

The Role of Scientific evidence in law enforcement for forest and land fires cases

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Abstract

One of the best way to reduce fire impact for wildfire made through illegal burning is prevention activity which started couple months before fire blow-up, it will succeed if and if supported by enough facility, man power and technology if not then fire suppression will depend on. Actually there is one important activity in minimizing illegal burning which produce negative impact that is law enforcement. To apply this activity in order to get the suspect hence scientific evidence as the best answer according to the law. Through scientific evidence the negative impact made from illegal burning such as air pollution and peat destruction can be used to bring the suspect to the jail. In Indonesia especially during 2006 the case from forest and land fire increased significantly means law enforcement can be used as a tool in fire management. Hopefully through this way the negative effect made from illegal burning can be solved and healthy environment produced.

Introduction

1997/1998 Indonesian forest fires at least 20 million of peoples were directly and indirectly affected by fire. Black smokes contain many air pollutants: CO, CO₂, SO₂, NO_(x) and NH₄ and bacteria such as Streptococcus causes many diseases such as diarrhoea, pneumonia, bronchitis and brain disturbance. Thousand of people in Riau, Jambi, South Sumatra, and Central, West and East Kalimantan were hospitalized for medical treatments. Smokes that continued for at least two months in southern Sumatra at which time the lack of sunshine reduced food production and caused many peoples to seek emergency food sources. Hundreds of peoples also died in Irian Jaya because the transportation of food and other supplies could not reach their areas due to smoke.

It has been scientifically demonstrated beyond reasonable doubt that fire has been part of the natural ecosystem in Indonesia for many thousands of years, and burning coal seams have been part of the landscape in that time. The vulnerability of Indonesian forest is also linked to more fundamental issues of forest management and the role of communities and local governments. There is very little attention given to the existence of local communities living close to the forests, including those that are vulnerable to fire (UNCHS 1999).

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Usually when fire broke up in many provinces in Indonesia, many people's blames shifting cultivator as cause of it. Unfortunately, it was proved that the sources of fires in 1997 forest fires were mostly from land preparation using fire for forest plantation and estate crops. It was shown that 65 % (Anonymous 1998) until 80 % (WWF 1998) of the forest area burned in East Kalimantan was done in the forest concessions and estate crops. This was also supported by the Ministry of Forestry statement which announced the list of 176 companies that suspected burn they land for forestry and estate crops planting. By the way, none of those companies being subject for punishment by the government due to not enough evidence. In 1999 again it has been known that more than 40 companies doing the same things like in 1997/1998 but no punishment then followed by more than 50 companies in the year 2000 and at the same level in the year 2001. Fire is used in the land preparation for forest plantation, as it is easy, cheap and very simple. At the 1st October 2001, for the first time one oil palm company punished due to using fire illegally for their land preparation. Judge come to the conclusion that they are found guilty due to using fire illegally for land preparation and because of it the General Manager was punished 2 years in jail and 250 million rupiahs for the compensation. The important things behind of this judge decision was that fire science that used by forest fire expert witness in front of the court can be used to explain the situation and to make sure who behind the fires. Environmental law No.23/1997 especially with article 41 and 46 was used in this case. By now more than 50 forest and fire cases had been investigated especially during 2006 and half of it had been punished through court trial where illegal burner compensated for 1-2 years in jail.

Fires Disastrous

Forest fires have been reported a number of times over the past 150 years on the island of Borneo and such fires probably also occurred in Sumatra. Records of forest fire were first made in the late 19th century when Michielsen (in 1882) conducted a survey of the region between the Kalanaman and Cempaka Rivers (now Sampit and Katingan Rivers) in Central Kalimantan. He reported that forest fire had damaged a number of sites in 1877. Soon after Gerlach recorded evidence of forest fires in what is now the Sentarum Lake Wildlife Reserve in the Southwestern region of West Kalimantan. It can no longer be assumed that tropical forest fires are a recent phenomenon. But the frequency and intensity of tropical forest fires have increased in parallel with the frequency and intensity of human activities in the forests (Schindler 1998).

An analysis of remote sensing data from the mid-1980s indicated that the Indonesian archipelago contained about 10 million ha of grasslands at the time (RePPProT 1990). Much of the remaining forest has been logged in recent years, and logged forests are frequently degraded or converted to agriculture. The present landscape is a mosaic of vegetation types and land uses, including some intact forest ecosystem, logged forest in various stages of regeneration, scrubland, grassland, annual crops, and tree plantations (Qadri 2001).

Periodic fires have been reported in the Lake Sentarum Wildfire Reserve in West Kalimantan since the middle of the 19th century. Brunig (1971) reports that the relatively fire-prone *kerangas* of heath forest of Sabah and Sarawak burned spontaneously or by human action in the 1880_s, the early 1930_s, and the late 1950_s. So while the burning of forest of Sumatra and Kalimantan is clearly not a recent or geographically unique phenomenon, the fact that these islands remained largely forested until recent decades indicates that neither naturally caused fire or human use of fire led to significant deforestation in the past (Qadri 2001).

During pronounced *El Nino* years, when conditions are usually dry, fire and smoke problems tend to be much more serious. Serious fire occurred in 1982-1983, 1987, 1991-1992, 1994-1995, and 1997-1998, 2000, 2002 and 2005. The economic cost of the fires has extended far beyond the destruction of large tracts of forestland. In addition to the direct damage these fires have caused to human and animal populations living in the affected areas, the resulting smoke has directly imperilled human health and economic well-being in adjacent AMCs (Qadri 2001).

One of the most serious of the recent fires was in East Kalimantan during 1982-1983, demonstrating the greater vulnerability of disturbed forests to blazes. In the fire season, ENSO caused large-scale wildfires, which ran out of control from several land clearings and slash-and burn sites as well as from logging areas, *alang-alang*, and camping sites. It has been estimated that the overall land area of Kalimantan affected by fire exceed 5 million ha, where in East Kalimantan alone, about 3,5 million ha were affected by drought and fire.

Land and forest fires that occurred during the extended dry periods in 1987 (66,000 ha), 1991 (500,000 ha), and 1994 (5.11 million ha) were distributed over some 25 provinces, including Maluku and Sulawesi. These fires were larger than during years with normal rainfall. The smoke emitted from the Indonesian archipelago during these years was not primarily caused by forest fires alone, but also by the application of fire for converting forest into estate tree crops and forest plantations, as well as by slash-and burn agriculture (Goldammer 1998).

Noted by UNEP as one of the biggest environmental shocks since 1950, the 1997-1998 forest fires of Indonesia were among the most damaging in recorded history (UNEP 1999). The area affected by fire has been estimated as 9.76 million ha. Indonesia (and Malaysia) experienced one of the worst recorded droughts in recent history during that period. It occurred in two spells. The dry conditions that started around April 1997 abated briefly by November 1997. But the *El Nino* persisted and drought resumed in early 1998, in a pattern reminiscent of the *El-Nino* drought and fires of 1982-1983. The second spell lasted from January to May 1998, until the onset of rain. Less serious, sporadic fires occurred in the dry season of 1999.

Sources

Illegal Shifting Cultivators

Usually when fire broke up in many provinces in Indonesia, many people's blames shifting cultivator as source of it, because they used fire for land preparation for agricultural purposes. It was proved by jailing three of them in East Kalimantan in 1997 and also in Riau in 1999 and another's six person in the year 2005. Of course shifting cultivators used a fire for they land preparation, because it was cheap, and easy to do, and it was done for thousands years ago (Goldammer 1993) without any environmental problems like it happens now. Shifting agriculture systems in their early practice and extends use largely determined by low human population pressure on the forest resources. They provided a sustainable base of subsistence for indigenous forest inhabitants, and their patch impacts had little effects on overall forest ecosystem stability (Nye and Greenland 1960). By burning they will got a free mineral from ash that rich of organic-carbon, phosphorus, magnesium, potassium, and sodium. The nutritional value increase temporarily after burning, however, because when rainy comes, it will be leached and decline (Garren 1943; Jordan 1985 and Saharjo 1995).

The origin of the 1982-83 fire has not been definitely identified, but swidden agriculture has been considered as one of the most plausible sources (Wirawan 1985). Swidden, slash-and-burn or shifting agriculture has been traditionally practiced by rural people in Borneo, as in many other parts of the tropics. With the intention of planting crops at the onset of the rainy season in November and December, they usually start clearing and then burning their fields during the second half of the dry or less rainy period, usually in September and October, while in Sumatra on August to September. The timing of their slash-and-burn practice is well established and is primarily based on the annual variation of the Monsoon.

By the way one of the reasons why shifting cultivators activity become environmental problem is because of illegal shifting cultivator did it (Saharjo and Husaeni 1998). They are not the real shifting cultivators but they are a new comer from other cities or region who never did shifting cultivation and without any experienced. For the real shifting cultivator they are know how to burn and prevent fire jump to other place, for instance using fire breaks and they know also when fire should be put down and stop. This knowledge is not a simple and easy thing to be done quickly by the new comer. Some time they never think about this, then, burn it directly and we can imagine what would happen, burned are become larger and spread everywhere. Some time it takes several days, with black smoke in the sky.

Forest and land (oil palm)

It was proved that the sources of fires in 1997 forest fires were mostly from land preparation using fire for forest plantation and estate crops. It was shown that 65 % (Anonymous 1998) until 80 % (WWF 1997) of the forest area burned in East Kalimantan was done in the forest concessions and estate crops. This was also supported by the Ministry of Forestry statement

which announced the list of 176 companies that suspected burn they land for forestry and estate crops planting. By the way, none of those companies being subject for punishment by the government due to not enough evidence. In the year 1999 it has been known that more than 40 companies in Riau province doing the same things like in 1997/1998 but no punishment.

After the year 2000 then forest plantation and oil palm (un or intentionally) and the community with business perspective become the most significant activities produce smoke within the country. Fortunately in the year 2001 an oil palm company finally was punished, and until the year 2005 at least around 25 companies being investigated for court.

The use of fire is officially forbidden although every company uses it, because this is the only viable and economic method of reducing the huge biomass. The underlying cause is, hence, the policy that plans to convert 500,000 ha of forest into plantations every year (Schindler 1998). The government (CIFOR 1998) has licensed and stimulated many companies to develop new industrial plantations of rubber, oil palm and pulpwood, as well as transmigration sites. These activities require the clearing of hundreds of thousands of hectares of land, and fires are their cheapest option. The traditional method of claiming forested land as in many parts of the world has been to burn and then plant. It seems likely that migrants, particularly in areas near cities, as well as large government-sponsored agricultural or forestry development programs, are clearing forest to establish land claims.

Logging

Logging activities have greatly increased both fire risk and hazards (Mackie 1984). Access roads opened up the forests to both immigrant and local people for making field (Wirawan 1993). By opening up the forest canopy, logging activities have greatly stimulated the growth and accumulation of plant biomass near the ground. Additional dead biomass is also provided by deformed logs and branches left behind by loggers. The failure of the rainy season to arrive on time, as was the case in late 1982, prolonged dry season, dried this plant biomass and then helped the fires started by shifting cultivators in September or October to spread wildly unchecked for several months until heavy rain fall in May 1983. As a result, 70 % of the burned forest in East Kalimantan, occurred in the logged-over forest areas (Wirawan 1993).

When logging companies enter into a new area, they automatically bring with them the fire problem. They are opening up the forests and making them more susceptible to forest fires through road, logging waste, bulldozing through the stands and opening up the canopy and finally bringing in people as the source of fire (Schindler 1998).

Fire risk is increased dramatically by the conversion of material forests to rubber and oil palm plantations, and by the logging of natural forests, which opens the canopy and dries out the ground cover. Plantations are drier and trees are move evenly spaced than natural tropical moist forests, thus increasing the opportunities for fire to spread. Evidence also suggests that fires burned mostly easily in secondary forests that had already been disturbed through (frequently illegal) timber operations. Selective logging

destroys much of the most undergrowth and the closed canopy that reduces the likelihood and impact of forest fires in natural forests (Dudley 1998). Recently fire is used to exploit the natural rain forest especially in Kalimantan by the name of salvage logging. It was realized when fire come to their area and they do not have ability to fight it, resulted in the cleaning of the natural forest from shrubs and grass create a condition which easily entered. Unfortunately they do not cut down the trees burned but also fresh trees which are the main target.

Law enforcement

It has been well known that through recording data that fire emerge is not only wild behave but also manage by some one with certain purposes that is prohibited according to the law. To this kind of fire law enforcement is the answer to solve the problem by using scientific evidence at it had been done successfully in Riau province since the year 2000.

The investigation for illegal burning cases starting from hotspot found in the burnt area that was exist for a certain period, it might be in an oil palm plantation, forest production, shrubs, grasses and forest production area. In order to know the hot spot is real hot spot or fire spot then a team of investigator send to the burned area completed with Ground Positioning System (GPS). Recorded data hotspot from NOAA satellite for certain period that exist in the burned area that was investigated used for field checking. One of the success story on how law enforcement used for an oil palm plantation below show how it works.

Hot spot investigation

Based on NOAA 12 and 14 hotspot data reported by Regional Environmental Agency Sumatra found that there were many hotspots in the coordinate 1. E:101.59.06.3; N: 00.21.04.3, 2. E: 101.55.32.5; N: 00.21.32.0, 3. E: 102.00.24.8; N: 00.23.19.6 especially on 3 and 5 March 2000. To identified where it was and how the fire blow, a team consisted of forestry district staffs, state crops staffs, regional environmental agency Sumatra, forest fire expert witness and accompanied by regional police officers went down to the burnt area. Field identification/investigation resulted data and information such below:

- Burnt areas were in the village of Nilo Kecil and Telayap, Bunut sub-district, Pelalawan district, Riau province, in the land preparation area belong to PT.Adei Plantation and Industry (an oil palm plantation)
- Most of the burnt land is peat and flat
- Burnt area was completely covered with ash and charcoal
- Materials burnt was logs, branches, leaves, shrubs, and litter
- Fire ended at the edge of the site of block and was not jumped to the other block or community forest adjacent to the plantation
- Burnt logs indicated that fire blow-up with high fire intensity supported by 1 cm depth of heat penetration on log with 30-40 cm diameter
- At least 200 ha of land was burnt further ground surveying using satellite data found that burnt area due to fire was 2970 ha

- There were no found fire prevention and suppression facilities available in the burnt area and other plantation area

Field data analysis

Further investigated made by forest fire expert witness to the burnt area was focused on burnt peat. Burnt peat samples for physical, chemical properties and biological aspects were taken for laboratory analysis. Physical properties analyzed were peat moisture content, pores, while chemical properties analyzed were pH, NH₄, NO₃, P and ash while biological aspects was fungi, micro organism, respiration and C-mic. In order to know the depth of heat penetrated resulted from burnt fuel at the surface to the peat, then burnt peat was dig for every 10 cm depth to the below ground.

Based on the data/information taken from field investigation and laboratories analysis proved that fire in the land preparation for oil palm plantation was planned and systematically done in order to reach the target plantation with low production cost. Without fire this company should pay for their land ready to plant is around Rp.8-10 million/ha while using fire they just need Rp.700,000- Rp. 1 million/ha.

Fire was set up by putting gasoline or other type of fuel in the edge of block, which was one of the strategy to control fire not to jump to the non target area and fire end-up safely. They managed logged by stacking it in the land preparation area, which will not let fire jumped to the non-target area and they burnt between stacking. Covering burnt area with ash uniformly means that fires was under controlled where rate of the spread of fire had been arranged with fuel arrangement, because if it was not treated or uncontrolled then there should be an area that will not burn irregularly.

Further analysis found that the science and technology behind of those fires that mostly done in March. Riau province is relatively humid with high rainfall but not for March and July. This means that even though in March is relatively humid there will be a few days without rain at least for 7 to 10 days. This dry period will have an impact to the water table condition in peat layer. Water table in peat layer will decrease for a few cm (10 to 15 cm) and this will have an impact to the fuel load at the top layer which will drier. If fire applied in this period the penetration heat will have an average depth is around 10-15 cm, because below this lane the water will prevent fire to penetrate deeper. One of the reasons why they used fire in their land preparation is to increase peat acidity (pH) from low (around 3) to be around 6 which is trees normally growth and produce the fruits (oil palm). Without burning they should provide budget many times compared to using fire. 10-15 cm peat depth burnt is better than more than 50 cm if the fire applied in the dry seasons which let them lost media for planting. Only those persons who have a basic knowledge on agro-meteorological sense and have a basic of peat performance that can running this burning which should conducted carefully. Unfortunately economic benefit taken from using fire in the land preparation is not the only product resulted because negative impact to the environmental destruction occurred due to burning should be not to be left and should be focus for rehabilitation.

These measurement and calculation and laboratory analysis was done in order to make sure the judge team in making decision that fire found in the land preparation belong to an oil palm plantation was not wildfire but controlled fire managed by some one and due to the using fire illegally peat destroyed. This scientific analysis should be done in order to legitimate article 41(1) Environmental act No.23/1997 stated “ that any person who in contravention of law intentionally carries out an action which results in environmental pollution and/or damage, is criminally liable to a maximum imprisonment of 10 years and a maximum fine of Rp.500,000,000 “ and article 46 stated that “if a criminal action is provided for in this chapter is done by or in the name of legal body, company, association, foundation or other organization, criminal charges are made and criminal sanctions along with procedural measures as provided for in article 46 are imposed both against those who give the order to carry out the criminal action concerned or who act as leaders in the carrying out of it and against the two of them”. Peat destroying has a consequence to the economic impact, environmental impact, and others. Due to this reason based on Environmental act No.23/1997 they should rehabilitated to be like it happened without fire. All these things can be explained through forest fire science knowledge made by forest fire expert witness during the court session. Field court will be one of the key important how to show these things happened in the field.

On 1st October 2002, based on the fire science knowledge presented by forest fire expert witness that used as a basic information for this case during the courts session come to the conclusion that PT.Adei Plantation and Industry found guilty of using fire illegally in their land preparation area for oil palm plantation, due this reason the General Manager of the company being punished 2 years and Rp.250 million as a compensate cost.

Ecological and economical impact

Ecological, economic and atmospheric impact due the fires in the land preparation area belongs to the oil palm company as is follows:

Ecological impact

Peat layer has soil physical properties that have pores volume bigger than soil compaction that is 80-90%. This bigger soil pores create a peat condition which has an ability to keep water big enough. Unfortunately, due to the fires reduces the depth of peat surface 10 cm which cause the losing of water reserve 650m³/ha. This situation cause no place for the water to be released out of burnt area due to the peat surface destroyed already which can not keep the water anymore, for a large area flood will usually emerge after rain. Due to the loss capacity to reserve the water of 650m³/ha, which might be will cause flood in the rainy season and drought in the dry season, new reservoir should be established to compensate 10 cm peat destroyed. New reservoir that should be established has the specific arrangement that is 20 m wide, 25 m long and 5 m height. If the construction cost per 2001 was Rp.100,000/m² means that new reservoir need cost Rp. 190.095 Billions.

Economical impact

Fire that used in the land preparation area for an oil palm plantation illegally in a few hours caused 10 cm peat layer destroyed which in natural processes will take 15 years to be replaced. During 15 years operation period and if fire is not used for the land preparation, the company could have started production and so there is a loss of benefit. This has been calculated as follows:

Assumption used

- 2970 hectares burned
- Oil palm start production at 4 years old
- CPO production per ha : 4000 kg/year
- CPO price per kg: Rp. 3000 (Price at 2000)
- Years production lost 11 years (15 years-4 years)

Calculation cost for 2970 ha for oil palm plantation (with price at 2000)

a. Planting cost	Rp. 39,337,600,000
b. First year maintenance cost	Rp. 14,942,070,000
c. Second year maintenance cost	Rp. 13,249,170,000
d. Third year maintenance cost	Rp. 13,471,920,000
e. Fourth year maintenance cost	Rp. 19,201,050,000
f. Fifth year maintenance cost	Rp. 17,255,700,000
g. Sixth-Fifteenth year maintenance cost	Rp. 200,772,000,000
Total cost spent for 15 years	Rp. 318,229,560,000
Harvested product sales for 11 years	Rp. 392,040,000,000
Profit lost due to fire	Rp. 73,810,440,000

Burnt logs cost

- a. Logs which actually can be used for chips:
 $10\text{m}^3/\text{ha} \times \text{Rp. } 150,000,00/\text{m}^3 : \text{Rp. } 1,500,000,00/\text{ha}$
- b. Logs which actually can be used for other purpose:
 $20\text{m}^3/\text{ha} \times \text{Rp. } 50,000,00/\text{m}^3 : \text{Rp. } 1,000,000,00/\text{ha}$

Totally economic lost per ha due to burnt logs was Rp. 2,500,000,00, for 2970 ha burnt area cost was Rp. 7,425,000,000,00

Total damage cost

Total damage cost due to 2970 ha burnt in PT. Adei Plantation and Industry

a. Ecological impact cost	Rp. 190,055,000,000,00
b. Economical impact (time lost production)	Rp. 73,810,440,000,00
c. Burnt logs cost	Rp. 7,425,000,000,00
d. Ecological activated cost	Rp. 9,325,800,000,00
Total	Rp. 280,616,240,000,00

After the company's manager being punished and stay in jail hence the activities of using fire for the land preparation reduce. Year by year law enforcement used by the government to fight the year and the cases being investigated increased significantly. At the year 2006 at least 50 person of the peoples who used fire for the land preparation from they own land had been punished and more than 20 companies (mostly an oil palm) being investigated and running in the court.

Conclusion

As the fire made by communities for the land preparation area for they own land, or for companies that are prohibited by law could be recognized have certain purposes, then through scientific evidence it can be solved. Through scientific evidence fire behaviour and damage can be clearly prove hence could be show who behind the fires.

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