Daniel Murdiyarso is a Senior Scientist at the Center for International Forestry Research (CIFOR) working in the area of forest and climate change. He has Bachelor degree in forestry and PhD in meteorology. He was a convening lead author of the IPCC TAR WG II (chapter 11), IPCC special report on Land-use, Land-use Change and Forestry (LULUCF) and a review editor of the IPCC 4AR WG II (chapter 11). His current research on climate change is related to both mitigation and adaptation aspects and their importance to the forest sector.

Southeast Asian forest and land fires: how can vulnerable ecosystems and peoples adapt to changing climate and fire regimes?

Daniel Murdiyarso[1] and Louis Lebel[2]

[1] Center for International Forestry Research (CIFOR), Jl. CIFOR, Situgede, Bogor, Indonesia
[2] Unit for Social and Environmental Research (USER), Chiang Mai University, Chiang Mai, Thailand

Forest and land fires – both natural and human-lit – are not new to the landscapes of Southeast Asia. Today's fire regimes are a consequence of past interactions between humans, climate and ecosystems. In many places fire is a tool for converting forests to agricultural lands and in subsequent land management [1]. But fire is also described as a problem, or even, disaster. Carefully distinguishing among types of fires, the ecosystems in which they occur, and their relationship to spatial and temporal scales of historical fire regimes is important but does not eliminate politics. Differences in interests and perspectives affect land and forest policies in ways which can have important consequences for ecosystems and human well-being at several levels [2].

The importance of different perspectives and scale for understanding fires is illustrated sharply in situations where vulnerable ecosystems and peoples coexist with important stocks of carbon susceptible to fire. In the context of Indonesia this means managing risks of low frequency, but high impact, fires in peatlands.

Peatlands are important for the hydrology of a region as they buffer flooding as well as for conservation of biodiversity, fishing and hunting, and carbon storage. Peatlands cover more than 10% of Indonesia's land area including many agricultural locations critical to sustaining livelihoods of vulnerable peoples. When peatlands are drained upper layers dry-out and become prone to fire. Fire policies need to give high priority to the management of vulnerable peatlands.

The large fires of 1997/1998 in Indonesia resulted from a combination of fires lit to clear and prepare land by smallholders and larger firms as well as accidental fires in forest and peat swamps. Dry weather generated by El Niño Southern Oscillation (ENSO) made conditions ideal for fire. Impacts on timber and estate crops were relatively modest; valuable investments and assets were protected. Other forest types, like logged-over forests suitable for conversion to oil palm plantations, on the other hand, were extremely "vulnerable" to being burnt.

Peat fires in Kalimantan and Sumatra made a huge contribution to trans-boundary smoke haze. Heil et al. [3] modelled dispersion of fire pollutants. They found that if peat fires are excluded then ambient air quality standards would only be exceeded close to the main fires, whereas if peat fires are included air quality standards are exceeded far away from the source as was observed. For Asia, burning of forest comprises 45% and burning of crop residues in the fields comprises 34% of vegetation burnt openly, that is, outside stoves [4].

Goldammer's [5] study of recovery of forests after major fire is important to policy in several ways. First it underlines the need, from a biodiversity conservation perspective, to go beyond peat lands and look carefully at vulnerable dipterocarp forest ecosystems. Excessive use of fire in dipterocarp forest ecosystems is altering tree family-level composition. Second, it draws attention to the very different fire-vegetation relations in seasonally dry tropical forests and pine forests. Here outright fire suppression policies would be misplaced and likely to be detrimental to the ecosystems. Fire suppression policies may also increase the vulnerability of swidden farmers dependent on using fire to clear forests for cultivation. Fire management policies need to be adjusted to local ecological and social contexts.

Fire mitigation has largely been conducted in conjunction with building capacity in fire fighting. Prior to the large forest fires in Borneo 1982 fire fighting strategies and infrastructure were not well developed in many parts of Southeast Asia. During the past 20 years 40 international fire projects and missions costing well over US$ 30 million have been implemented, primarily in Indonesia [6]. National governments have also invested significantly in fire management and capacity building at local levels.

Science has made an important contribution to the understanding of the causes and impacts of fires, and in turn, has informed operations. Early warning systems such as the Fire Danger Rating System (FDRS) for Indonesia and Malaysia, for example, were developed jointly by scientists and government agencies [7]. Research has also highlighted alternative ways to manage land to reduce episodes of high fire-related emissions to the atmosphere [8]. These involve delays in time of burning as well as use of zero-burning methods for disposing of waste vegetation. Incentives and regulations are justified because of immediate benefits to human health at local and regional levels. In addition, where total long-term emissions of greenhouse gases could also be reduced through such efforts then this provides additional reasons to encourage such practices.

A focus on building adaptive capacity in fire management could be an effective way to adapt to climate change. Changes in fire regimes, as a result of recurrent droughts and human interventions, mimic some of the key features of the anticipated impacts of climate change on forest and plantation ecosystems. Chokkalingham et al. [9] in particular emphasise the importance of stimulating alternative livelihood options during drought years. They also suggest that, properly guided, the private sector could play an important role through estate tree or palm crops and agroforestry systems rather than current emphasis on annual crops. Industry expertise could be a helpful ally in estimating costs of adaptation to climate change in the commercial forestry sector.

Ultimately adaptation to fire regime changes resulting from climate change would benefit from an explicitly multi-level approach that recognizes some capacities are more appropriately developed at particular levels (e.g. Adger et al. [10]). Better coordination of smoke-haze monitoring and risk management at the regional level would be useful. The vulnerable carbon-rich peatland areas would benefit from improved fire management at district or national levels

Fire has very different meanings and policy implications when viewed as a tool for clearing, as a producer of damaging smoke, or as a source of greenhouse gas emissions. The biophysical and social implications of fires vary greatly from place to place. More attention needs to be paid to the relationships between fire regimes and vulnerable ecosystems and peoples, both under current and future climate. With improved understanding of these interactions and differences the possibility arises of moving tropical forest fire management from *suppression everywhere* to a more reasoned *guided use.*

d.murdiyarso@cgiar.org

Capacity to control fire is important. But how can such capacity be built at community level?

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