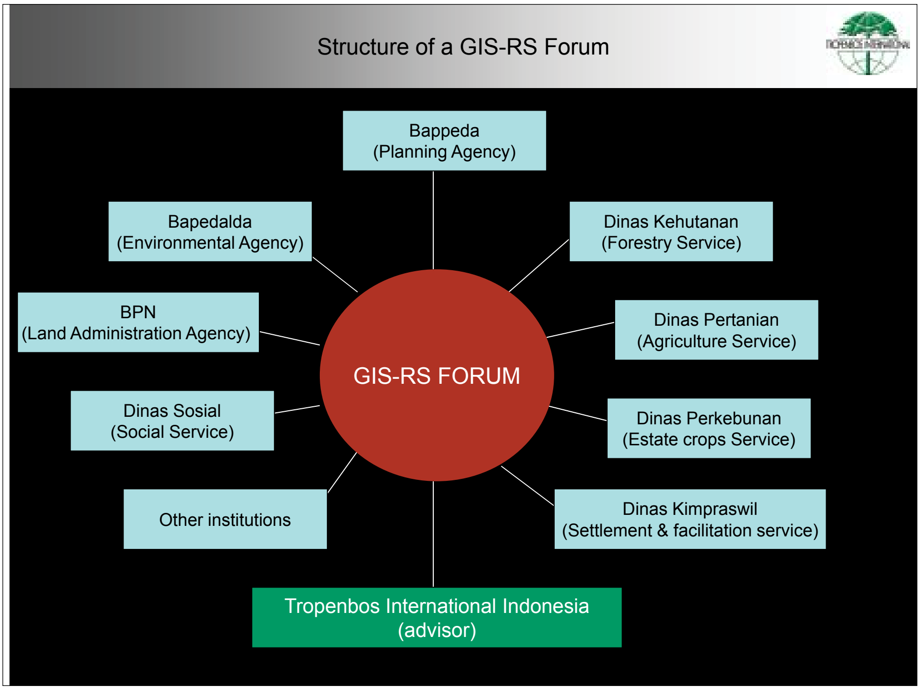


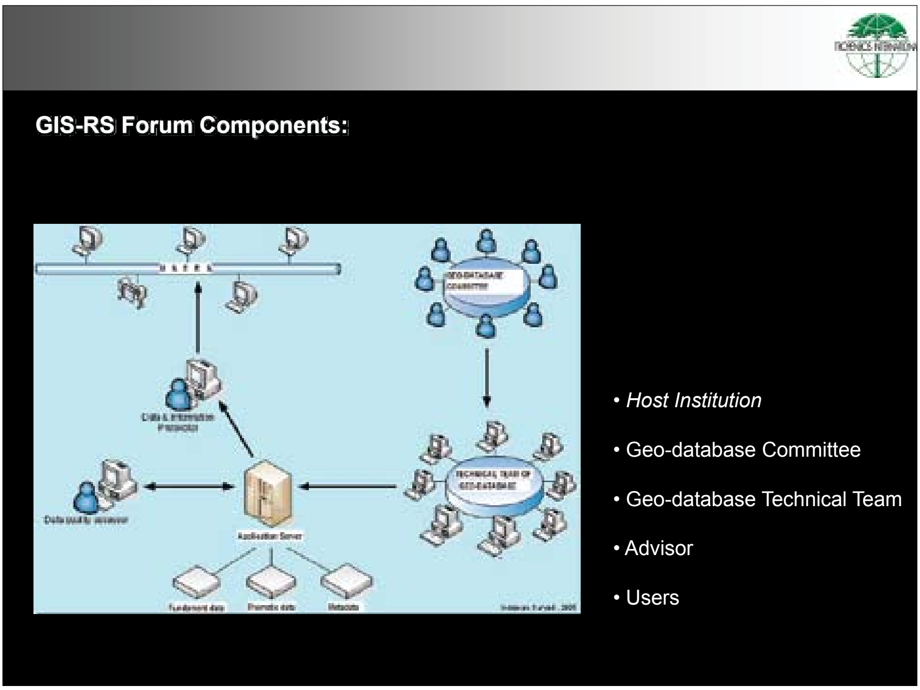

MAJOR PROBLEMS THAT FACED IN THOSE TARGET AREAS:
Lack of quality data
Fact:
Data doesn't reflect the reality in the field
Solution:
Series of Remote Sensing and GIS training
Lack of coordination amongst institutions
Fact:
• Inconsistence or unmatched data amongst institutions
• lack of coordination in planning decision making
Solution:
GIS-RS Forum development

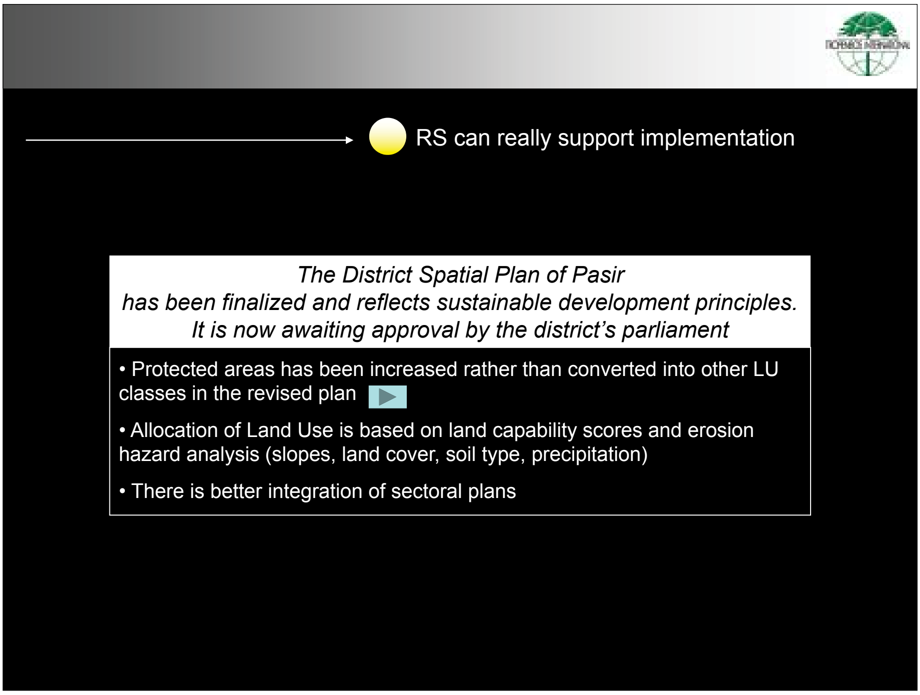

Better forest management
Spatial planning
(national, provincial, and district level)
Sectoral spatial planning
(forestry, estate crops, agriculture, mining, etc)
Data and interpretation method coordination amongst sectoral institutions
• RS/GIS forum
• Spatial data infrastructure

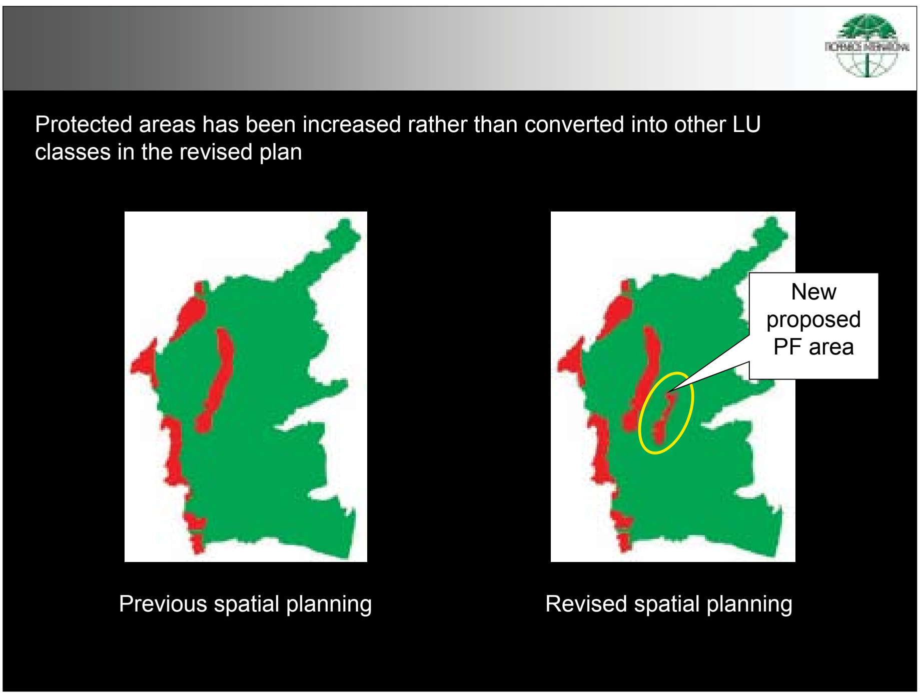

Most of partners/ implementing agencies (i.e. local governments) believe that RS is an exclusive and difficult technology
This limits their interest in using RS technology to support their programmes/ activities


APPROACH:
Training in GIS and RS techniques (in basic level)
Awareness raising about the problems of coordination and data quality
GIS-RS forum development
Series of trainings and technical assistance
Coordinated spatial planning based on GIS and RS implemented at district level


Structure of a GIS-RS Forum
Bappeda
(Planning Agency)
Bapedalda
(Environmental Agency)
Dinas Kehutanan
(Forestry Service)
BPN
(Land Administration Agency)
Dinas Pertanian
(Agriculture Service)
GIS-RS FORUM
Dinas Sosial
(Social Service)
Dinas Perkebunan
(Estate crops Service)
Other institutions
Dinas Kimpraswil
(Settlement & facilitation service)
Tropenbos International Indonesia
(advisor)


GIS-RS Forum Components:
• Host Institution
• Geo-database Committee
• Geo-database Technical Team
• Advisor
• Users


RS can really support implementation
The District Spatial Plan of Pasir
has been finalized and reflects sustainable development principles.
It is now awaiting approval by the district's parliament
• Protected areas has been increased rather than converted into other LU classes in the revised plan
• Allocation of Land Use is based on land capability scores and erosion hazard analysis (slopes, land cover, soil type, precipitation)
• There is better integration of sectoral plans


Protected areas has been increased rather than converted into other LU classes in the revised plan
New proposed PF area
Previous spatial planning
Revised spatial planning

RS can really support implementation

The District Spatial Plan of Pasir
has been finalized and reflects sustainable development principles.
It is now awaiting approval by the district's parliament

- Protected areas has been increased rather than converted into other LU classes in the revised plan
- Allocation of Land Use is based on land capability scores and erosion hazard analysis (slopes, land cover, soil type, precipitation)
- There is better integration of sectoral plans

3. Lessons Learned

1. An intensive approach to district governments is needed to have a real influence on Spatial Planning decisions.
2. Good personal relations with key persons in the district (particularly Development Planning Agency) is very important.
3. Support from all agencies' heads is required
4. A decree from the district head to formalize the GIS-RS Forum is needed to make it function
5. The most effective training is when class room training is alternated with field exercises and is followed up by assistance with data analysis 'on the job' after the formal course is over.
6. Peer-to-peer extension is a powerful way of disseminating the concept

Further extension of the GIS-RS Forum concept

Peer to peer exchange

Development of training materials

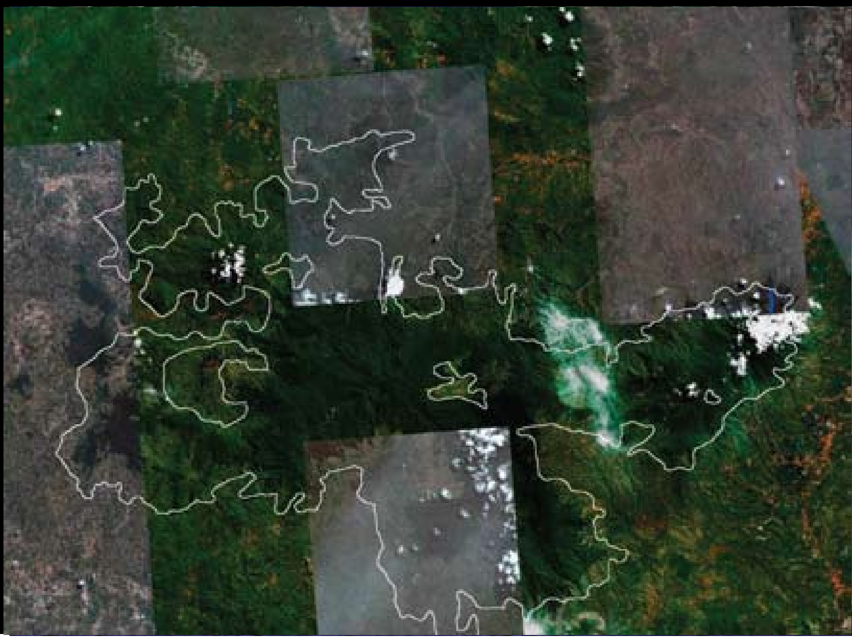
Documenting of experiences

Train trainers

4. Remote sensing for management Gunung Halimun-Salak National Park

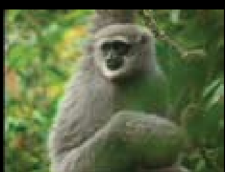
Werdi Septiana, Gunung Halimun Salak National Park

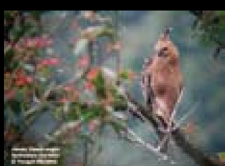
GUNUNG HALIMUN-SALAK NATIONAL PARK

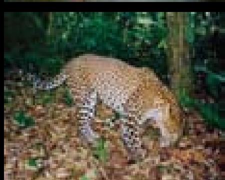


GUNUNG HALIMUN-SALAK NATIONAL PARK

BACKGROUND







- The largest rainforest remain in Java, ± **113.000** Ha
- Rich of biodiversity; species : **61** mammals and **224** of birds
- **3** key species: **Javan Hawk Eagle**, Javan Gibbon and **Spotted Leopard**
- Park area includes more than **300** kampong

HISTORY

- The area has been protected since **1924**
- In **1992**, it was endowed with national park status, named as Gunung Halimun National Park (GHNP)

HISTORY

- **June 2003,** expanded the area (Mt. Salak, Mt. Endut and other forest surrounding GHNP)

  from **40.000 Ha** to **113.000 Ha**
- Renamed: Gunung Halimun Salak National Park (GHSNP)

HISTORY

- 3 Section: Lebak, Bogor, and Sukabumi
- Divided into 14 resort

CHALLENGES

- Supported only **106 staffs** (that fit for previous park area → **40.000 Ha**)
- Area after extension → **113.000 Ha**
- Ratio → **1.070** Ha/ personnel
- Ex Perhutani's area → many kampongs [**300**], villages and has different management system
- Need **new approach** for management of NP

OPPORTUNITY

REMOTE SENSING

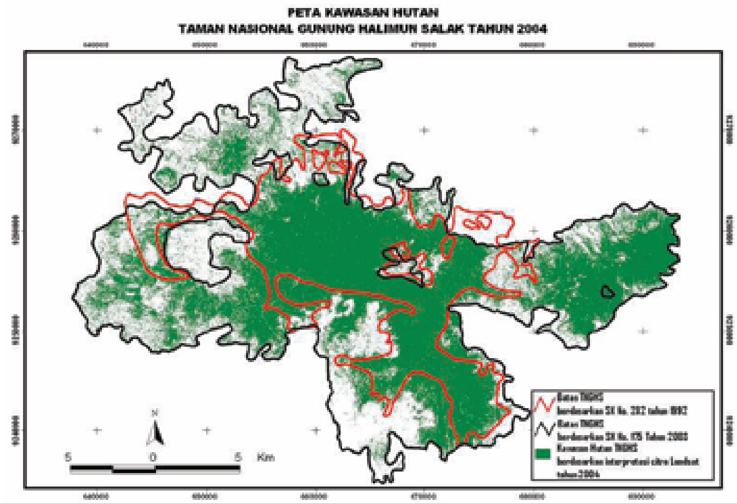
Represent One Of Assistive Appliance in Sustaining Planning (zoning), Monitoring and Updating To Support Decision of Management GHSNP

APPLICATION

of **Remote Sensing** in order to support the management of National Park:

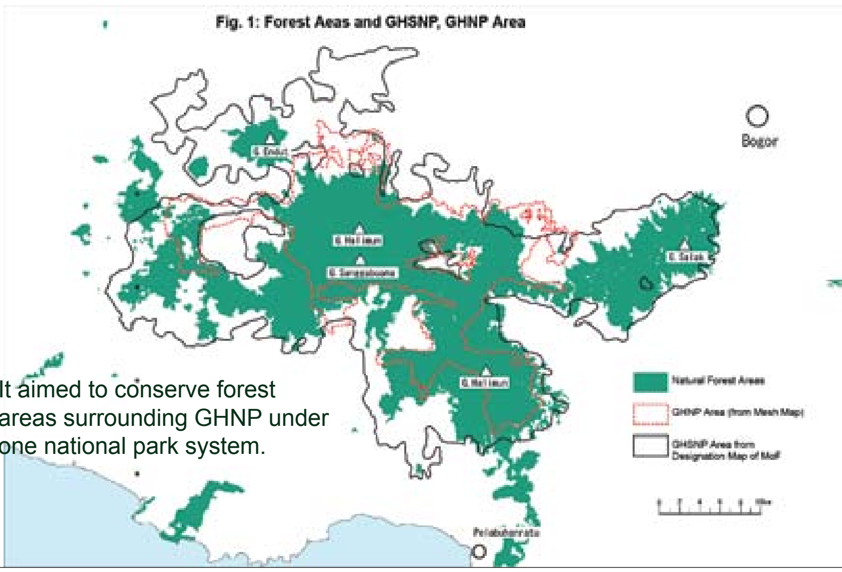
- For monitoring of land cover change periodically within the National Park
- For monitoring of deforestation
- To support the management plan of NP, including zoning of NP and other purpose
- To calculate of potential carbon absorbent of NP forest
- Modeling the acceleration of deforestation

The largest primitive forest in Java is shrinking and fragmented at alarming rate



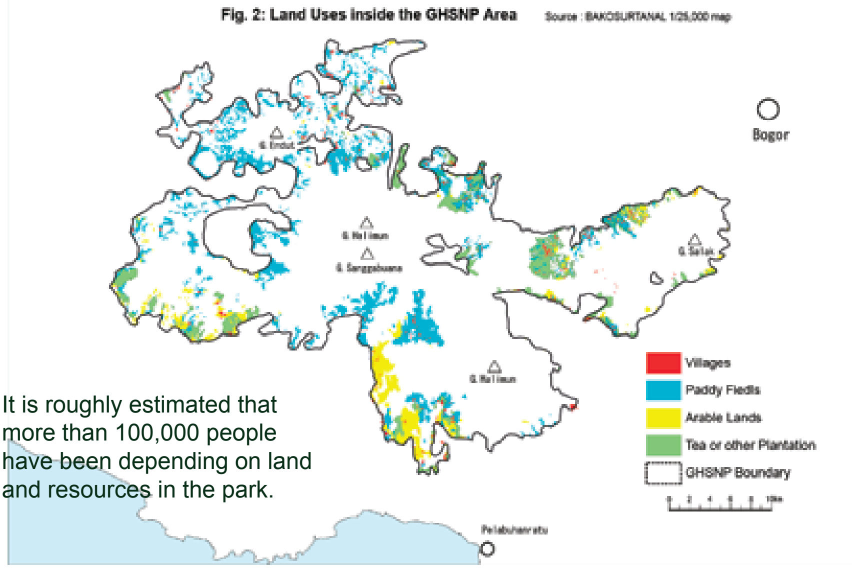
EXPANSION OF THE PARK

(June 2003 by SK 175)



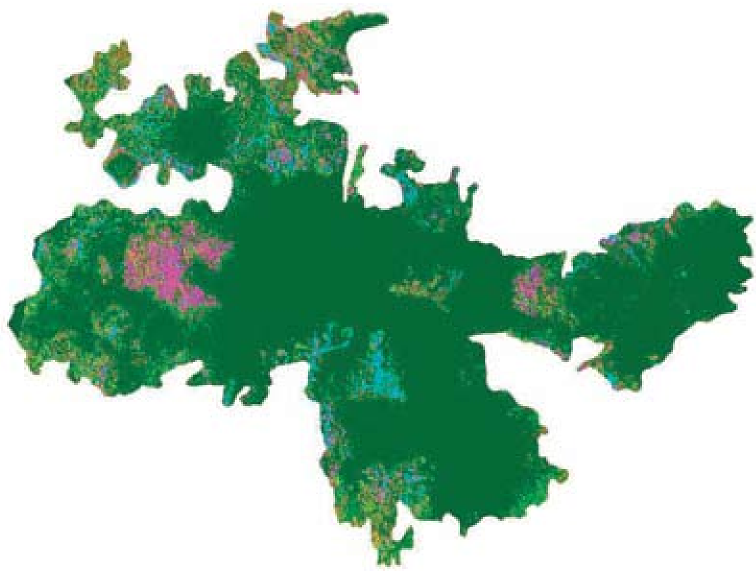
It aimed to conserve forest areas surrounding GHNP under one national park system.

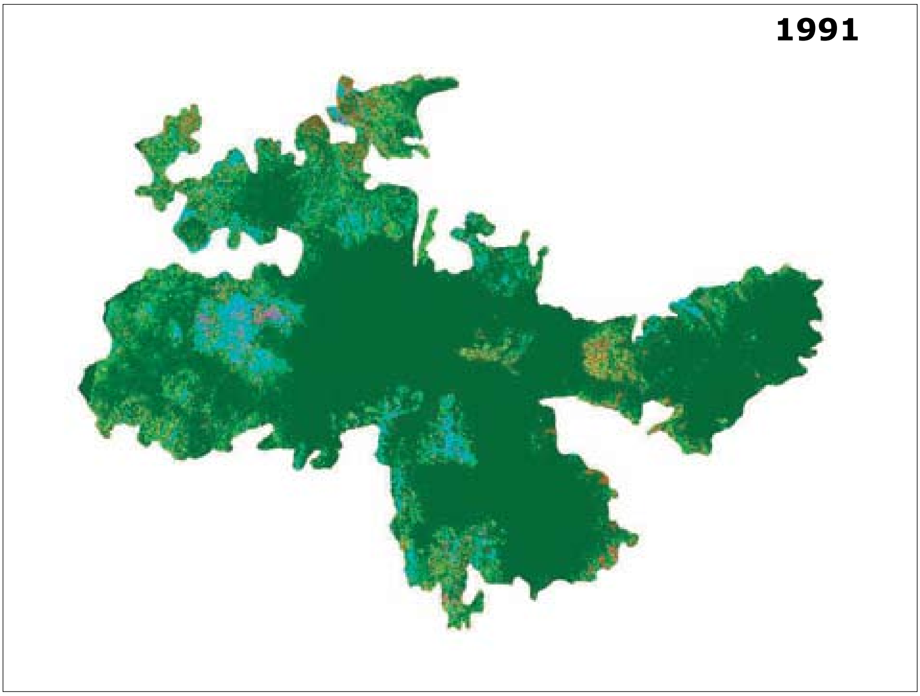
UNLAWFUL LAND USES IN THE PARK AREA

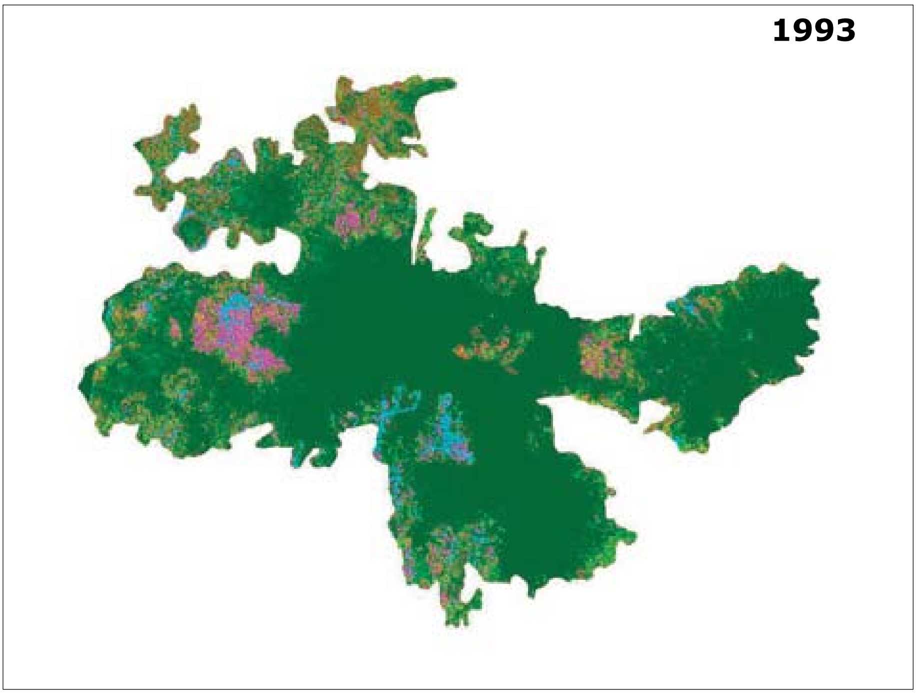


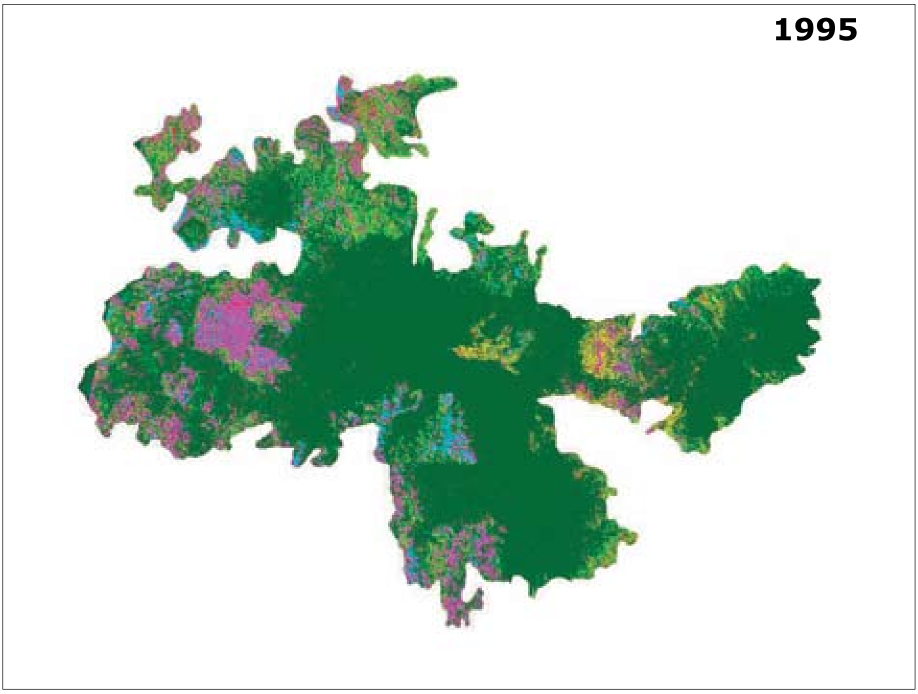
It is roughly estimated that more than 100,000 people have been depending on land and resources in the park.

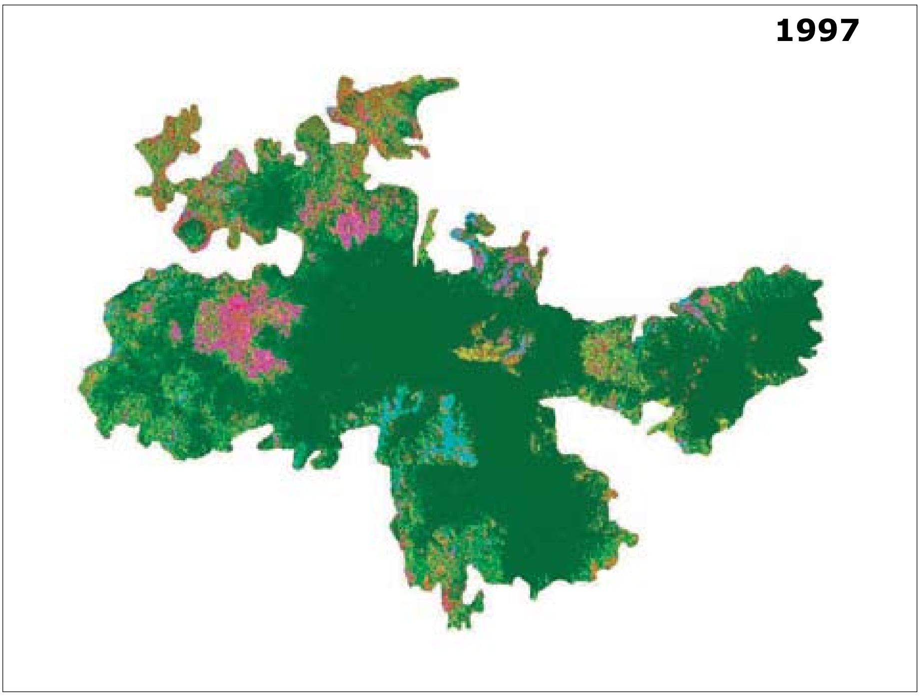
1989

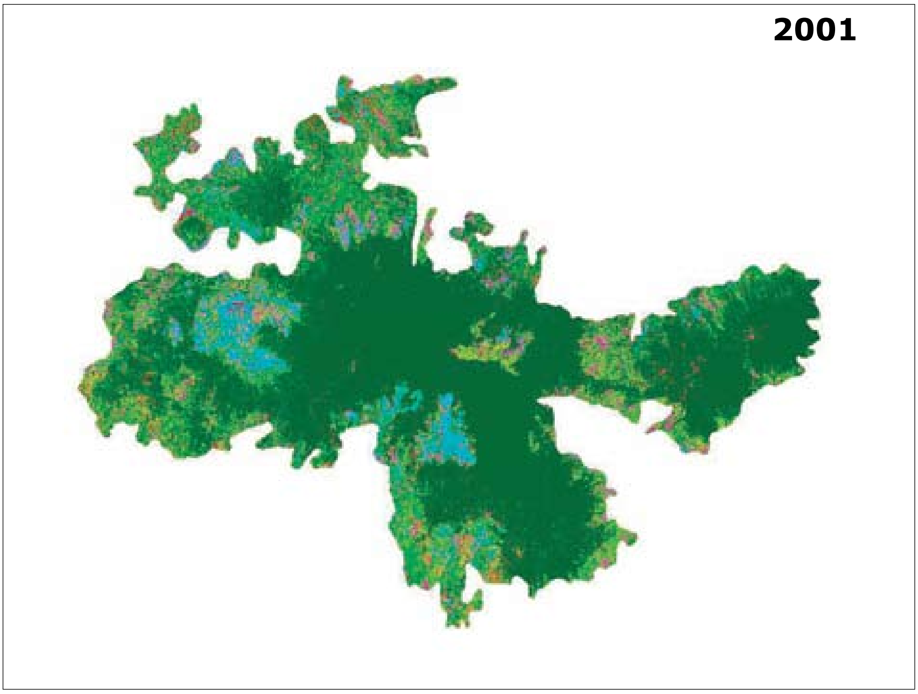


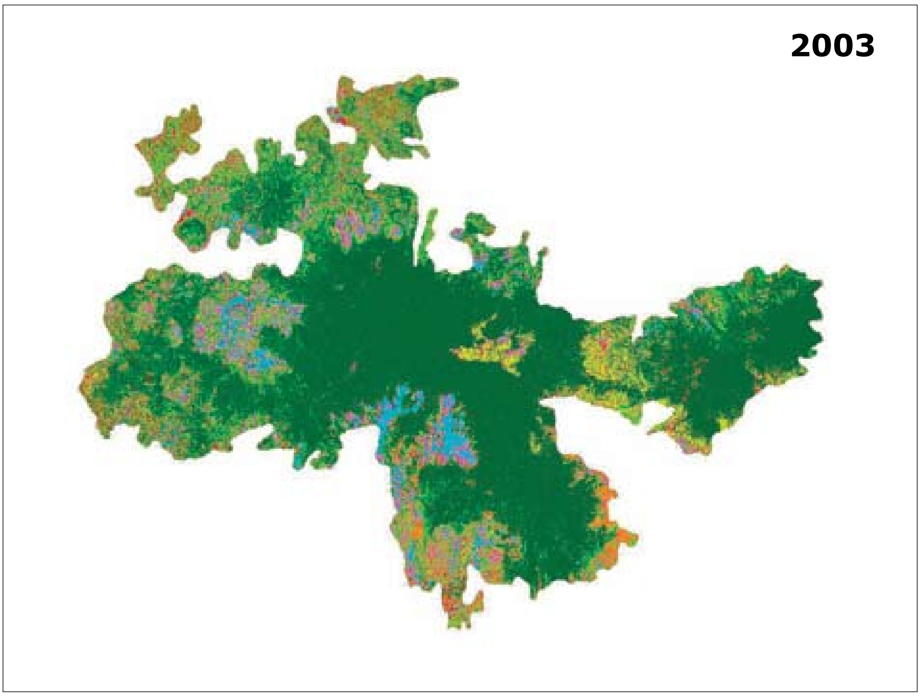

1991

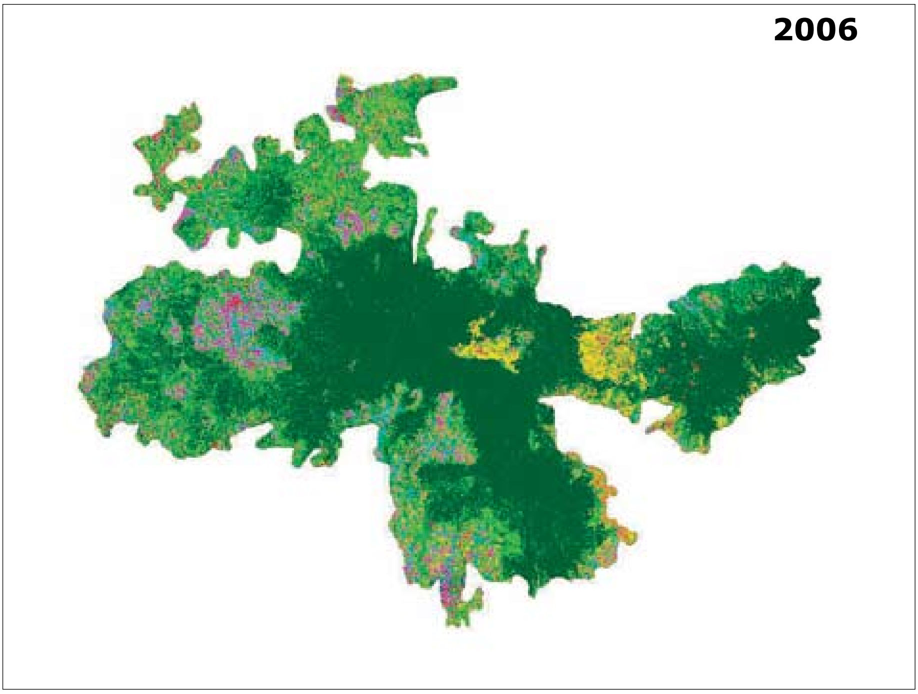

1993

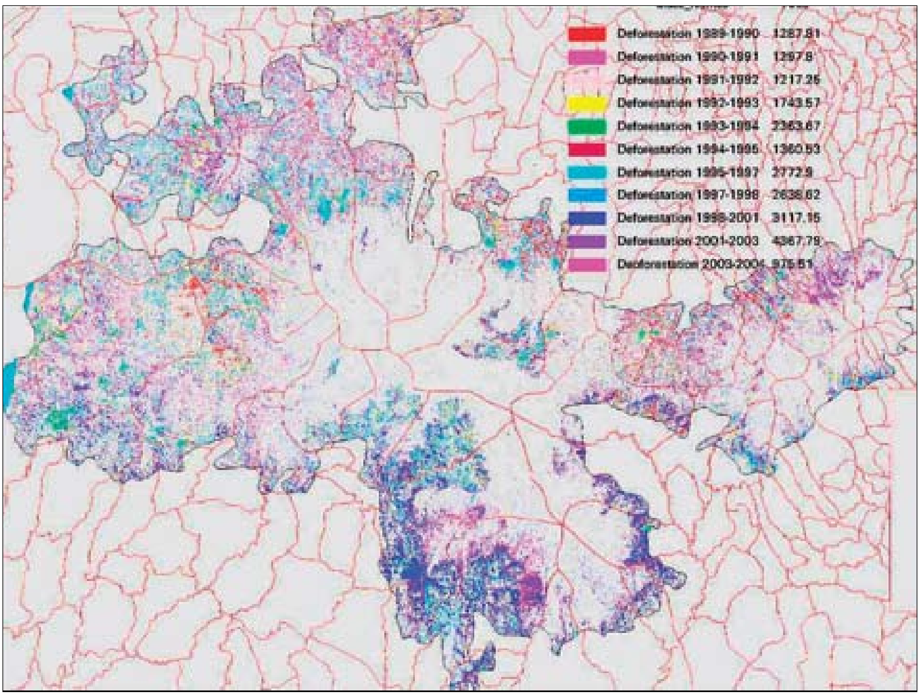

1995

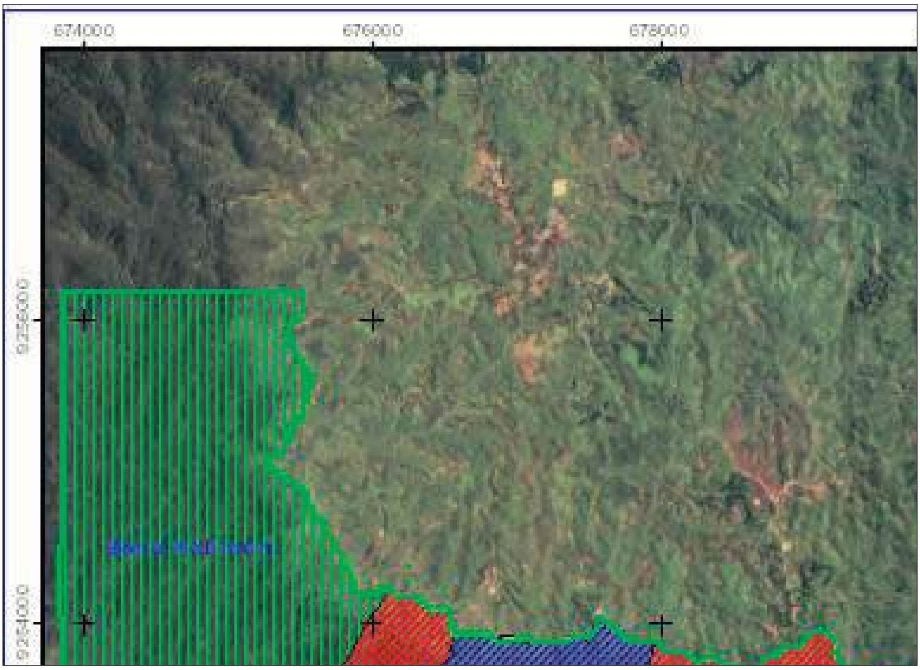

1997

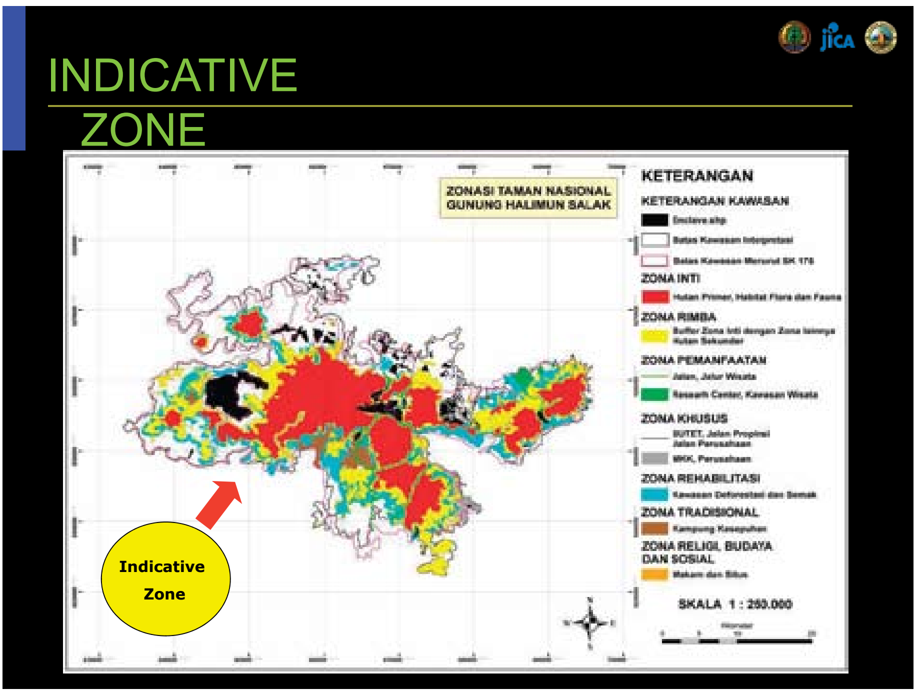

2001


2003


2006


Deforestation 1989-1990 1287.91
Deforestation 1990-1991 1297.8
Deforestation 1991-1992 1217.26
Deforestation 1992-1993 1743.57
Deforestation 1993-1994 2363.67
Deforestation 1994-1995 1360.53
Deforestation 1995-1997 2772.9
Deforestation 1997-1998 2638.02
Deforestation 1998-2001 3117.15
Deforestation 2001-2003 4367.79
Deforestation 2003-2004 975.51




INDICATIVE
ZONE
ZONASI TAMAN NASIONAL
GUNUNG HALIMUN SALAK
KETERANGAN
KETERANGAN KAWASAN
ZONA INTI
Hutan Primer, Habitat Flora dan Fauna
ZONA RIMBA
ZONA PEMANFAATAN
ZONA KHUSUS
ZONA REHABILITASI
ZONA TRADISIONAL
ZONA RELIGI, BUDAYA
DAN SOSIAL
SKALA 1 : 250.000
Indicative
Zone

EXPECTATION

With time series data, in the future GHSNP can do:

" MODELING "

- DEFORESTATION MODEL
- BIOMAS ESTIMATION
- HABITAT MONITORING
- FOREST COVER CHANGE MODEL
- LAND EVALUATION MODEL
- SOIL EROSION MODEL

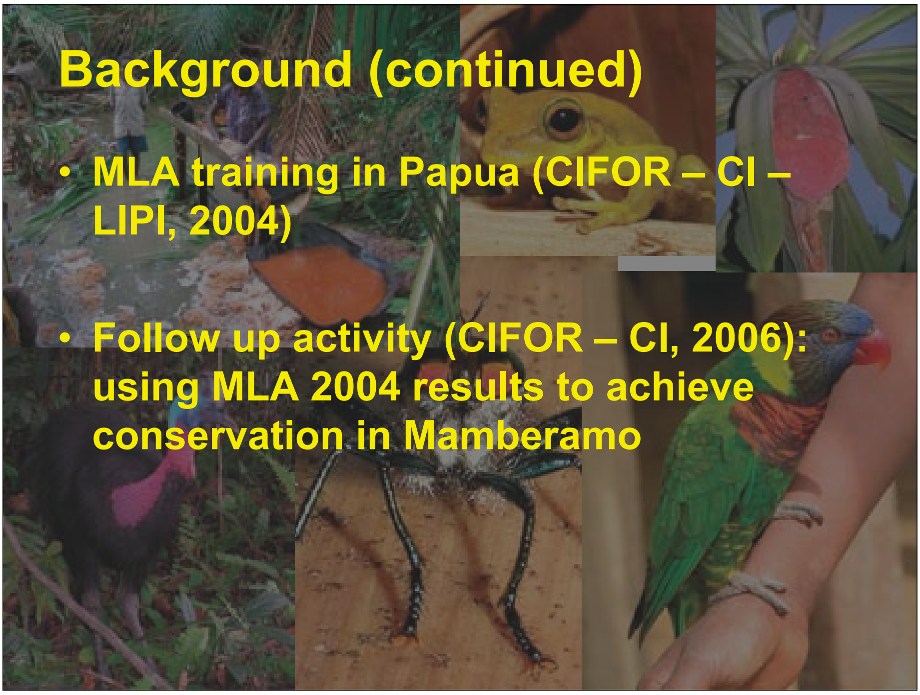
(Interpretation with Clustering and Ground Truthing)

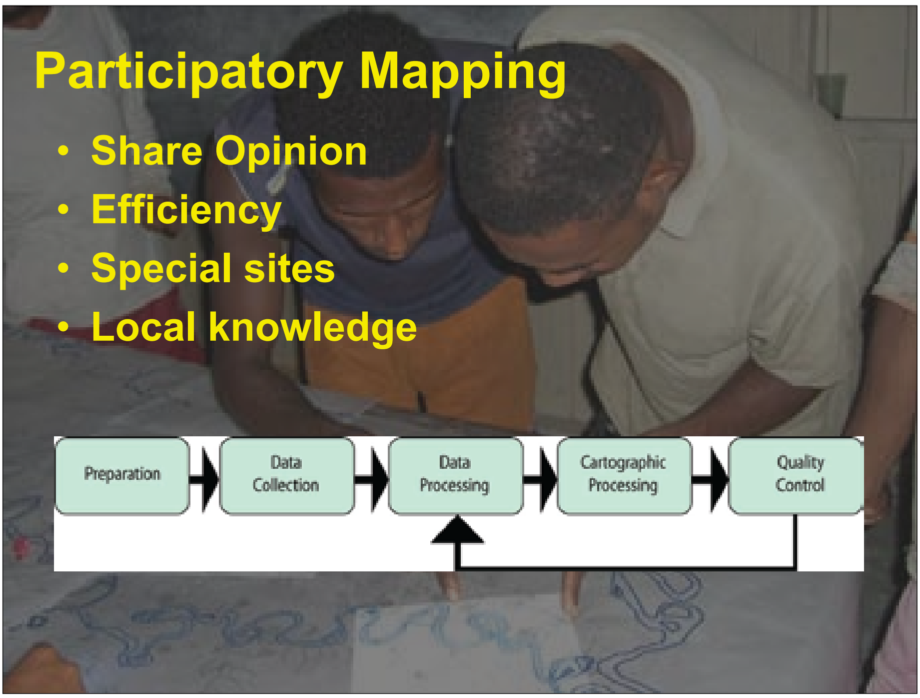
THE PROBLEM

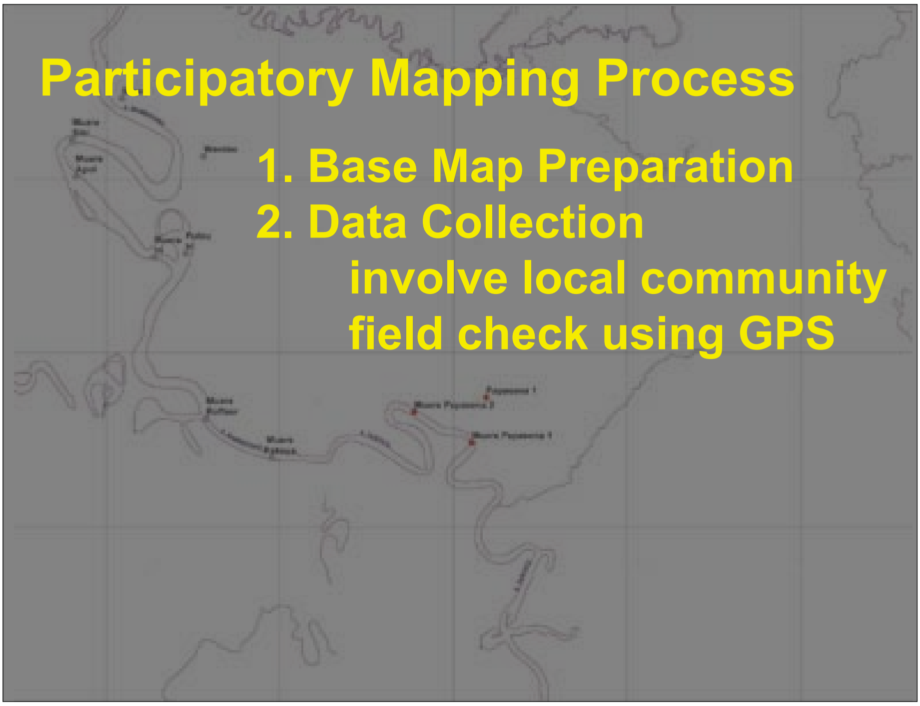
- Images (IKONOS / QB) has a lot of information, but still need more effort to make it more usefull
- Need cooperation with another user (researcher) for more utilization in order to support the NP management
- Need improvement of human resources

5. Participatory mapping for conservation in Mamberamo

Michael Padmanaba, CIFOR


Background (continued)
• MLA training in Papua (CIFOR – CI – LIPI, 2004)
• Follow up activity (CIFOR – CI, 2006): using MLA 2004 results to achieve conservation in Mamberamo


Participatory Mapping
• Share Opinion
• Efficiency
• Special sites
• Local knowledge
Preparation
Data Collection
Data Processing
Cartographic Processing
Quality Control


Participatory Mapping Process
1. Base Map Preparation
2. Data Collection
involve local community
field check using GPS


An example

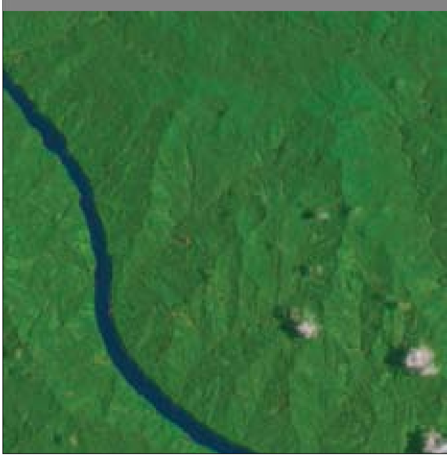
Participatory Mapping Process (continued)

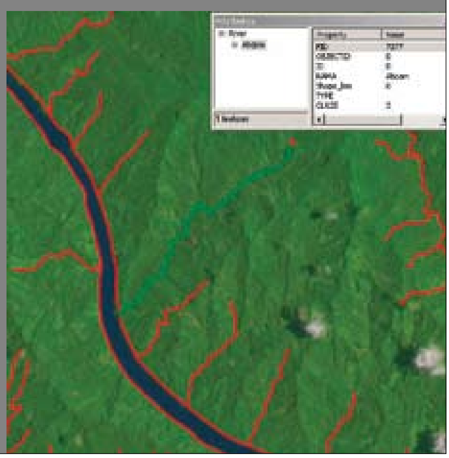
3. Data Processing

a. Geo-referencing

Participatory Mapping Process (continued)

b. Digitizing





Participatory Mapping Process (continued)

c. Adjustment

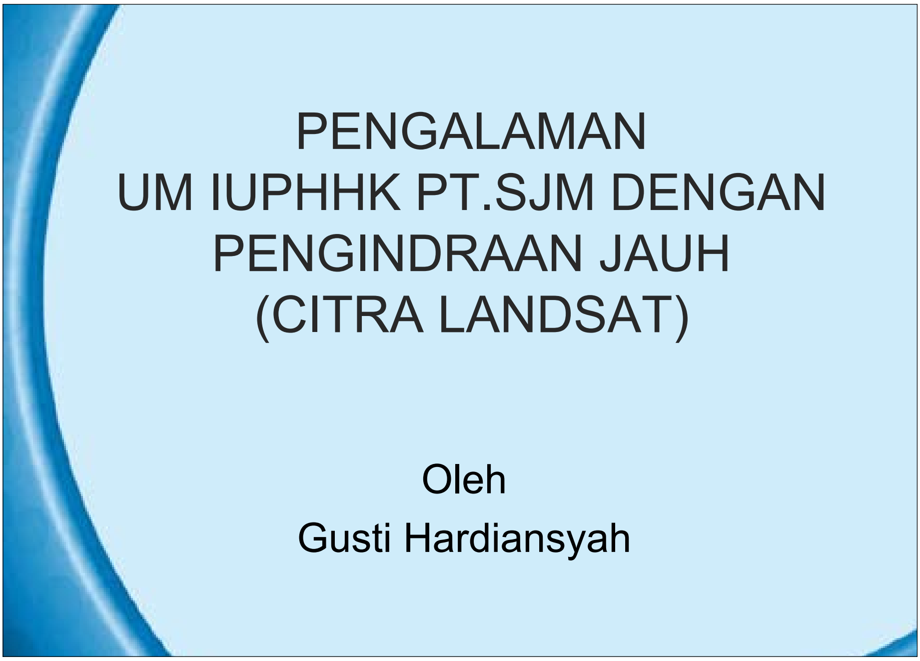
Participatory Mapping Process (continued)

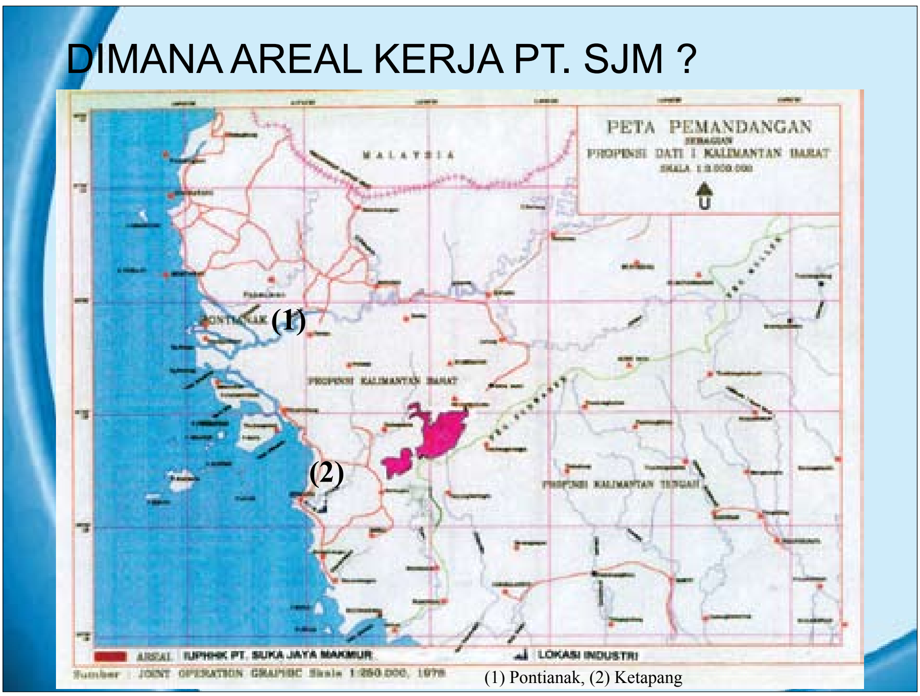
4. Cartographic
5. Quality Control
   - accuracy
   - details


And…here is the product
Peta Partisipatif Penggunaan Lahan Desa Kwerba, Papua
• Represent local priorities and perspectives on land management
• As consideration to promote key biodiversity area
• As source of information for conservation goals and for the sustainable spatial planning by local government

6. Remote sensing application for managing concession forest: Experience of the management unit of PT Suka Jaya Makmur

Gusti Herdiansyah, PT Suka Jaya Makmur





KEADAAN UMUM

a. PT. Suka Jaya Makmur Kelompok S. Pesaguan – S. Biya – S. Batang Kawa.

b.Letak Menurut Wilayah Pengelolaan : Dinas Kehutanan Propinsi Kalimantan Barat, Kabupaten Ketapang dan Melawi.

c. Luas Areal : 171.340 Ha

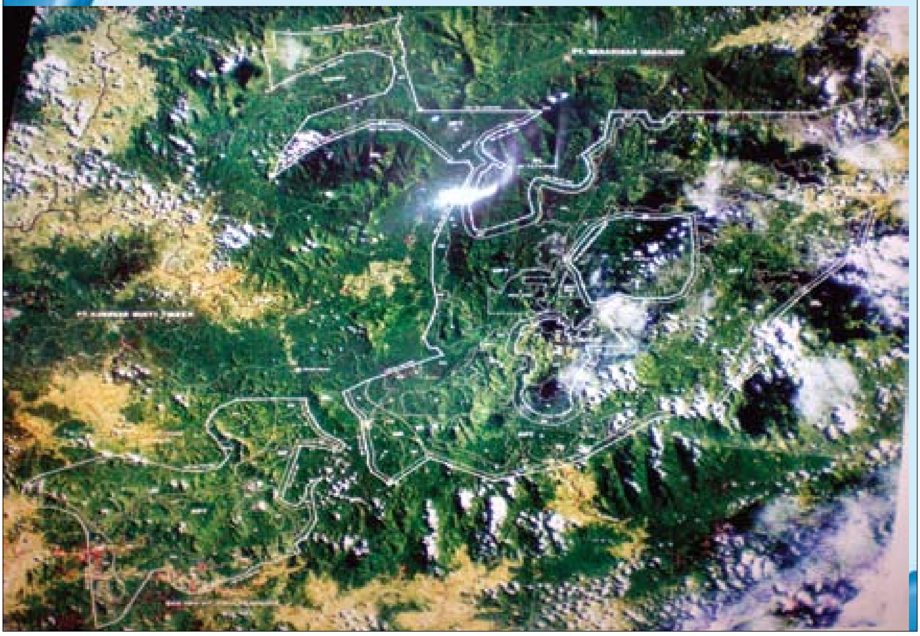
- Berhutan	:	56.700 Ha
- Tidak Berhutan	:	4.994 Ha
- Bekas Tebangan	:	109.646 Ha

d. Letak menurut Administrasi Pemerintah Propinsi Kalimantan Barat Kabupaten Ketapang dan Melawi.

Pendahuluan

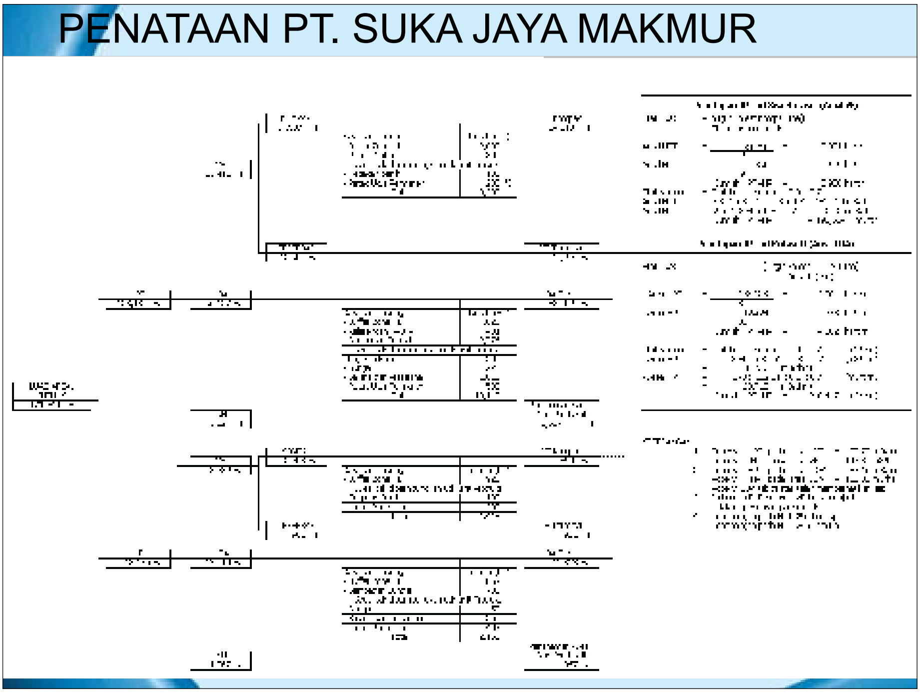
- Penggunaan Pengindraan jauh di Kehutanan adalah sebagai Alat untuk memperoleh Data Yang Digunakan untuk Tujuan Tertentu (Smith, 1993)
- Citra Landsat secara nyata pernah & sampai saat ini dimanfaatkan dalam pengindraan jauh oleh UM. Capaian yang diberikan adalah sebagai pendukung kegiatan pengelolaan hutan, terutama pengelolaan hutan bekas tebangan (LOA), perencanaan pemanenan kayu dan penanaman kembali lahan hutan bekas tebangan.

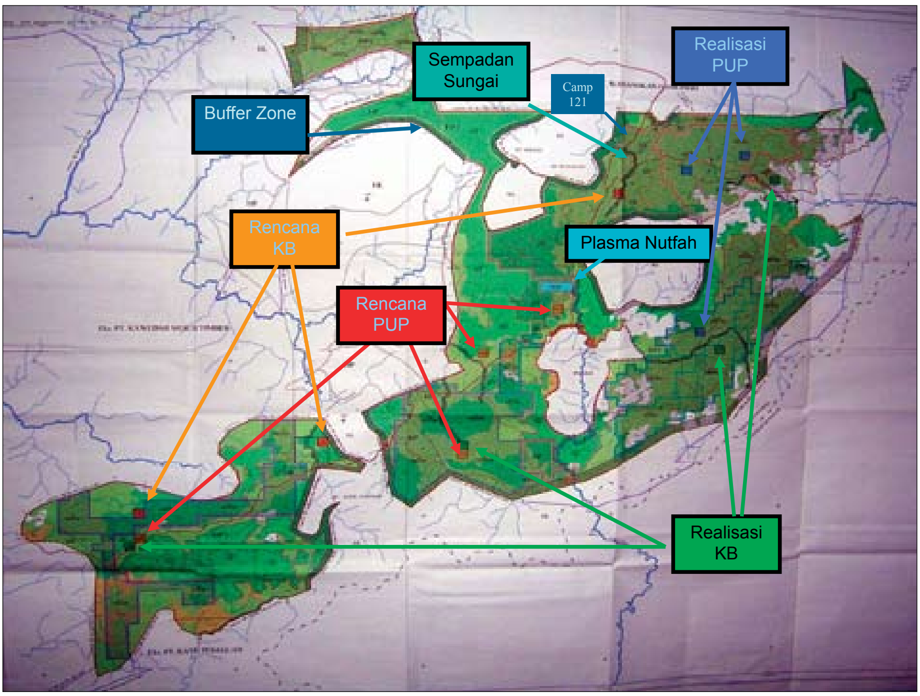
Citra Landsat SJM

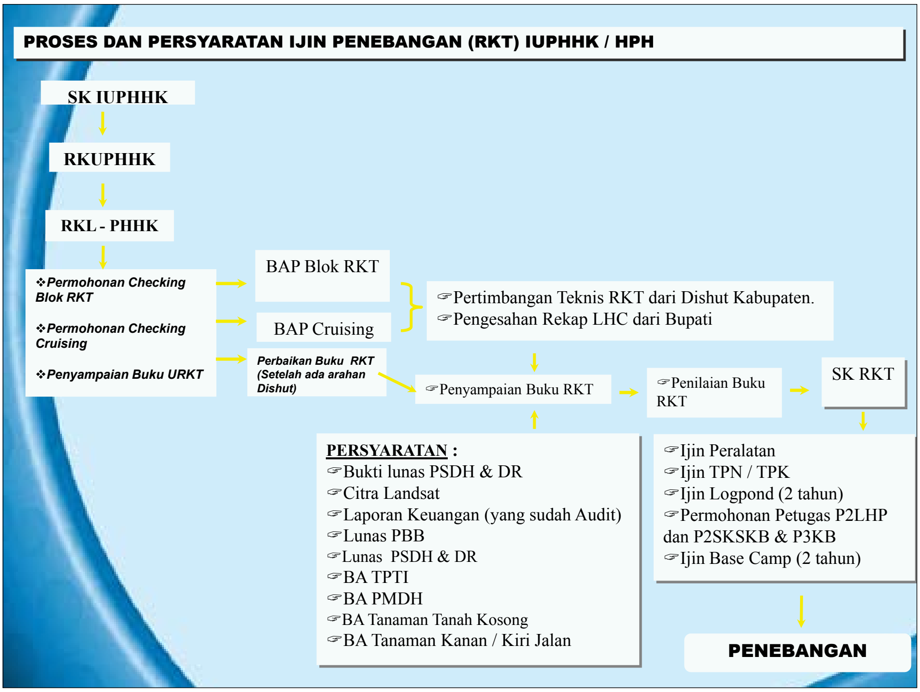


Informasi Citra Landsat Dipergunakan dalam penataan UM,yaitu:

1. Untuk menafsirkan kondisi vegetasi pohon pada areal UM secara makro dalam penyusunan RKU
2. Mendeliniasikan Luas VF (kompak, tersebar), LOA (bekas tebangan) dan NH (non hutan) pada areal UM
3. Menentukan Rumusan Etat Luas UM pada Rotasi I dan selanjutnya
4. Menentukan lokasi Blok RKT apakah VF atau LOA
5. Tools dalam membantu perencanaan umum (PWH, Produksi, Kawasan Lindung) dan restorasi ekosistem (Pembinaan Hutan, Silvikultur TPTJ) serta pengelolaan PMDH


PENATAAN PT. SUKA JAYA MAKMUR

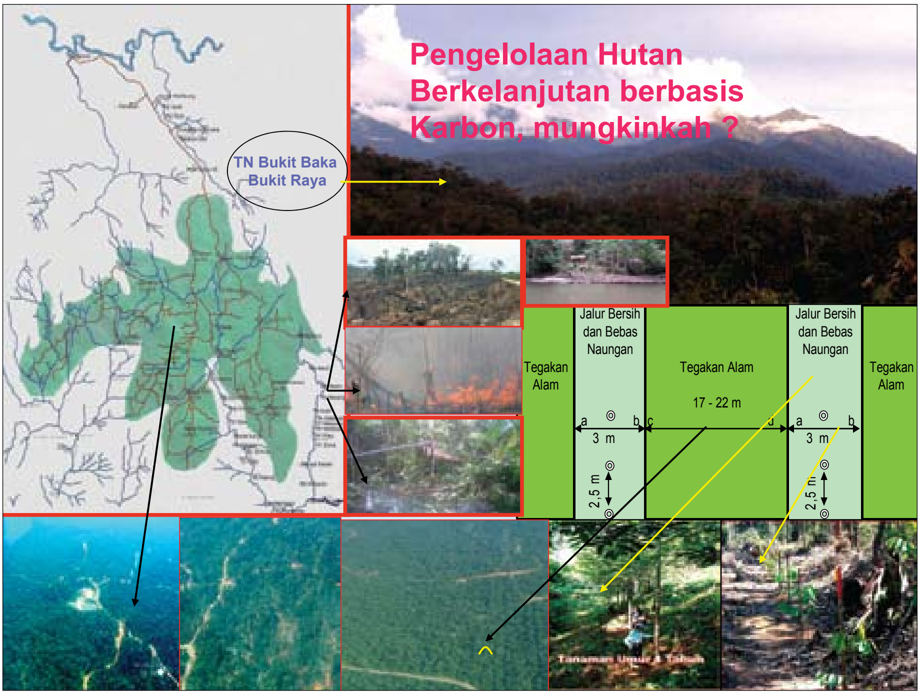

Sempadan Sungai
Realisasi PUP
Camp 121
Buffer Zone
Rencana KB
Plasma Nutfah
Rencana PUP
Realisasi KB



Laju Perkembangan Areal Non Hutan Tahun 1999 s/d 2006

Tahun	Luas	%
1999/2000	9239.55	6.26
2000/2001	13161.22	8.92
2002/2003	16200.67	10.98
2006	7756.6	5.26

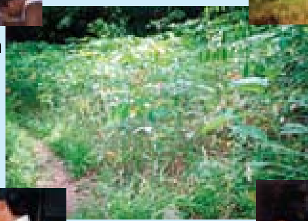
Sumber: Citra Landsat dan Pengukuran Planimetris


Pengelolaan Hutan Berkelanjutan berbasis Karbon, mungkinkah ?
TN Bukit Baka Bukit Raya
Tegakan Alam
Jalur Bersih dan Bebas Naungan
Tegakan Alam
17 - 22 m
Jalur Bersih dan Bebas Naungan
Tegakan Alam
a
b
c
d
a
b
3 m
3 m
2,5 m
2,5 m


Tanaman Jalur Umur 17 Tahun
Tanaman Jalur Umur 6 bulan
Tanaman Jalur Umur 1 Tahun
Tanaman Jalur Umur 2 Tahun
Tanaman Jalur Umur 5 Tahun


Pelatihan pengolahan rotan


Pembangunan Kebun Karet bersama masyarakat


Persemaian Karet


Penyerahan sertifikat kebun karet melalui prona


PKK dan Panganan Lokal

Remote Sensing has contributed to forest and landscape management. The technology, which includes sensors, processing software and analysis, has been extensively studied and applied. Studies that employed remote sensing have improved understanding of the sites studied. At the strategic level of forest planning, or in general planning for forest resource allocation over a wide area, remote sensing can play an important role in estimating and monitoring forest cover. At the tactical level, however, when planning forest management activities in a specific forested landscape, remote sensing has not yet contributed as much as expected: Methods proved successful under research conditions cannot always be applied to operational management. There is a gap between scientific and operational uses.

Recognising this gap, forest management practitioners and scientists gathered for a daylong focus group discussion to examine constraints and understand better what practitioners expected remote sensing to do for them. The following recommendations arose from the group discussions.

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