

# REMOTE SENSING APPLICATION IN RAINFOREST MONITORING IN BRUNEI DARUSSALAM

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## Abstract

Remote sensing application has advances over the decades from primarily aerial photography to detection and measurement of energy patterns from different portions of the electromagnetic spectrum to obtain information of an area or phenomenon on the earth surface or near environmental surface to study the physical and chemical characteristics from distance. This is common and ideal in forest sector study particularly in monitoring of forest cover changes. These interrelated disciplines have succeeded to observe the changing patterns of the rainforest in Brunei Darussalam from the year 1990 to 2015 based on primary and secondary sources relative to Brunei Darussalam. The monitoring of rainforest cover with more than 90% accuracy using multi temporal Landsat images deduced the trend of forest cover change in Brunei Darussalam with 46% non-forest expansion; 27% forest conversion and 12% forest regeneration in 25 years. Relatively, health, safety and environmental (HSE) procedure; statistical data for non-wood forest products; recognition of the shared indigenous culture in Brunei in relation to Borneo, and; sustainable development is suggested to supplement the rainforest sustainability.

**Keywords** Rainforest, Remote Sensing, Forest Cover, Monitoring and Sustainability.

## *The management of rainforest*

The resulted CIAF value of 29 are grouped into a built index matrix for forestry sustainability status that stood between 25 and 32 aligned with index 4 under well-managed category that indicates sustainable condition hence, reflects sustainable condition of Brunei forest under well management practice as presented in Table.

Table shows the Index-weighting matrix.

Weighting	Index	Categories	Condition
1-8	1	Poorly Managed	Unsustainable
9-16	2	Moderately Managed	Marginally Sustainable
17-24	3		
25-32	4	Well Managed	Sustainable

On the remote sensing component of multi temporal change detection analysis, supervised classification based on > 90% accuracy for each raw Landsat 4-5 TM and 8 OLI images were performed using Multispec 2.12.15 software from the year 1990 to 2015 acquired from USGS.

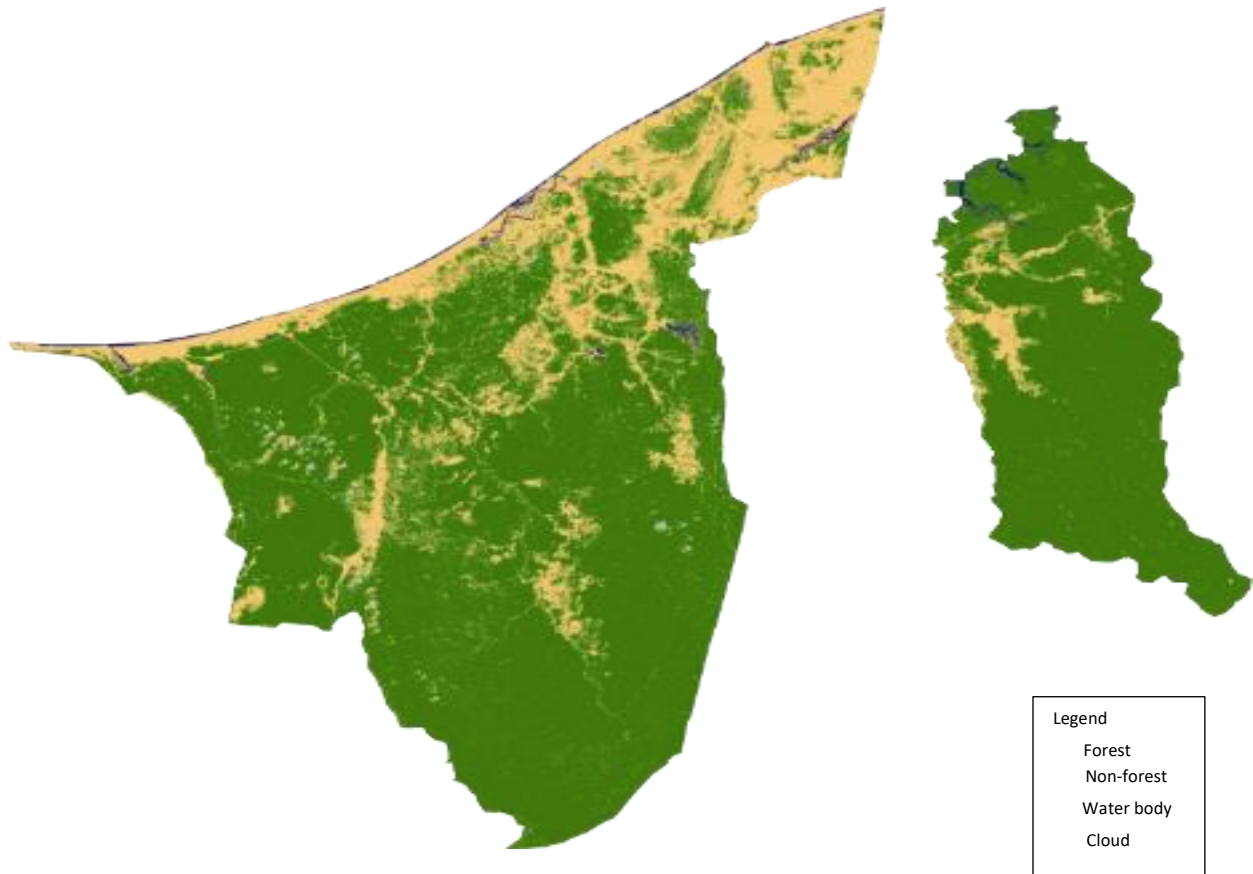


Figure1: shows the Supervised image re-classification of forest and non-forest cover in 2015.

Brunei are driven by: i) non-forest expansion from its focal point; ii) forest conversion into non-forest for built areas, plantation that overtime partially generate into sparse vegetation; iii) shift deforestation of forest regeneration and forest conversion on side to side; iv) incomparable forest regeneration, v) tracks development, and; vi) water body as development of reservoir. The extent and trend of the forest and non-forest cover changes over the years presented is in the Figure 2 and 3.

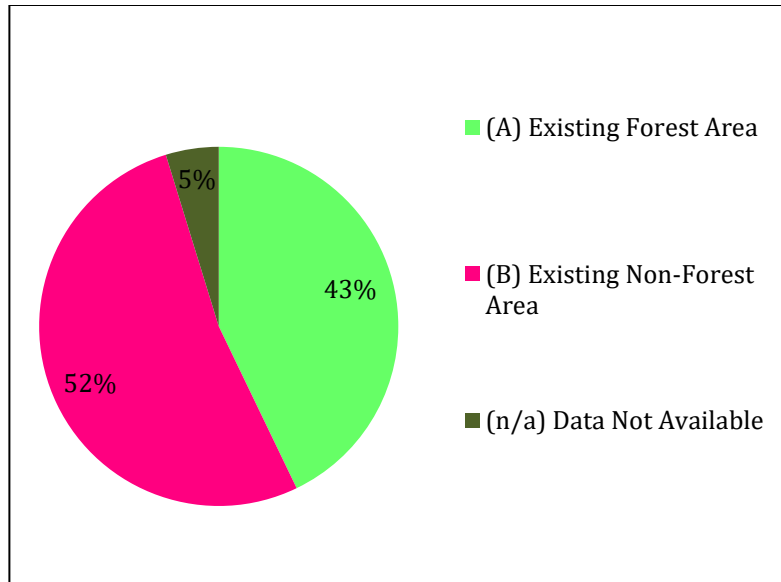


Figure 2: Forest and non-forest cover trend of changes in 1990

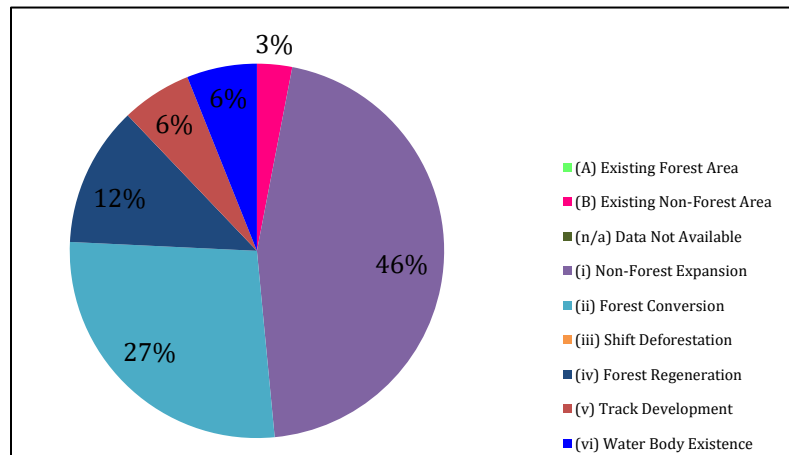


Figure 3: Forest and non-forest cover trend of changes in 2015.

Figure 2 shows existing forest area (43%), existing non-forest area (53%) and missing data area (5%) in 1990. By 2015 [Figure 3], the existing forest area had undergone changes

which detects increasing non-forest expansion (46%), forest conversion (27%), decreased in forest regeneration (12%), tracks development (6%) and newly covered water body (6%) leaving shift deforestation and existing forest area 0% [Figure 3]. Whereas the missing data areas have newly gained coverage identified as existing non-forest areas (3%). Therefore, the adoption of both ITTO C&I and remote sensing application in this research has perceived the tropical forest sustainability and visualize the progress of forest cover change in the frame of development, urbanization and economic demand.

## **Conclusion**

In conclusion, the use of both ITTO C&I of SFM for Tropical Forest and remote sensing application of multi temporal change detection analysis has measures and comprehends Brunei tropical forest sustainability in 25 years. The well-managed and sustainable forest management accompanied by active forest cover change in Brunei are contributed from the centralized forest management practice [1], oil and gas industry [20], traditional lifestyle evolution into modern form [9], preference with involvement in formal sector and awareness of formal education value [12].

Nevertheless, in association with the loose factors, relative initiatives to supplement forest sustainability in Brunei are suggested for instance: i) a set of detailed HSE procedures to guide forest workers, forest environment, forest industry and environmental forestry including educational or recreational forestry; ii) consideration of the non-wood forest products statistical data and harvests in the informal market as its myriad products are used or consumed in everyday life hence would be beneficial and significant resources; iii) recognition of the regionally shared unique indigenous culture of Brunei with the neighbouring states would be an added value to both forestry and eco-tourism industry hence to the national economy, and; iv) relevant sustainable development initiative [6] to support sustainable forest cover of the country in the long run such as co-finance investment between government and investors for certain land use or promotion of production practices in afforestation, sustainable forest management and sustainable land management. As well as subsidies provision for sustainable land management practice; green technology (water treatment plants, soil conservation equipment, energy efficient light bulbs) or; non-monetary provision of technical assistance, seed and plants.