Typology Analysis of Land and Forest Fire in Riau Province, Indonesia

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International Workshop on Land Use/Cover Change and Air Pollution
Bogor, 4-7 August 2015
Outline

• Introduction
• Fire Season in Indonesia & Riau
• IFEWS
• Fire Types
• Canal Blocking
• Burned Area
• Remarks
Facts

• Indonesia experiences the world’s 2nd highest deforestation rate
• Including one of the largest emitters of greenhouse gasses emission due to: forest cover loss and peatland degradation

Problems

• Complex and conflicting definition
• Lack of adequate data sets
• Need a robust method
• Insufficient infrastructure for the work at national scale

Consequences

• Cannot provide near real time information
• Lack of consensus for areal extent and temporal trends of forest cover loss
Forest Area in Indonesia & Riau (MoF 2014)

- Production: 88%
- Conservation: 9%
- Protection: 3%

Forest Area in Riau Prov (MoF 2014)

- Production: 88%
- Conservation: 9%
- Protection: 3%

Forest Area in Riau Prov

- Riau: 7,121,344.00 hectares
- Indonesia: 129,425,443.66 hectares
Ministry of Environment & Forestry

DG of Climate Change

Adaptation

Mitigation

GHGs Inventory & Monitoring

Mobilisation

Resources

Land and Forest

Fire

Early Warning System

Early Detection System

Burned Area Estimation

LAND USE/COVER CHANGES AND AIR POLLUTION IN ASIA

AUGUST 4th-7th 2015, BOGOR, INDONESIA
Directorate of Land and Forest Fire Control

- Planning
- Prevention
- Supression
- Fire Community
- Equipments

↑ FDRS
↑ Hotspot

Fire Brigades Manggala Agni
Fire-Caused Emissions

Combustion → Emissions
Emissions = GHG + Pollution

GHG – A Global Problem
Pollution – National, A Regional & International Problem
Emissions are a National & Regional Problem

Human Health, Commerce, Transportation, Regional Haze, Trans-Boundary Geo-Political Issues

Sumatra, February 28, 2014

Peat Fires, Indonesia, June 2013
Monthly Hotspot Pattern in Indonesia (2010-2013)
Fire & Haze Season in Indonesia

First Season: February – March
(North/South Sumatra, Riau, Jambi)

Second Season: June - September
(Whole of Sumatera and Kalimantan)
Fire Pattern in Indonesia

Peat land Fire Region – Open Burning Practices

Ground Wildfire Region
Big fire episode in Indonesia

Fire in Riau: short period, high intensity
Fire in Riau Province, 26 July 2013
credit photo: Agus Wibowo-BNPB

Burnt area
### Fire Hotspots on Forest & Non Forest

<table>
<thead>
<tr>
<th>Year</th>
<th>Forest</th>
<th>Non Forest</th>
<th>Forest</th>
<th>Non Forest</th>
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<th>Non Forest</th>
<th>Forest</th>
<th>Non Forest</th>
<th>Forest</th>
<th>Non Forest</th>
<th>Forest</th>
<th>Non Forest</th>
<th>Forest</th>
<th>Non Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>28%</td>
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<tr>
<td>2008</td>
<td>22%</td>
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<tr>
<td>2009</td>
<td>72%</td>
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<tr>
<td>2010</td>
<td>10%</td>
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<td>2011</td>
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<tr>
<td>2012</td>
<td>12%</td>
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<tr>
<td>2013</td>
<td>13%</td>
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<td></td>
</tr>
</tbody>
</table>

**Fire Hotspots 2006-2013**

- Forest, 28%
- Non Forest, 72%
Indonesia Fire Early Warning System (IFEWS)


MODIS-FHS Dissemination

MoFr-LAPAN-MoNatEd – Inherent (Indonesian Higher Education Network)
POTENSI TINGKAT KESULITAN PENGENDALIAN APABILA TERJADI KEBAKARAN HUTAN DAN LAHAN

Fire Weather Index

Berdaku untuk 06 Juni 2015 Wilayah Indonesia

Keterangan:
- Aman
- Tidak Sult
- Sulit
- Sangat Sulit

Subdit Cuaca Ekstrim Bidang Peringatan Dini BMKG
Sumber Data: Data Realtime Pengamatan Sinoptik BMKG
POTENSI TINGKAT KESULITAN PENGENDALIAN APABILA TERJADI KEBAKARAN HUTAN DAN LAHAN

Fire Weather Index

Berdalu untuk 15 Juni 2015 Wilayah Indonesia

Keterangan:
- Aman
- Tidak Sulit
- Sulit
- Sangat Sulit

Subd Cuaca Ekstrim Bidang Peringatan Dini BMKG
Sumber Data: Data Prakiraan (MODEL WRF)
FDSR application at Siak Fire Brigades Office, Riau

FDSR application at Minas Fire Brigades Office, Riau
Study Area

- Riau province as the highest number of hotspot
- Highest land and forest fire occurrences
- Fire prone area designated
- Source of transboundary haze pollution
- Peatland (3.8 mio ha/ 43% Riau area)
Fire in Riau
### Hotspot in Riau based on Land Use

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation Area</td>
<td></td>
<td>49</td>
<td>50</td>
<td>232</td>
<td>262</td>
</tr>
<tr>
<td>Natural Forest</td>
<td></td>
<td>90</td>
<td>181</td>
<td>294</td>
<td>244</td>
</tr>
<tr>
<td>Planted Forest</td>
<td></td>
<td>395</td>
<td>819</td>
<td>1.059</td>
<td>1.077</td>
</tr>
<tr>
<td>Protected Forest</td>
<td></td>
<td>47</td>
<td>126</td>
<td>271</td>
<td>234</td>
</tr>
<tr>
<td>Plantation</td>
<td></td>
<td>121</td>
<td>263</td>
<td>337</td>
<td>417</td>
</tr>
<tr>
<td>Land/Others use</td>
<td></td>
<td>1.005</td>
<td>2.097</td>
<td>2.493</td>
<td>2.948</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1.707</strong></td>
<td><strong>3.536</strong></td>
<td><strong>4.686</strong></td>
<td><strong>5.182</strong></td>
</tr>
</tbody>
</table>

**Source:** MoF
Fire Hotspot in Indonesia, Riau Prov & Dumai District

Year | Hotspot Count
--- | ---
2010 | 15,525
2011 | 45,814
2012 | 52,079
2013 | 40,187
2014 | 42,083

Indonesia

Riau
Hotspot in Riau based on Districts

![Graph showing hotspot distribution across districts in Riau with data for 2013 and 2014, highlighting the Dunai district with a red circle.]

- Bengkalis
- Pelalawan
- Siak
- Rohul
- Rohil
- Dumai
- Inhul
- Inhil
- Kampar
- PKU
- Kuansing
- Meranti

**Graph Key:**
- Blue bars represent data from March 2014.
- Red bars represent data from 2013.
### Peatland in Riau Province

**Total Riau : 8.915.015,09 HA**

<table>
<thead>
<tr>
<th>No</th>
<th>District</th>
<th>Area (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indragiri Hilir</td>
<td>982.526</td>
</tr>
<tr>
<td>2</td>
<td>Indragiri Hulu</td>
<td>222.396</td>
</tr>
<tr>
<td>3</td>
<td>Bengkalis</td>
<td>856.386</td>
</tr>
<tr>
<td>4</td>
<td>Pelalawan</td>
<td>679.371</td>
</tr>
<tr>
<td>5</td>
<td>Siak</td>
<td>503.669</td>
</tr>
<tr>
<td>6</td>
<td>Rokan Hilir</td>
<td>453.874</td>
</tr>
<tr>
<td>7</td>
<td>Rokan Hulu</td>
<td>50.481</td>
</tr>
<tr>
<td>8</td>
<td>Dumai</td>
<td>159.595</td>
</tr>
<tr>
<td>9</td>
<td>Kampar</td>
<td>119.775</td>
</tr>
<tr>
<td>10</td>
<td>Pekanbaru</td>
<td>5.231</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4.033.304</strong></td>
</tr>
</tbody>
</table>
Peat Fire Characteristics

• Peat fires in Riau mostly surface fires: spread fast and consumes surface fuel in short time.
• Deep peat fire (smoldering fires) spread slowly.
• Peat fires may occur after the peat has been drainaged and under ground water level more than 40 cm.

Peatland Fire vs. Peat Fire
Peatland Fire = Fire on a peat dominated site
Peat Fire = Ground Fire burning in Peat Soil

surface fires on peatlands lead to peat fires when peat soil is dry.
Fire Types

1. Small scale land fire owned by community for a particular planting eg pineapple.
2. Area extention by burning the shrub
3. Encroachment using fire at plantation area
4. Open a new land for plantation
5. Fire at natural forest (conservation area and core zone of biosphete reserves)
Sources of the fires

- Land Conversion
- Drought
- (Illegal) Shifting Cultivators
- Land preparation using fire for forestry and oil palm activities
- Logging
Fire in Riau Province, 26 July 2013
credit photo: Agus Wibowo-BNPB
Declared by UNESCO-MAB programme as biosphere reserve at Jeju, South Korea 25 – 29 Mei 2009
Minister of Forestry as of 1 July 2009 (705.271 ha)
Fire at Giam Siak Kecil Biosphere Reserve
Fire at Giam Siak Kecil Biosphere Reserve
Land fire at Sepahat sub-district, February 2014
Surface fire in wild *Acacia* forest in Siak District, Riau (March, 2014)
Peatland fire at Siak District, Riau 2014
Land fire at Dumai District, Riau, February 2014
Land preparation using fire near Riau airport (July, 2015)
Burned at Sepahat, Dumai district, Riau

Burned area at Pelintung, (along left-side the road), Dumai district, Riau
Land for sale...
Canal Blocking

There has been a big program call blocking canals in Riau as part of prevention activities. Actually the Government plan to set up 1000 blocking canals in order to re-wetting the peatland. But, the latest proposal is to set up 629 canal blocking in Riau itself.

125 locations already verified to build the canal. But the progress is too slow due to administration procedure.

Under the Ministry of Environment and Forestry, 25 blocking canals in Kepulauan Meranti have just established. Since last March 2015, Riau province stated as 'fire emergency status' till the end of August.

UNDP is also interested in establishing the blocking canal for other location in Riau as well as Jambi province, and July 2015 they start to verify the locations.
Shallow water level at Siak Giam Kecil, Riau, prevented the fire from establishing a deep peat fire. Fires here thus categorized as surface fires on peat. The fires spread quickly and brought high damage severity to the area. The areas were burned at February, 2014.
The development of an appropriate canal will reduce the negative effect of using the peat land. In the reality many of the development of canals did not follow the rules, so the negative effects were occurred, i.e. flooding, disappearance of flora and fauna, increased forest fires, sedimentation and reducing the quality of river (Anwar, 2006)

Canal in Giam Siak Kecil Biosphere Reserve

Canal in four years old oil palm plantation
Canal constructed by community in Pelintung, Duma, Riaui for oil palm land preparation
### Burned Area in 2013 (official report from Regional Offices)

<table>
<thead>
<tr>
<th>Provinces</th>
<th>Burnt Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Sumatra</td>
<td>175.00</td>
</tr>
<tr>
<td>Riau</td>
<td><strong>1,077.50</strong></td>
</tr>
<tr>
<td>Jambi</td>
<td>199.10</td>
</tr>
<tr>
<td>South Sumatra</td>
<td>188.76</td>
</tr>
<tr>
<td>West Kalimantan</td>
<td>22.70</td>
</tr>
<tr>
<td>South Kalimantan</td>
<td>417.50</td>
</tr>
<tr>
<td>Central Kalimantan</td>
<td><strong>0.05</strong></td>
</tr>
<tr>
<td>West Java</td>
<td>257.78</td>
</tr>
<tr>
<td>Central Java</td>
<td>31.20</td>
</tr>
<tr>
<td><strong>East Java</strong></td>
<td><strong>1,352.14</strong></td>
</tr>
<tr>
<td>Yogyakarta</td>
<td>6.00</td>
</tr>
<tr>
<td>Bali</td>
<td>60.50</td>
</tr>
<tr>
<td>West Nusa Tenggara</td>
<td>12.00</td>
</tr>
<tr>
<td>East Nusa Tenggara</td>
<td>624.11</td>
</tr>
<tr>
<td>North Sulawesi</td>
<td>0.25</td>
</tr>
<tr>
<td>SE Sulawesi</td>
<td>13.00</td>
</tr>
<tr>
<td>South Sulawesi</td>
<td>36.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,469.09</strong></td>
</tr>
</tbody>
</table>

MoFr received FBA data from the regional office.
Landsat 8 as source of burned area estimation

2013

2014
Fire Hot Spot in Riau Province
Fire Hot Spot in Dumai City, Riau Province
Burned Area Estimation: Semi-Auto Classification

Landsat Image Riau 2010-2015 CC 20%

- 2010: 7
- 2011: 2
- 2012: 7
- 2013: 9
- 2014: 10
Landsat8 127/59, 24.03.2014
Band 2-7 (Blue-Green-Red-Nir-SWIR1-SWIR2)
RGB 543 (Color Infrared – Vegetation)

DN to Reflectance
Fire Detection

ROIs

Burned Area Classification
FHS MODIS Validation
Ground truth validation
Burned Area Estimation
Depth of fire on peat, Riau 2014

20-30 cm
Community Development

FDRS sign board at Siak Fire Brigades Office
Fire Controlling
- Prevention
- Suppression
- Handling of Impact

Manggala Agni: 2,800
Community Fire: 7,308
Remarks

- Peatland fire will be repeatedly occur in Riau. Need a proper policy based on scientific knowledge.
- Surface fires on peatland lead to peat fires when peat soil is dry.
- Development an applicable methodology to measure the burned area (and depth) of peatland fire is very important (eg. for MRV).
- Applicable methods needed to estimate BA regularly...
Outlook

- Ground truth at study area (validation)
- Study with BAMS (Burned Area Mapping Software, 2014)
- Compare Landsat Reflectance
Thank you