Primary forests in the Asia-Pacific region: status, extent and diversity

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Asia-Pacific Forest Sector Outlook: Roadmap for primary forests conservation. Online expert workshop

23-25 March 2021
Primary forests...

Gibson, L. (2011) Primary forests are irreplaceable for sustaining tropical biodiversity.

Watson, J. E. et al. (2018). The exceptional value of intact forest ecosystems

Potapov et al. 2017 Intact Forest Landscape

Krogh, A. 2019. State of the tropical rainforest. Rainforest Foundation Norway “One third of the original tropical rainforest is still intact, one third is degraded.

Recent development of an “Forest Landscape Integrity” index (Gantham et al. 2020) or assessment of “Deforestation Fronts” (Pacheco et al. 2021)
• Of the Asia Pacific region’s 723 million hectares of forest, only 19 percent (140 million hectares) is primary, much lower than the global average (32 percent) (APFSOS III: FAO, 2019)

• Reversing this trend must be a priority for all countries in the region now and in the next decade to ensure our survival, notably in the face of climate change
Historical trends 2000 – 2020 of natural forest cover

Data
• Landsat 5 TM, 7 ETM, 8 OLI 30m
• Image selection for non-tropical zones: summer time
• NASA SRTM Digital

Pre-processing and image enhancement
• Cloud masking
• Image correction and composition
• Indices generation: NDVI and NDII

Sample collection
• Stratified random sampling
• Visual interpretation
• Sample references: forest maps from AP countries

Classification
• Band: near infra red, short wave infrared 1, short wave infrared 2, NDVI, NDII
• Grid is used to divide area into smaller parts: 182 grids
• Support Vector Machine

Sample collection
Landsat composite NIR, SWIR1, SWIR2
Location: Indonesia
Ecozone: tropical rainforest, tropical mountain system

Location: Tasmania, Australia
Ecozone: temperate oceanic forest, temperate mountain system

Forest
Non-forest
Natural forest cover
Asia Pacific year 2000

771,142,000 ha
Natural forest cover 2020 (732,264,000 ha) and deforestation 2000-2020.
Indonesia: Deforestation 2000-2010 (yellow), 2010-2020 (red)
Results overlaid on ecological zoning for stratification.
Global Ecological Zone, FAO

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//www.fao.org/geonetwork/

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<th>Eco-floristic zoning and ecological mapping</th>
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<td>Temperate deciduous broadleaves</td>
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Forest and Eco-floristic Sectors

Legend

- Province Boundary
- Natural Forest Cover in Eco-floristic Sectors
  West Coast
  - Tapakwuran-Bantru-Anekt Block (+ 500 m)
  - Aramalga-Beklukun Block (+ 500 m)
  - Pessar-Takuru Block (+ 500 m)
  - Bengkulu Block (> 500 m)
  - Western Hills
    - Tapakwuron-Bantru-Anekt Block (500 - 1000 m)
    - Aramalga-Beklukun Block (500 - 1000 m)
    - Pessar-Takuru Block (500 - 1000 m)
    - Bengkulu Block (500 - 1000 m)
  - Sulawesi
    - Submontane North (1000 - 2000 m)
    - Submontane Central (1000 - 2000 m)
    - Submontane South (1000 - 2000 m)
  - Montane
    - Montane North (2000 - 2500 m)
    - Montane Central (2000 - 2500 m)
    - Montane South (2000 - 2500 m)
  - Low Forest and Thickets of the Dipterocarpus Zone (> 2000 m)

- East Coast
  - Langsa-Banda-Anekt Block (500 - 1000 m)
  - Aramalga-Langsa Block (500 - 1000 m)
  - Tabuk-Talutun Block (500 - 1000 m)
  - Sonol trigosa-Tembolo Block (500 - 2000 m)

- Eastern Lowland
  - Langsa Block (< 500 m)
  - Anekt Block (< 500 m)
  - Piau Block Sawai to Batuwar (< 150 m)
  - Upper Bajang Hru-Lower Bajang Hru (< 250 m)
  - Upper Bajang Hru-Lower Bajang Hru (< 500 m)
  - Jero Block South of Kavenen (< 150 m)
  - Tipahpuh Mountine Block (< 500 m)
  - Tipahpuh Mountine Block (< 1000 m)
  - Palamting Block, South of Muar (< 100 m)
  - Lampung Block (< 100 m)

- Swamp
  - Fresh Water Swamp on Alluvium (Shallow Pond)
  - Mixed Peat Swamp
  - Peat Swamp Mosses, Deep Peat Mus

- Other
  - Coastal Forest Formations
  - Vegetation on limestone
  - Takengon Peat Forest

- Non Natural Forest Cover
  - Non Forest
  - Water body
  - Cloud

1985
1. Tigapuluh Mountains (ancient flora of the Sunda shelf “Riau Pocket”)

2. Langsa lowland and hill forest Aceh

3. Peat swamps

4. Submontane Bengkulu
Looking for Primary Forest
1st Approach K-Means Clustering

• K-Means clustering with proper input bands can be powerful enough to differentiate intact and degraded forest in classification.

• Can then be used as basis to select intact and degraded forest samples in supervised classification

• Principal Component Analysis (PCA) or Supervised Classification can be used to identify correlation between classes and input bands

• How far is it efficient in detecting degradation criteria?
Landsat archives

Pre-processing
- Cloud-masking
- Topographic correction
- BRDF correction
- Median composite using 3 years-window

Feature processing
- Create NDs: NDVI, NDWI, NDBI, EVI, SAVI, SLAVI
- Create PCA of NDs
- Create 7 Haralick's texture: con, corr, savg, idm, asm, ent, var
- Create PCA of Textures
- Add band: Tree cover masked with loss

Data ready for processing
- Six Landsat bands
- 3 first bands of PCA NDs
- 2 first bands of PCA NDs
- Tree cover

K-Means Clustering Analysis using k=20

Labelled clusters: tentative forest cover 2000 & 2019
Un-labelled clusters
Clustering Analysis
2nd tested approach: Intact forest classification using Landsat time-series trajectories (adapted from Wang et al. 2019)

- Intact/undisturbed forest tend to have very low slope of regression and very low standard deviation.
- Forest which have experienced large disturbances would be expected to have higher CV than undisturbed forests.
Forest cover 2020 (draft)
Using Landsat time-series trajectories (Wang et al. 2019)

Forest cover 2020 (reference)
(Vancutsem et al. 2020)

Fragmentation: measuring the spatial density of forest cover, Forest Area Density (FAD, Riitters et al. 2002), at five observation scales using a moving window analysis with square neighborhood areas of length 7, 13, 27, 81, 243 pixels.

- **FAD**: concurrent multi-scale analysis at 5 fixed observation scales + multiscale summary
- **FOS**: same as FAD analysis but at user-defined single observation scale
Thank you