

# Global Review of Forest Fires

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# Preface

The forest fires of 1997 and 1998 created enormous ecological damage and human suffering and helped focus world attention on what is an increasing problem. In December 1997, WWF issued a report entitled “The Year the World Caught Fire.” At the time Claude Martin, Director General of WWF, said:

“This is not just an emergency, it is a planetary disaster. As the guilty are identified and the blame is apportioned, we must ensure that national and international responses go further than identifying a few scapegoats. This must never be allowed to happen again”.

There is growing feeling within WWF and IUCN that action is needed to try and catalyse a strategic international response to forest fires. There are no “magic bullets” for forest fires. The issues to be addressed are complex and cut across sectors, interests, donors, professions, regions, nations and communities. The organisations feel that action only takes place when fires are burning and that little attempt has been made to address the underlying causes.

This report is therefore issued as a follow-up to the 1997 report. It is part of an on-going programme of work by the two organisations to address forest fires. In early 1998 IUCN - the World Conservation Union and WWF - The World Wide Fund For Nature, joined forces in developing a Programme for “Strengthening National, Regional and International Networks for Forest Fire Prevention and Management, world-wide”.

This “FireFight” Programme seeks to secure essential policy reform at national and international level to provide a legislative and economic base for controlling harmful anthropogenic forest fires. The programme is intended as a contribution to efforts by national governments, and international organisations such as UNDP, FAO, UNEP and ASEAN, to establish more effective fire management and strategic, preventative responses.

It will mobilise the in-country and international staff of IUCN and WWF and contribute their scientific, environmental, legal and communications skills to develop an integrated policy response. It will cover five major regions of the world, Asia, Central and South America, Russia, the Mediterranean and the Sub-Saharan Africa.

Programme “FireFight” is being implemented in collaboration with regionally based WWF and IUCN staff and in close consultation with key UN agencies such as UNDP, FAO and UNEP. It covers a wide range of activities from analysis of the costs of fires and improved understanding of underlying causes, through to policy dialogue and follow up action.

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# 1. Executive Summary

This report is a follow-up to the WWF International Discussion Paper The Year the World Caught Fire which was published in December 1997. However, eighteen months after some of the worst forest fires in the modern era, which saw lush tropical forests ended up as smouldering landscapes and millions of people affected by smoke, the fires started again.

Early in 1999, parts of the Brazilian Amazon, and forests in China were alight. For the tropics, it was only the beginning of the dry season yet areas of South East Asia had already burnt. In October, one of the world's greatest areas of biodiversity - Manu National Park - in the Peruvian Amazon caught fire too. So did whole regions of Brazil, Bolivia and Paraguay. Hundreds of thousands of hectares of boreal forests in Russia and North America have also been affected by fire during the northern summer.

The pervading sense within WWF and IUCN is that although action may be happening on a local, regional, national or even international level, it is too slow and, in many cases misdirected. Since the fires and haze hit the headlines in 97/98, they have slowly slipped off the international agenda.

This is just at a time when new research is telling us that the issue of forest fires should be moving up the political agenda. Firstly, there is increasing evidence that the world faces a positive feedback cycle in which climate change, exacerbated by forest fires and deforestation, increases the frequency of the El Niño phenomenon, which in turn causes more forest burning. The frequency and intensity of El Niño could be increasing, which means the world faces warmer more violent weather, and more forest fires.

While some experts believe that it is too early to say when the next El Niño will occur, others say it might be within eighteen months, before the forests that burnt last time have had a chance to recover. New evidence from the Amazon has concluded that fire causes a positive feedback cycle in which the more forests burn the more susceptible to future burning they become. Second fires are much more intense and may destroy up to 90% of living biomass. The research shows that there is much more damage in logged areas.

This raises the possibility of large wildfire episodes happening on such a frequent scale that the forest ecosystem will not endure. The scientists believe the whole Amazon itself is threatened, with the rainforest being replaced by fire-prone vegetation. This has global consequences for biodiversity and climate change. Fires are already a significant source of climate change. Emissions from tropical forests in a year of bad fires could be equivalent to one-third of the emissions from fossil fuel burning.

While there has been some action to address the problem of forest fires, it is not enough. WWF and IUCN believe it is time to profoundly rethink our approach to forest management, with a much greater emphasis on community involvement in fire management and use of fire. There is also a fundamental need to address the underlying cause of forest fires.

**The pervading sense within WWF and IUCN is that although action may be happening on a local, regional, national or even international level, it is too slow and, in many cases misdirected. Since the fires and haze hit the headlines in 97/98, they have slowly slipped off the international agenda.**

## 2. Introduction

**there is mounting evidence that forest fires will increase in number and size due to a link between climate change and the climate phenomenon called El Niño, which caused the drought that affected much of the forests which caught fire in 1997 and 98. The frequency and intensity of El Niño could be increasing<sup>1</sup>, which means the world faces warmer more violent weather, and more forest fires.**

All the weather forecasts for 1999 predicted rain. After the drought-fuelled fires of the previous two years, we were meant to have a wet year. However, eighteen months after some of the worst forest fires in the modern era, which saw lush tropical forests ended up as smouldering landscapes and millions of people affected by smoke, the fires have started again.

Early in 1999, parts of the Brazilian Amazon, and forests in China were alight. For the tropics, where the dry season had just begun, areas of South East Asia were already burnt. In October, one of the world's greatest areas of biodiversity - Manu National Park - in the Peruvian Amazon caught fire too. So did whole regions of Brazil, Bolivia and Paraguay. Hundreds of thousands of hectares of boreal forests in Russia and North America have also been affected by fire. By September, the United States had experienced its second worst fire season ever recorded.

As international agencies wonder how to respond to the scattered, glowing red dots on satellite images that depict fires burning across the globe, the pervading sense within non-governmental organisations that have taken a lead in fire as an environmental issue, such as WWF and IUCN, is that although action may be happening on a local, regional, national or even international level, it is too slow and, in many cases misdirected. The unpalatable truth is that since the fires and haze hit the headlines in 97/98, they have slowly slipped off the international agenda. This is just at a time when new research is telling us that the issue of forest fires should be moving up the political priority scale.

Two important pieces of scientific evidence are emerging which should revolutionise the forest fire debate and move it from being seen as a peripheral environmental, social and economic issue into a central issue of concern for the international community.

Firstly, there is mounting evidence that forest fires will increase in number and size due to a link between climate change and the climate phenomenon called El Niño, which caused the drought that affected much of the forests which caught fire in 1997 and 98. The frequency and intensity of El Niño could be increasing<sup>1</sup>, which means the world faces warmer more violent weather, and more forest fires.

Second, while some experts believe that it is too early to say when the next El Niño will occur, others say it might be within eighteen months, it will likely be before the forests that burnt last time have had a chance to recover. New evidence from the Amazon has concluded that fire causes a positive feedback cycle in which the more tropical forests burn the more susceptible to future burning they become. This raises the possibility of large wildfire episodes happening more frequently and on such a scale that tropical forest ecosystems will not endure. The scientists believe the whole Amazon itself is threatened, which has global consequences for biodiversity and climate change<sup>2</sup>.

As the fires began to burn again in 1999, many forests had not recovered from the fires of 1997/98. This report shows that the ecological, cultural, social and economic cost of fires is so immense that it needs committed strategic thinking backed up by firm practical action now.

### 3. Fire - An Explanation.

Over hundreds of years fire has been viewed by many as an environmental horror. Fire has been linked with reduced soil fertility, destruction of biodiversity, global warming and damage to forests, land resources and of course human assets. Contentions like these fail to make important distinctions about different types of fires and the wrong types of fires in the wrong places.<sup>3</sup>

Forest fires occur either because of anthropological or natural causes. The majority of fires around the globe are caused by human activity. Lightning is probably the most common natural cause of fire. It has been estimated that annually fires burn across up to 500 million hectares of woodland, open forests, tropical and sub-tropical savannahs, 10-15 million hectares of boreal and temperate forest and 20-40 million hectares of tropical forests.<sup>4</sup>

Fire is one of the oldest tools known to humans. It has been used as a management technique in land clearance for centuries. For the thousands of farmers, ranchers and plantation owners on the edge of the agriculture frontier pushing into forests, fire is the obvious mechanism. It is normally the least expensive and most effective way of clearing vegetation and of fertilising nutrient poor soils. Fires are normally lit at the end of the dry season and under most normal conditions these fires can be controlled. However if the rains fail, as they do in many parts of the tropics in El Niño years, the results can be catastrophic, as the fires burn out of control.

Fire is a paradox - it can kill plants and animals and cause extensive ecological damage, but it is also extremely beneficial, the source of forest regeneration and of nutrient recycling. Fire, the experts say, is nature's way of recycling the essential nutrients, especially nitrogen. For many boreal forests, fire is a natural part of the cycle of the forest, and some tree species, notably Lodgepole Pine and Jack Pine are "serotinous" - their cones only open and seeds germinate after they have been exposed to fire. Mountain ash, a flowering tree of temperate Australia, also requires a site to completely burn and be exposed to full sunlight for the species to regenerate. Fire in these circumstances is essential. Burning quickly decomposes organic matter into mineral components that cause a spurt of plant growth, and can also reduce disease in the forest.<sup>5</sup> But it is important to remember that fires under extreme weather conditions can be devastating to these forests.

In contrast, fire causes severe damage to tropical forest ecosystems, which are characterised by high levels of humidity and moisture. They do not normally burn and are extremely prone to severe fire damage. Research from the Amazon is only just beginning to show us how long-lasting damage from fire can be on the tropical forest ecosystem<sup>6</sup>.

The impacts of forest fires can have global consequences: Forest fires also produce gaseous and particle emissions that impact the composition and functioning of the jet stream and the global atmosphere, exacerbating climate change.<sup>7</sup> Tropical forest destruction, through fire, could also spiral our weather systems in new and unpredictable directions<sup>8</sup>.

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**People have excluded or suppressed fires and changed the nature of the landscape so that a naturally occurring fire will not behave in the same way it would have in the absence of human impact. The inter-relationship between humans, fire and forests is a complex one and has been the subject of countless studies and reports.**

Just as too much fire can cause problems so can too little. Many fires in boreal forests are naturally caused by lightning. However, some countries, especially the US, have had a policy of suppressing fires that threaten to grow out of control. Under these circumstances fire suppression can lead to unnatural conditions in which forests, which have historically adapted to small intermittent fire episodes, no longer burn. Conventional thinking held that suppression can lead to a build up of dead biomass, and altered tree species composition, so when a fire does start, instead of being relatively small, it is much more intense and large-scale.<sup>9</sup> However recent historical analysis of Californian brushland has concluded that fire suppression and rotational burning may not actually affect the occurrence of large fires in this vegetation type<sup>10</sup>.

Fire has played, and will continue to play, a major role in shaping forest ecosystems throughout the world. While some ecosystems depend on fire for their regeneration (e.g. Mountain Ash forests in Australia), other forest ecosystems are prone to severe damage by fire (e.g. tropical lowland, peat forests). Fires can produce local extinctions of species, alter species compositions and successional stages and bring about substantial changes in ecosystem functioning (soils and hydrology). In almost all forest ecosystems throughout the world, humans have altered the natural fire régimes by changing the frequency and intensity of fires. People have excluded or suppressed fires and changed the nature of the landscape so that a naturally occurring fire will not behave in the same way it would have in the absence of human impact. The inter-relationship between humans, fire and forests is a complex one and has been the subject of countless studies and reports.<sup>11</sup>

Fires are mostly started intentionally by people for a purpose. There are too many started. There are too few circumstances where responsibility for planning, containing and using fires is clear. The benefits of good land management and of the costs of poor practice are too diffuse. The implications and impacts are unclear and too poorly understood. The influences and causes of such characteristics underlie the symptom that presents of “uncontrolled forest fire”. Consequently the “cure” is a process in parallel with efforts to counteract chronic circumstances: poverty, national debt, perverse economic incentives and land tenure clarity and security.



## 4. What Burnt in 97/98 - An Overview

Although most major forest areas in 1999 burned to some degree, the scale and impact are much smaller than in 1997/98. During late 1997 and early 1998 fires raged in South East Asia, South and Central America, Europe, Russia, China, Australia and the USA. A combination of the dry conditions caused by El Niño and uncontrolled burning practices took their toll on the world's forests. "Unchecked land, bush and forest fires in various parts of the world are rapidly becoming a disaster of regional and global proportions," said the UN<sup>12</sup>. It seemed, as WWF said at the time, that 1997 was simply "the year the world caught fire"<sup>13</sup>.

A detailed breakdown, with references, of fire episodes broken down on a regional scale is given in the Appendix. In South East Asia - from Papua New Guinea in the East through to Malaysia, and Indonesia the fires damaged hundreds of thousands of hectares of forest and other lands. They burned the most in Indonesia, with fires in Java, Borneo, Sulawesi, Irian Jaya and Sumatra affecting some 9.5 million hectares, of which 49%, or 4,655,000 hectares was forested. The economic cost of the fires was estimated to be anywhere between US\$5-10 billion. At its height, the smoke resulting from the fires stretched over one million square kilometres adversely affecting up to 70 million people's health.

Eighty per cent of the fires were believed to have been started in plantation areas for forest conversion and land preparation. As Indonesia and its neighbours look to expand palm oil production, and as efforts to implement "zero-burning" struggle, it is likely that forest fires will continue to be significant problem for South East Asia for the foreseeable future.

Other tropical forests also burnt in 97/98. In Brazil an estimated 3.3 million hectares of land burnt of which 1.5 million was rainforest in the northern Amazonian state of Roraima alone, scene to some of the worst fires in the region. Further North in Mexico and Central America, a further 1.5 million hectares of forest was burnt, affecting numerous ecological reserves and national parks. Millions of people throughout the region, including the Southern United States, suffered from the resulting pollution too.

Temperate forests burned as well. Over five million hectares of forest were affected in the United States and Canada. In Russia, the total area burned by fires was estimated by the UN to be 2 million hectares, in what they called a "world-wide ecological disaster."

In total for 1997 and 1998, at least 22 million hectares of land was impacted by fire of which some 14 million was forest. Over 130 million people's health was adversely affected.

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## 5. What's Happened Since The 1997/98 Fires?

### 5.1 CHINA

An unusual drought occurring throughout the major parts of South, Southwest, East and North China, which created favourable conditions for forest fires ushered in 1999.

According to preliminary statistics, in the first two months of the year, over 2,000 forest fires broke out, damaging some 12,000 hectares of forest. Some 33 people were killed and 198 people injured. The serious fire episode was blamed on high temperatures and low rainfall that had started in the autumn of 1998, forest fuel accumulation and more fires than usual being caused by humans<sup>14</sup>.

### 5.2 LATIN AMERICA

January and February 1999 also saw dangerous forest fire conditions in the Amazon state of Roraima with continuing drought conditions, but before extensive fires spread, rains eased the problem. Tinder-dry conditions throughout Brazil by the end of the summer created the right conditions for fires to start across the country. According to Brazil's Environmental Agency, Ibama, 80% of Brazil was under a serious risk of burning. By August some 31,000 fires were reported in 15 states. "Everything is at risk", said a spokesperson for Ibama's Forest Fire Prevention and Combat unit. "There appears to be a lot more fires than last year"<sup>15</sup>.

As September started the state of Mato Grosso, declared an emergency. Over 11,000 fires burnt in the region after no rain for 60 days. Mato Grosso contains both Amazon rain forest and the Pantanal, the world's largest wetland.<sup>16</sup> In the neighbouring state of the Mato Grosso do Sul an estimated 150,000 hectares of land were affected by fire. "The number of hot spots has completely run out of control," said Jadilza Andrade Araujo, spokeswoman for the state's Environment Secretariat. "Our (agency) is very small. It's not up to the task"<sup>17</sup>.

In September fire burnt an estimated 50,000 hectares of the Ilha Grande National Park, in the southern state of Parana on its border with Mato Grosso do Sul. Over 70 hectares of the Serra dos Orgaos National Park, near Rio, including pristine tracts of Atlantic forest were also devastated<sup>18</sup>. Meanwhile in the Peruvian Amazon, fires spread through Manu National Park, an area of immense ecological and cultural biodiversity. In Bolivia, the government declared Guarayos and Moxos provinces "national disaster areas", after fires affected over 100,000 hectares and destroyed some 650 homes, making 3,000 people homeless. Fires were ablaze in Paraguay too<sup>19</sup>.

### 5.3 INDONESIA

Relatively dry weather conditions began to be felt in the South East Asian region in mid-July 1999. As a result, an increase in forest fires and hotspot activity was observed over central Sumatra and West Kalimantan. By August, despite the normally wet conditions associated with the opposing climatic phenomenon to El Niño, called "La Niña", 1999 was beginning to look like a re-run of 1997. Scientists at the Global Fire Monitoring Centre at the University of Freiburg declared that "there is every indication that this year's fires could be a repetition of the fire situation of 1997". President Habibie of Indonesia, meanwhile, warned of an impending environmental disaster<sup>20</sup>.

People in Jakarta, Singapore and Kuala Lumpur considered a return to smog masks, due to the adverse air quality. By August, the Malaysian Government had banned air pollution monitoring experts and agencies from publishing the figures. We do not want "to drive away the tourists" explained the Environment Minister<sup>21</sup>.

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Across the region, satellite images found over 400 hotspots - showing areas of forest burning - prompting the press and others to accuse the Indonesian authorities of inaction. “Malaysia, Singapore and Brunei have to think about taking Indonesia to the International Court of Justice for the lack in its political awareness,” argued Longgena Ginting, co-ordinator for forest advocacy at the Indonesian Forum for Environment, known as Walhi, which is Indonesia’s leading environmental organisation<sup>22</sup>. Walhi believes that 94 percent of the fire sites were large plantations and forestry companies<sup>23</sup>.

By August, a thick blanket of pollution was once again covering the region with visibility down to 100 metres in some areas. The authorities in Riau province on the island of Sumatra declared a state of emergency for land, sea and air traffic<sup>24</sup>. Pollution levels exceeded the “life-threatening” level 400, and were recorded at 978 in late July and 568 in early August, comparable to the readings two years previously<sup>25</sup>.

As people compared the fires to two years ago, the impact of the 97/98 fires had to be considered to assess how damaging the fire season would be. The 97/98 caused extensive degradation of primary and secondary forests, a lingering effect which makes any remaining forest much less fire resistant and therefore more susceptible to future burning. The fires also assess the spread of “alang-alang” (*Imperata cylindrica*) grasslands, which themselves facilitate the spread of uncontrolled fires over large areas<sup>26</sup>.

By the end of September, fire activity had reduced. The Integrated Fire Management Project in Kalimantan recorded only 22 hotspots and the Meteorological Service of Singapore reported that South East Asia was “generally clear of smoke haze and hot spots”.<sup>27</sup>

#### 5.4 RUSSIA

In August, fires restarted in the Russian taiga. According to the Federal Forest Service of Russia, by 7th September 1999, some 28,176 fires had occurred in forests under their control. The fires had affected some 541,309 hectares of forest and 194,787 hectares of non-forest areas inside forest lands. By early September some 200 fires were still burning. Six of these were over 50 hectares in size, which were occurring in the Kareleia and Vologda regions<sup>28</sup>.

#### 5.5 NORTH AMERICA

In August 1999 some 300 wildfires were raging in California, Nevada, Oregon, Utah and Idaho. Mostly caused by lightning, campers were also blamed for the fires. In Alaska some 400,000 hectares had been burnt by fires, mainly caused by lightning. Early the following month, over 11,000 fire-fighters tackled 11 large fires still burning in the western US, with “very high to extreme fire indices” occurring in 14 states. As some of the worst fires for years were recorded in California, Christopher Wood, a Senior policy advisor to the US forest service said “it took a century’s worth of fire suppression to get us into this mess and it will take a while before we get ourselves out of it. But the longer we wait, the fewer options we have”<sup>29</sup>.

At the end of September, very high to extreme fire indices were reported in California, Oregon, Washington, Idaho, Nevada, Arizona, Illinois, Indiana, Mississippi, Georgia, Kentucky, and Texas. For the whole of the US, it had already been a bad year, with some 76,131 fires burning across some 1,954,157 hectares of land. In Canada, by the middle of September, some 7,200 fires had affected 1,678,000 hectares. In late September 22 fires were burning out of control<sup>30</sup>.

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## 6. Is the Situation Getting Worse or Better?

Although 1997 was a bad year, some experts believe that it was not unprecedented. In 1982/83, at the end of what was at the time the worst El Niño event of the century, some 2.7 million hectares of forest burned in East Kalimantan, plunging the region into haze. Smaller fire episodes occurred in 1987, 1991 and 1994.<sup>31</sup>

So the crucial question is, are forests fires getting worse or better? On the one hand one could ironically argue that in some parts of the tropics there is not much forest left to burn, therefore the situation could be getting better. On the other hand, there are two reasons why we should be extremely concerned.

### 6.1 EL NIÑO

On the whole the tropical Pacific Ocean is characterised by warm surface water in the west, but cooler water in the east<sup>32</sup>. El Niño, or the Spanish for “little child” or “Christ child”, is the name given by fishermen to the annual seasonal warming of the eastern ocean surface temperatures, particularly along the coasts of Ecuador and northern Peru. It acquired its name of “Christ Child” as it usually occurs towards the end of the calendar year in December, around Christmas.

Over time, though, the term, El Niño, has been used to describe major climatic events which occur every two to seven years when a much stronger warming of the ocean happens and lasts for a period of twelve to eighteen months at a time. El Niño is normally followed a year later by an opposite state of cooler, wetter weather, called La Niña<sup>33</sup>.

El Niño is closely aligned with atmospheric conditions associated with one extreme of the Southern Oscillation - a seesaw in atmospheric pressure between the eastern equatorial Pacific and Indo-Australian areas. Because of this scientists often connect the two phenomena and refer to the El Niño-Southern Oscillation (ENSO).

Starting in the tropical Pacific, the effects of El Niño are felt around the globe, as it changes the trade winds, air pressure and precipitation patterns. El Niño particularly impacts the tropics through a decrease in rainfall throughout the western tropical Pacific and in Central America and northern South America.<sup>34</sup> These areas just happen to be home to some of the last remaining tropical forest on the globe.

Analysis of data by the US National Oceanic and Atmospheric Administration (NOAA) from the ten strongest El Niño's of the past century has shown that “they are occurring more frequently, and that they are becoming progressively warmer”<sup>35</sup>. Since 1970, El Niño has occurred in 1972, 1976, 1982/3, 1987, 1991/2, 1994, and 1997/98. While NOAA say that “it cannot be determined from current evidence whether El Niños are becoming more frequent or more intense as a direct result of global warming”, they believe that “there is observational evidence to suggest that rising global temperatures may be linked to stronger, more frequent El Niños<sup>36</sup>.”

Some scientists disagree with this. For example Michael Daley, from the Seasonal Climate Prediction Unit, at the UK-based Meteorological Office, believes that it is too early to tell whether there is a definitive relationship between climate and El Niño. “The jury is still out on that,” he says<sup>37</sup>.

**So the crucial question is, are forests fires getting worse or better? On the one hand one could ironically argue that in some parts of the tropics there is not much forest left to burn, therefore the situation could be getting better.**

Other scientists believe otherwise. For example, in 1996, Kevin Trenberth and Tim Hoar, from the National Centre for Atmospheric Research in Boulder, Colorado, examined data for over a hundred years relating to El Niño. They concluded that, because of the increased frequency of El Niño and the long-lasting nature of it in the early nineties, it “opens up the possibility that the ENSO [El Niño Southern Oscillation] changes may be partly caused by the observed increases in greenhouse gases<sup>38</sup>.” Two years later, the same scientists concluded that the recent pattern of more El Niño and fewer La Niña events since the late 1970s was “highly unusual and very unlikely to be accounted for solely by natural variability”<sup>39</sup>.

These assertions have been backed up by climate scientists whose model predicted both the onset and decline of the 97/98 El Niño several months in advance<sup>40</sup>. The scientists, from the Max-Planck Institute in Germany, found that because of increasing greenhouse-gas concentrations, more frequent El Niño-like conditions and stronger cold events (La Niña) result<sup>41</sup>.

Other climate modellers from NOAA and the Institute for Global Change Research in Japan, have also concluded that “the observed warming trend in the eastern tropical Pacific is not likely to be solely attributable to internal (natural) climate variability. Instead, it is likely that a sustained thermal forcing, such as the increased of greenhouse gases in the atmosphere, has been at least partly responsible for the observed warming<sup>42</sup>.”

In short what the scientists are saying is that it looks like rising temperatures caused by climate change could cause the El Niño to become more frequent and intense. These El Niño events could in turn cause further climate change. The daunting fact is that the world faces a positive feedback cycle in which climate change exacerbated by forest fires and deforestation, increases the frequency of El Niño, which in turn causes more forest burning.

“With the likely increase in the frequency and severity of ENSO” argues Johann Goldammer, “as a consequence of increasing greenhouse gas concentrations, the stage is set for an increasing number of fires and, consequently, for more forest destruction<sup>43</sup>.”

In this context, we have to remember that not all forest fires are bad. However, the effects of El Niño on the Amazon could have global repercussions. Of major concern for the Amazon is the way El Niño affects the region, causing increased precipitation in the South of the country and intense dryness in the North, just where the rain is needed in the Amazon basin - home to 70% of the remaining humid forest on the globe. Predictions are for increased dry weather in the Amazon, which could significantly affect the equilibrium of the rainforest, by making it more susceptible to burning. According to scientists at the Instituto de Pesquisa Ambiental da Amazônia (IPAM), during extreme El Niño events the normally evergreen and extremely humid forest becomes dry enough to catch fire<sup>44</sup>.

**it looks like rising temperatures caused by climate change could cause the El Niño to become more frequent and intense. These El Niño events could in turn cause further climate change. The daunting fact is that the world faces a positive feedback cycle in which climate change exacerbated by forest fires and deforestation, increases the frequency of El Niño, which in turn causes more forest burning.**



**The implications are severe, because if the normally fire-resistant Amazon forest dries out, this could change the hydrologic cycle and hence the whole climate of the region, which has global implications, not least for global climate.**

The humid forest acts as a natural barrier to stop fires spreading and if it dries out whole areas of the Amazon could burn totally out-of-control. Much has to do with the length of roots. For example, rainforests in the Amazon are deep-rooted - nearly 20 metres deep, which means that the clay soils are a natural sponge or buffer by acting as a source of water for the trees during the dry season. However, during exceptional dry years the forest literally sucks the soil dry, meaning that in that year or for a number of subsequent years, there may not be enough water to sustain the forest and it crosses the threshold of flammability<sup>45</sup>.

Up to 40% of the Brazilian forest is extremely sensitive to small reductions in the amount of rainfall. In the 1998 dry season, some 270,000 sq. km of forest became vulnerable to fire, due to completely depleted plant-available water stored in the upper five metres of soil. A further 360,000 sq. km of forest had only 250 mm of plant-available soil water left.<sup>46</sup>

Scientists from Woods Hole Research Centre (WHRC) and IPAM (Instituto de Pesquisa Ambiental da Amazônia) who have undertaken ground-breaking work on fires in the Amazon, conclude that “in a scenario of increasingly frequent El Niño events, Amazonia is poised to experience catastrophic forest fire events that dwarf the fires of Roraima in early 1998 and of deforestation activity in scale”<sup>47</sup>.

The implications are severe, because if the normally fire-resistant Amazon forest dries out, this could change the hydrologic cycle and hence the whole climate of the region, which has global implications, not least for global climate<sup>48</sup>.

## **6.2 FOREST FIRES AND CLIMATE CHANGE**

Not only are forest fires a significant source of carbon emitted into the atmosphere which exacerbates climate change, but forests are an irreplaceable sink of carbon too. So when forests burn, there is a double negative effect on the climate because instead of actually absorbing carbon dioxide, the gas is emitted by the burning biomass<sup>49</sup>.

It must not be forgotten that forest fires themselves are a significant source of carbon emissions, which fuel climate change. Estimates vary but biomass burning is now recognised as a significant source of carbon dioxide generally considered by most authorities as being around 20% for both fires and land use change. One study in its early stages named World Fire Web being co-ordinated by the European Commission’s Global Vegetation Monitoring Unit even notes that fires may perhaps account for 40% of annual global greenhouse emissions in severe fire years.

Of all burning from all types of vegetation (generating nearly 4000 million tonnes of carbon) tropical and boreal forest could release some 700 million tonnes of carbon in a bad fire year into the atmosphere<sup>50</sup>.

Other estimates exist: UNEP has calculated that from the forest fires in Kalimantan and Sumatra, an estimated 11 million tonnes of carbon dioxide was released, out of a total of 191 million tonnes from forests, agriculture and peat fires combined<sup>51</sup>. It has been estimated that the Amazon forest fires in 1998 could have been responsible for 10% of the net annual carbon emissions stemming from human activities worldwide that year.<sup>52</sup> If all the fires from tropical forests in 1998 were added up, one estimate is that they could have produced some 1 to 2 billion tonnes of carbon, which is equivalent to one-third of the emissions from fossil fuel burning across the world<sup>53</sup>.

While fires accelerate climate change, some scientists argue that El Niño events give us a preview of what it will be like to live in a higher carbon world, with the possibility of El Niño becoming a violent and annual event. Indeed modellers from the Max Planck Institute believe that the average climate in the 21st Century will become more like the El Niño conditions experienced in the last few years<sup>54</sup>.

### 6.3 THE FUTURE

So when will the next El Niño occur? Scientists at the American Climate Prediction Centre believe that La Niña conditions will prevail globally until March 2000 and it is too early to say when the next El Niño will be. However, the Eighth ASEAN Ministerial meeting on Haze in August concluded that as “La Niña is expected to weaken by the end of this year, meteorological experts have predicted a likely recurrence of dry conditions associated with the El Niño phenomenon next year or by 2001<sup>55</sup>”.

#### 6.3.1 INCREASING DAMAGE TO RAINFORESTS FROM FIRE

New research from South East Asia and the Amazon shows that fire is not only a major cause of depletion of tropical forests, it also increases the vulnerability of forests to future burning<sup>56</sup>. Fire increases the flammability of the forest, causing a positive feedback cycle in which the more forests become degraded - either through deforestation or by fire - the more susceptible to future burning they become, and the more they burn when they do actually catch fire. What this means is that previously burned forests become susceptible to fire not only in El Niño years, but under common dry conditions<sup>57</sup>. This raises the possibility of large wildfire episodes that have previously only occurred in El Niño years, happening much more frequently.

Under normal conditions, rainforests, which are extremely moist and humid ecosystems, do not readily burn and are extremely resistant to drought. Humidity levels in forests have been shown to be the single most important limit to combustibility. Unless humidity levels drop below 65%, burning is unlikely<sup>58</sup>.

But although rainforests are not adapted to fire, charcoal analysis shows that people have been periodically burning forests for at least 17,500 years. Fire is the primary tool to clear forests and people take advantage of the dry season to clear land, when humidity levels are lower and the forest burns more easily

The logic is simple; you burn during the dry season, expecting the onset of the rainy season to extinguish the fires. If the rain fails, as it does in an El Niño year, there are often wildfire episodes. For example in the Amazon, scientists believe that 90% of the forest burning has occurred during El Niño years<sup>59</sup>. As El Niño events increase in frequency, the result is that over the last couple of decades, forest fires have increased significantly in size, frequency and intensity<sup>60</sup>.

However, one of the most disturbing findings of a new book into forest fires in the Amazon by scientists from WHRC and IPAM, “involves the impacts of so-called forest surface fires” such as those that struck Roraima in the Amazon in 1998. At first glance, the authors argue that “those impacts appear to be small” because “surface fires are usually confined to the forest floor, where they consume organic material and underbrush. Yet even such low-intensity fires damage the bark of rainforest trees, which slowly die during the following year”<sup>61</sup>.

**Fire increases the flammability of the forest, causing a positive feedback cycle in which the more forests become degraded - either through deforestation or by fire - the more susceptible to future burning they become, and the more they burn when they do actually catch fire.**



**Logging can increase the flammability of forests by reducing forest leaf canopy coverage by up to 50%. Canopy loss may increase temperatures, reduce humidity and hasten the drying of wood waste and litter, making it more combustible.**

The authors contend that “this slow death builds up substantial amounts of fuel on the forest floor, and the gradual opening up of the forest canopy reduces the high humidity in the understory, which normally protects tropical forests from burning. As a result, forests that are lightly burned by surface fires are susceptible to catastrophic fires during the following year’s dry season”. Their findings, they argue, suggest that fires in the Amazon this year could be far worse than last year, even though it is not an El Niño year<sup>62</sup>.

The scientists found that “second” fires are much more intense and move much faster through the forest than “first” fires. If undisturbed or selectively logged forest does burn, it generally loses less than 10% of living biomass, but recurrent fires can kill 80% or more of the living biomass.<sup>63</sup> Woods Hole researchers estimate that heat release in a first fire is in the order of 7,500 kWm<sup>2</sup> and 75,000 kWm<sup>2</sup> in subsequent burns. This means large trees that may survive a first burn may not survive the next. Indeed after one or more recurrent fires 98% of trees may be killed<sup>64</sup>.

Logging can increase the flammability of forests by reducing forest leaf canopy coverage by up to 50%<sup>65</sup>. Canopy loss may increase temperatures, reduce humidity and hasten the drying of wood waste and litter, making it more combustible. Forests that have been logged may also contain large amounts of waste wood on the ground that will burn readily, in the case of a fire.<sup>66</sup>

The time between fires termed “periodicity” is also important. Research from the Amazon, where fires occur somewhere in the forest every 7 to 14 years, has shown that fire return intervals for an individual piece of forest of less than 90 years can eliminate trees species and intervals of less than twenty years may kill off trees entirely<sup>67</sup>. The more damaged the forest beforehand the longer it takes to recover after a fire. For example, evidence exists from the 1982-83 fires in Indonesia that there is more extensive fire damage in logged areas, compared to unlogged areas. Indeed, researchers have concluded that damage to forests by fire is directly proportional to prior disturbance by humans<sup>68</sup>.

These findings mean that time is of the essence in addressing the forest fire problem, but what has been achieved in the last eighteen months and is it really enough?



## 7. What are the Lessons from 1997/98, that Haven't Been Addressed

While there has been an increase in activity by certain agencies - much of that action is focused on fire fighting and some on mitigation rather than prevention. The “prevention” undertaken often uses “high tech” equipment to try monitor and forecast when fire will occur. There is little or no “prevention” that sees plans made, risks assessed, fuel concentrations modified, training or equipment needs analysed and met, or weather and fire danger monitoring processes established. Very little effort seems to be going into where it is most needed - fundamentally addressing the underlying causes of forest fires: the reasons people, companies and governments are clearing forest in the first place, and broader issues such as poverty and debt.

### 7.1 THE RESPONSE FROM AGENCIES AND KEY GOVERNMENTS:

There are positive signs, but change is not happening fast enough and the root causes of the fires are not being addressed effectively or consistently. Agencies and governments have focused on (mostly existing) hi-tech elements of the spectrum of fire management activities, without getting to grips with underlying causes. The approach also seems to be mostly short-term and top-down not long-term nor bottom up. While the agencies and the experts may have become carried away with the latest remote sensing technology, research from the Amazon shows it probably does not reflect the real size of forest burning anyway.

There has been change. The Global Fire Monitoring Centre (GFMC), operating out of Freiburg University has been established as an initiative within the UN International Decade for Natural Disaster Reduction (IDNDR). The centre collects global fire statistics and its web-site offers global up-dates on fire<sup>69</sup>. As the IDNDR came to a close, the UN set up a replacement Inter-Agency Task Force on Natural Disasters. Under their auspices, Johann Goldammer from the GFMC who is also the chair of the UN/FAO/ECE forest fire specialists, is pushing for an Inter-Agency Task Force on Fire. This fire task force would include input from UN agencies, non-governmental organisations, and the new initiative from the World Bank - the ProVention Consortium on Natural and Technical Disasters. The task force would try and streamline fire initiatives from different agencies, acting as a conduit for information exchange<sup>70</sup>.

Apart from the fledgling task force, Goldammer argues that “it seems that more action at international level is underway than ever before. Several UN agencies, UN programmes and other international organisations, notably FAO, IDNDR, UNEP, UNESCO, WHO, WMO, the World Bank and several NGOs, for example, have taken decisive steps to investigate their role and future involvement in the global fire theatre”<sup>71</sup>.

On other levels there have been improvements: In 1997 there were only four important on-going forest fire projects in Indonesia - funded by GTZ, the EU, JICA, and ITTO, but now there are thirty-five. Most of these later efforts are shorter-term and tend also to be related to sophisticated remote sensing technology for monitoring and fire prediction<sup>72</sup>, tasks which they may perform with varying success. Generally these projects do not try to address the underlying causes of forest fires. Some actors are lukewarm seeing little change happening or progress possible through such efforts. Globally donors also may be forming preliminary (and presumptive) concepts identifying the fire problem as a “natural” or “climatic” (El Niño) phenomenon.

**There are positive signs, but change is not happening fast enough and the root causes of the fires are not being addressed effectively or consistently. Agencies and governments have focused on (mostly existing) hi-tech elements of the spectrum of fire management activities, without getting to grips with underlying causes.**



**“The international donor’s community panicked when the fires picked up and many countries wanted to help. But all the players were completely helpless and a lot of money was wasted for the sake of doing something”**

Talking to people inside agencies they say - anonymously of course - that the issue of forest fires is slipping down the agenda as the rains extinguish the latest batch. Governments, agencies and donors, it seems, may have short-term memories, not a tendency to undertake long-term strategic planning. When disaster strikes again, and it will, they may simply react much like they did last time, argue people at the cutting edge of the fire debate. Ludwig Schindler, the co-ordinator of the IFFM project in East Kalimantan, argues that: “The international donor’s community panicked when the fires picked up and many countries wanted to help. But all the players were completely helpless and a lot of money was wasted for the sake of doing something”<sup>73</sup>.

Both Indonesia and Malaysia criticised the international community after a bilateral meeting in May 1999 for not delivering on promised assistance to fight forest fires. “They have promised us, but nothing is forthcoming,” said Malaysia’s Information Minister Datuk Seri Mohamed Rahmat in May 1999<sup>74</sup>.

## **7.2 GLOBAL PARALLELS**

Nations around the world are making efforts to face their forest fire problem. Plans, co-ordination and technical improvements are being considered and sought. In the Mediterranean many countries are re-evaluating their forest fire management requirements after disastrous fire seasons. Many countries have policy and structures in place but the results are poor. Both numbers of fires and forest area burnt have doubled in many Mediterranean countries since the 1970s <sup>75</sup>. Integrated Action Plans such as the one drafted by Indonesia are not common. Regional level interaction while not necessarily formalised, such as through ASEAN, does exist but perhaps is yet to realise the potential for addressing forest fires. In concert with South East Asia the responsibility for putting out forest fires in some countries is separated from those that manage forests or inhabit them.

Common to all the worldwide economic crisis has expressed itself and influenced forest fires. Searching for subsistence saw Russians, inexperienced in forests, start fires as they tried to hunt and collect food.

In South America, Latin America and the Caribbean large scale fires demonstrated that public policies and human practices, exacerbated by prolonged drought, contributed to the severity of impacts on forests. The sheer magnitude of the fires world-wide was often related to the significant amount of agricultural and land clearing burning as a result of both long-standing tradition and particularly industrial plantation development.

## **7.3 IS THERE A NEED FOR ALTERED EMPHASIS?**

The seven El Niño events in the last thirty years have provided governments such as Indonesia ample illustration of the problems of forest fires. One of the largest fires in recent years, coincided with the El Niño event in 1982/83. Every subsequent El Niño event has resulted in further fires and renewed calls for governments to act. The authorities supported by international agencies, donors and NGOs have failed to reduce the damage from forest fires. “Reading old reports about the fires in East Kalimantan in 1982/83, the obvious observation is that the conclusions of these reports are still valid and one could change the year and use them now. Not much has changed,” argues Ludwig Schindler, co-ordinator of the IFFM project in East Kalimantan<sup>76</sup>.

Why is this so? The answer lies in the fundamental nature of the influences that perpetrate fires and paralyse effective response. Technical solutions, often highly sophisticated and costly, do not address influences underlying the forest fire phenomenon.

A rethink of development policy that includes deforestation must be undertaken. It is probable that the next El Niño will impact forests in the tropics that have not recovered from the 97/98 forest fire episode. The damage inflicted on them is likely to be much greater and perhaps catastrophic. The increasing evidence of a link between climate change and the likelihood that El Niño will recur in the next twelve to eighteen months clarifies the need for fast fundamental reform as paramount.

The much more low-tech, but long-term, elements of a positive community based approach could be the way forward. Experience in Mexico and Indonesia indicate that the biggest fires occurred on state owned or industrial forest land while the least damage occurred on land that was community owned or managed.

Community based fire-management projects in Indonesia, Africa and the Amazon, in contrast, have seen real improvements through engaging in efforts with people to address underlying causes of fire.

This begs the question of how well national governments have responded to the fires. In many regions of the world there have been efforts, some massive, to try and turn the tide of fires. Most aspects of the forest fire difficulties demonstrate shared elements. The underlying causes are held at least in part in common and to varying degrees. The issues and interactions that lead to the “problems” exist worldwide with fire the globally obvious symptom. The cross-cutting sectoral and policy aspects include; land allocation policies and processes, land use practices (particularly fire for land clearing), clarity of land ownership and use rights, legal and regulatory structures and arrangements, economic incentives or requirements that are perverse, elements of governance and community capacity building.

Generally speaking these elements are also significant aspects in many endeavours to improve the social, economic and environmental circumstances in a number of countries. Notably few are specific to forest fires. Addressing forest fires of necessity demands effort to improve the fundamental workings of nations, governments, civil society and the private sector. Effort to make changes and advances has been initiated and continues around the world. One of the largest and most disastrous series of fires burnt in South East Asia. The circumstances and context of this region when examined (see Appendix) provide an illustration of the elements contributing to the forest fire dilemma. These aspects are just as applicable in all other regions and perhaps more urgent yet less well known. South East Asia is a model for the world’s forest fire problem, including the patchiness of international response. A model replicated in part in most regions of the world.

**In many regions of the world there have been efforts, some massive, to try and turn the tide of fires. Most aspects of the forest fire difficulties demonstrate shared elements. The underlying causes are held at least in part in common and to varying degrees. The issues and interactions that lead to the “problems” exist worldwide with fire the globally obvious symptom.**



## 8. Is it Time to Rethink Forest Management?

**“The massive regional failure of forest policies for half a century or more requires that we look beyond the managerial and technical problems facing forestry agencies to explore alternative management paradigms, community forestry being a logical candidate”**

With the increasing evidence of a linkage between climate change and El Niño, a radical reappraisal of conservation and management of forests will also have to address the causes of climate change. One of those changes is the need to recognise that the state control of forests in region’s like Asia has not worked. “The massive regional failure of forest policies for half a century or more requires that we look beyond the managerial and technical problems facing forestry agencies to explore alternative management paradigms, community forestry being a logical candidate”, argues Mark Poffenberger from IUCN<sup>77</sup>.

### 8.1 COMMUNITY FORESTRY

Community forests not only show greater levels of biodiversity, but also experience less burning during fire episodes. Compared to a monoculture cash crop, a community forest garden contains hundreds of plant species. Studies of indigenous forest management systems indicate that they retain some 50-80 per cent of the biodiversity found in neighbouring natural forest<sup>78</sup>.

Burn pattern analysis during the fires of 1983, 1997, and 1998, in Kalimantan has shown that in areas under community control experienced considerably less burning than areas being cleared for industrial crops<sup>79</sup>. In 1997, fire damaged 30,000 hectares of plantations north of Balikpapan in Kalimantan, yet only 30 hectares of community forest was burned. Meanwhile in Central America, where some 1.5 million hectares of forest burned, “almost none” burned on community managed forests.<sup>80</sup> Following are some examples of community forestry that works.

#### 8.1.1 NAMIBIA:

Proof that community forest works also comes from another continent: from Africa.

The Namibia-Finland Forestry Project was started in April 1997. A year earlier, while some 4-5 million hectares of land burned in the country, a pilot project had been initiated in the East Caprivi region of the country. Its aim was to transfer the responsibility for forest protection to the local communities, and to see whether African communities would manage wild fires in their areas<sup>81</sup>.

In 1996, seven tribal leaders were selected, with a further seven the following year and in 1998 a further 24 villages voluntarily joined the programme.<sup>82</sup> In the original pilot area of some 1.4 million hectares, the strategy was two-fold: Firstly to undertake forest fire prevention public relations within the government, whilst training local communities into fire management units. Secondly to undertake a massive fire awareness campaign in schools and local organisations, including the production of written material, posters, radio broadcasts and video.<sup>83</sup>

With over 10,000 fires in 1996, the strategy does not include fire suppression, just better fire prevention and mitigation. The project so far has been a success, with awareness raised in over 70 schools and amongst the public. By last year there had been a 30% reduction in fire incidents in three years. “The project has now been expanded to cover 7 million hectares, because we think that this year we are probably down 700,000 hectares in fire incidence in four years” says Mike Jurvélius, a fire specialist involved in the programme<sup>84</sup>. A survey undertaken of the benefits of controlling the fires has found that the poorest women in the community experienced the greatest gain in terms of added nutrition to their children.<sup>85</sup>

The forest control project is the first of its kind not to have local people employed by the government, with traditional authorities signed up to the programme. “Community forestry is the only option in Africa today with the growing population in the rural areas”, argues Mike Jurvélius. “We have to engage all the rural areas in the preservation of the environment, because the government is totally helpless, there is no money or resources.”<sup>86</sup>

### 8.1.2 INDONESIA

Andrew Vayda, a Professor of Anthropology and Ecology at Rutgers, examined certain community responses to fires in Indonesia. He visited the Teluk Pandan community living within the Kutai National Park in East Kalimantan and was told that, while fires burned elsewhere in the Park in 97-98, no forest was damaged by fires started by the Teluk Pandan. The head of the village maintained that his personal experience of the great fires of 1982-83 had alerted the village, which imposed strict rules for burning.

Rules such as: anyone who was going to burn on their land had to give the village head at least three days notice and during the burn, people had to be present with water and other instruments to put out fires. Villagers who broke those rules were required by the community to pay compensation<sup>87</sup>.

Also operating in East Kalimantan is the Integrated Forest Fire Management Project, which started in 1991, when Indonesia asked for international help to assist in forest fires in Kalimantan. The German government, through their development agency, GTZ, assisted in setting up a “Long-term Integrated Fire Management System for Indonesia” to improve fire management capacities in the East of the island. The project began in 1994 and is scheduled to last for eight years.

To begin with, a pilot area was set up in Bukit Soeharto, where the initial phase of the project was undertaken. At the village level, this included undertaking socio-economic studies to elaborate a concept for community based fire management and to organise volunteer fire response crews. The national mascot for fire prevention, “Si Pongi” has been promoted at schools and with children.

In April 1999, using the “Si Pongi” theme, a colouring and drawing competition was held for hundreds of children at Samarinda in East Kalimantan. This was followed by an environmental education seminar where government officers, including teachers from all school levels, representatives from the local University, NGOs, community organisations, and the media discussed ways to prevent forest fires and the need for the development of an Environmental Education Network.

The next phase of the project includes replicating the idea all over East Kalimantan, with the establishment and equipping of local fire centres, and training of personnel at all levels trained to prevent and respond to wildfires. A crucial factor is the involvement of the local population. “Community based forest management is the right way”, argues Hartmut Abberger, from the IFFM project. “You can see everywhere last year during the fires, that people do not feel responsible for the fires. They feel no ownership and as long as there is no ownership, I do not think you will successfully prevent forest fires<sup>88</sup>.”

**“Community forestry is the only option in Africa today with the growing population in the rural areas”, argues Mike Jurvélius. “We have to engage all the rural areas in the preservation of the environment, because the government is totally helpless, there is no money or resources.”**

In contrast, Abberger continues that, “if there is co-operation between the government and local communities establishing community forestry, establishing buffer zones, I am pretty convinced there will be fire prevention<sup>89</sup>.”

### 8.1.3 AMAZON

Scientists from Woods Hole and IPAM worked with farmers from the Del Rey community of eastern Pará, after much of their land was burned during the 1991-92 fire episode. Together the collaborative project designed and implemented a community fire ordinance, which is similar to the one designed by the Teluk Pandan in Kalimantan. It requires that<sup>90</sup>:

**Only one fire was deemed to have gone out of control when a farmer was ordered to pay compensation of “one thousand fence posts”.**

- Community members must give eight days warning to their neighbours in advance of deforestation burning,
- Neighbours should clear and burn their plots at the same time
- Members must prepare fire-breaks in both the forest and pasture adjoining the new clearing,
- Perpetrators of accidental fires pay their neighbours to compensate for economic losses caused by the fire.

During 1997, eight intentional fires were supervised in this way. Only one fire was deemed to have gone out of control when a farmer was ordered to pay compensation of “one thousand fence posts”. Although the scientists from Woods Hole and IPAM believe the scheme has been successful so far, they believe “it is too early to tell if the Del Rey Fire Regulation will provide a long-term solution to the problem of accidental fire in the community”<sup>91</sup>.

## 9. Recommendations

A clarification of the issues and aspects surrounding and underlying influences on forest fires, particularly causes, is paramount and overdue. Forest fires are overwhelmingly the result of human actions, starting fires for subsistence, for protection and in support of industrial scale forest conversion. Fire management, fire planning and fire fighting capacity, and the opportunity and responsibility to be active at the most effective level, the community level, underlies many of the solutions to forest fire problems. The means to educate, inform and equip communities can come from many sources including government, private sector, NGOs, donors and development banks. The motivation for communities to participate and adopt their potential role rests on the resolution of some profound underlying issues. These include aspects of governance and the root causes of deforestation, such as poverty, corruption, trade liberalisation, debt and the resulting export-at-any-cost-growth model.

The time for action is limited due to:

- Forests affected by fires have become more susceptible to second and subsequent fires with dramatically increased impact.
- The global economic shocks and the Asian Economic Crisis have increased the pressure from rural people seeking subsistence and export oriented commercial endeavours in countries seeking economic survival.
- The limited capacity of government to regulate and manage forests, eroded by the economic crisis, is echoed by a generic mantra nominating “governance” issues on many fronts. The opportunities for influencing the direction and didactic of governments are limited but must be pursued.
- The private sector responds in an “economically rational” manner to potentially perverse incentives and the outcomes are by degrees acceptable, environmentally damaging and perhaps ecologically ridiculously stupid. The benefits from creating information, concepts and practices for influencing improvements and advances in private sector practices and policies are potentially enormous. The reality requires recognition of the balance between costs, risks and profit margins.

The causes of fire are complex and many, there are no simple solutions to the problem. The most promising move is towards community education, empowerment, and involvement in forestry. The very successful mechanisms for this have been developed under mainly an “action research” approach with communities at a practical level.

A set of generalised recommendations follows that in part address the underlying aspects for progress in forest fires. They cover global, regional, national, government sector, private sector and community elements. While most will generate positive outcomes in most circumstances not all suggestions are suitable for all countries.

Potential thematic and sectoral activities at varying scale include:

- Community Level;
- Promotion of community involvement and education about forest and land fires.
- Encouragement of community management schemes for forests and land.

**The causes of fire are complex and many, there are no simple solutions to the problem. The most promising move is towards community education, empowerment, and involvement in forestry. The very successful mechanisms for this have been developed under mainly an “action research” approach with communities at a practical level.**

- Managing and developing fire use to improve outcomes and reduce “escaped” fires.
- Provincial/National Level;
- Fire management and early warning systems need to be build up and implemented
- More intensive (less extensive) agricultural practices, emphasising agroforestry systems, should be promoted in favourable areas, through zoning, credit, and research and extension policies.
- Effective enforcement and improvement of national and international law.
- Budgets for fire prevention/management have to be available at a provincial, not just national level.
- There needs to be an analysis of infrastructure development, such as roads, waterways, power-lines, oil and gas infrastructure, which is facilitating the incursion of people into the forests.
- National Level;
- Clear government commitment to fire prevention including law enforcement and education of government officers, private sector operators and communities.
- Fire management infrastructure in many countries has to be improved. Progress should be built on existing organisational and operational capacities. Specific technical needs once defined might be met if appropriate through seeking elements of practices, technology and systems from other countries for adaptation.
- Develop and implement an effective monitoring system for fire use and management. Improvement of national monitoring, international monitoring of natural resources management and use is needed to support forest fire management particularly the reduction in unwanted fires. An independent system of monitoring such as the Forest Stewardship Council and Global Forest Watch may make a significant contribution.
- Exploring ways to encourage and inculcate zero-burning practices for forest and land management. Included may be government incentives for the use of alternative techniques in land preparation. Promotion of ‘no burning’ land preparation activities in selected areas of different provinces in Kalimantan and Sumatra can be combined with forest fires early monitoring and rapid response projects. This pilot approach would not only directly reduce the potentially burned areas, but also serve as a training ground and example for other areas in the same province.



- A comprehensive review of land-use planning, with an emphasis on solving land tenure problems. All stakeholders, including local communities should take part in the planning process and the needs of local communities be addressed. Initially community involvement should be considered in key decision making and ultimately community management and possibly ownership of forests should be explored including forest peoples rights over their lands.
- Harmonisation of forest policy in general to promote ecologically sustainable forest management including soundly based expansion of plantations, eliminating illegal logging and improved logging practices to reduce dead wooden material and maintain forest cover.
- An examination of export-led growth strategies that influence the extent and rate of conversion of primary natural forests into plantations. Alternative, non forested land should be identified, operational methods developed for using it for plantations and seriously considered for implementation.
- Market based mechanisms for supporting and encouraging sound forest and plantation practices should be thoroughly examined.
- After the 1997/98 fires, there's an urgent need for rehabilitation. Governments should commit to rehabilitation and urge the private sector to fulfil their obligations according to the area burnt in their concessions.
- Global Level;
- The long-term development model of forests has to be changed from one of cheap resource exploitation to one which is ecologically much more sustainable.

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# 11. Appendix

## 11.1 GLOBAL FIGURES AND ESTIMATES OF DAMAGE FOR 1997/98

This table gives the best estimate so far of impacts of the fires in 1997 and 1998

	Area impacted (million hectares)	Forest area impacted (million hectares)	Protected areas affected	Indigenous	Population affected by haze	CO2 produced (tonnes)	Economic (US\$ billion)
South East Asia	8-10	4.66	19	60-80,000	70 million	11 million	10
Amazon	3.3	1.5	N/A	22,000	N/A	N/A	N/A
Russia	2	~2	4	19,000	1 million	30 million	N/A
Central America	~1.5	1.48	2	N/A	At least 50 million	N/A	N/A
Northern America	5.6	At least 4.7	N/A	N/A	N/A	N/A	At least \$0.5
Southern Europe	0.24	0.105	N/A	N/A	N/A	N/A	N/A
<b>Incomplete TOTALS</b>	<b>22.64</b>	<b>14.4</b>	<b>25</b>	<b>121,000</b>	<b>130 million</b>	<b>41</b>	<b>N/A</b>

## 11.2 SOUTH-EASTASIA

In 1997 and again in 1998 South-east Asia dominated the media head-lines - first for its economic collapse, secondly due to the political turmoil of the dying days of President Suharto's generation in power and thirdly the ecological and health fall-out from forest fires. The political and economic instability gripping the country helped fuel the fires already fanned by the drought caused by El Niño.

The fires ravaged South-east Asia - from Papua New Guinea in the East through to Malaysia, but Indonesia burned the most, with fires in Java, Borneo, Sulawesi, Irian Jaya and Sumatra. The choking smog and haze that resulted from the burning not only shocked the region, but the world. Indeed it has been said that while fires themselves only concern foresters and conservationists, "it is the smoke that causes politicians and economists to react."<sup>92</sup> Global television showed graphic pictures of choking children, smog engulfed cities and fires ablaze. Ships collided in the gloom and aircraft crashed in the smog. It was, said some, a disaster of biblical proportions.

Some of the newest technology - that of satellite imagery from space - showed the devastating damage done by humankind's oldest tool - fire. Satellite imagery shows the fires started in January 1997 in Sumatra. Later in the year they burnt out-of-control in September, October and November, in both Kalimantan and Sumatra. Declared a national emergency by the government in September, by November the rains had diminished the fires. Also in November, Indonesia signed up to a \$43 billion IMF "economic rescue package" necessitated by the country's economic collapse. Ironically the rescue package included conditions on Indonesia to increase exports of timber, palm oil and paper pulp, the very industries that were causing the forest burning.<sup>93</sup>

By mid-January 98, after a short wet season, the fires once again burnt uncontrollably. They finally ended with the on-set of the rains in May, which culminated in widespread flooding in East Kalimantan<sup>94</sup>.

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**“despite numerous Ministerial meetings and attention on the regional haze problem”, fires had returned to Sumatra, Borneo and Peninsula Malaysia, even after only a “brief dry spell”. Noting that “there are still large tracts of forested lands to be developed into plantations in Sumatra and Borneo”, the Ministers “strongly urged that open burning should not be allowed for the conversion of these large tracts of lands into plantations.”**

### 11.2.1 ASEAN

The Association of South East Asian Nations has convened to consider and address the forest fire issue, particularly spurred by the effects of smoke being transported across national boundaries.

On 22-23 December 1997, at an ASEAN Ministerial meeting on Haze, a Regional Haze Action Plan (RHAP) was completed. RHAP is being seen as a “turning point in ASEAN’s approach to preventing, monitoring and combating forest fires and the resulting haze”. It has three primary objectives<sup>95</sup>:

- To prevent forest fires through improved management policies and enforcement;
- operational mechanisms for monitoring land and forest fires;
- Strengthen regional forest land and forest fire-fighting capability and other mitigation measures.

In June 98, the Haze Technical Task Force had asked the ASEAN Secretariat to prepare a paper on “Agreements and Protocols on Regional Co-operation in Transboundary Atmospheric Pollution”<sup>96</sup>. In April 99, ASEAN Environment ministers agreed to a “zero burning policy”<sup>97</sup>. The definitional detail and the implementation of the policy are yet to be clarified.

Due to the fires, in August 1999, ASEAN’S Ministerial Meeting on the Haze was brought forward two months from October. Although the zero-burning policy was in place, the fires raging in Sumatra and Kalimantan were a clear indictment that implementation was difficult, as most of the fires were coming from plantations. “The Indonesian authorities have also given their pledge to disallow open burning to clear land. Unfortunately, at the ground level, the implementation has not been up to expectations,” said the chair of the meeting, Singapore’s Environment Minister Lee Yock Suan<sup>98</sup>.

At the meeting in late August, Ministers expressed “deep concern”, that “despite numerous Ministerial meetings and attention on the regional haze problem”, fires had returned to Sumatra, Borneo and Peninsula Malaysia, even after only a “brief dry spell”. Noting that “there are still large tracts of forested lands to be developed into plantations in Sumatra and Borneo”, the Ministers “strongly urged that open burning should not be allowed for the conversion of these large tracts of lands into plantations.” One positive measure from the meeting was that Malaysia offered to share enforcement experience and conduct training course relating to zero burning.

The considerable effort that has been expended has generated some very positive steps in addressing forest fires in the ASEAN Region. These forums though are convened among Ministers of the Environment and their senior staff. Donors and other actors participate. The transboundary haze impacts are seen as an environmental issue but the underlying causes are from activities under the ambit of other ASEAN Ministers (e.g.: Forests, Transmigration, Planning, Development, Industry).

The constructive efforts by ASEAN to date have been confined to a single ministerial group. The cross-cutting nature of forest fire demands a broader inclusive approach covering all relevant sectors of governance, particularly forest management.

Although the ASEAN Environmental Ministers have made political commitments to prevent forest fires, the issue of off-shore operators and investors remains to be addressed. It is indicated there are significant areas of fire that are linked to Malaysian plantations operating in Indonesia and Singaporean investors funding the creation of new plantations in Kalimantan and Sumatra. There is a need to mobilize support also from the private sector, especially to increase the level of commitment from off-shore palm oil plantation investors to discourage the use of fires in their Sumatra and Kalimantan plantations. Further investigations are needed to prevent global investors from financing forest fires.

### 11.2.2 THE ECONOMIC CRISIS

The Asian Economic Crisis has been a dramatic factor in the national and social lives of all in the region. It has been the view of the expertise applied to the situation that provided the needed changes are put in place South East Asia should emerge from the crisis better able to improve the lives of citizens and contribute to international stability and prosperity<sup>99</sup>. The necessary reforms may have very painful social costs. A reversal of the pattern of previous years saw large numbers of people returning to villages from cities in search of a better life. This trend increases the load and pressure upon rural landscapes and the environment including protected areas. One manifestation of pressure is fires used to support activities for subsistence.

### 11.2.3 INDONESIA

But Indonesia was not just engulfed in smoke: it was a country gripped by political and economic crisis. The economic turmoil which spiralled out of control through the region in 1997, led to the country's currency devaluation in mid-year, sparking growing civil unrest. Months of protest finally saw the removal of the country's president - Suharto in May 1998 - after a generation of power, just as the rains began to extinguish the fires. The corruption associated with the Suharto regime had much to do with the underlying causes of forest fires ravaging Indonesia.

As a new political dawn awaits Indonesia, it is too early to say whether the post-Suharto era will radically change land use policies in the country. There are already signs of change: the twenty or so forestry conglomerates with close links to the Suharto regime that have dominated the forestry sector, may not survive the new political era. Some of their concessions are already being handed down to smaller co-operatives<sup>100</sup>. But it is necessary to examine the underlying causes of the fires, to understand what changes are necessary to stop the fires from recurring.

There is no doubt that the 97/98 fires spurred governments into action. While fire control has tended to be more reactive than proactive the efforts are worthwhile. At the national level both the Environmental Impact Management Agency (a Directorate) and the Ministry of Forestry and Estate Crops (a sub-directorate) have forest fire units with permanent staff and budgets. Currently a working group with representation from relevant government agencies (Planning, disaster Management, Environmental Impact, Forestry and Estate Crops, Home Affairs) and an environmental NGO have been drafting an Integrated Action Plan. The process of preparation has enabled some key issues of responsibility and structure to be examined. This plan will contribute to the ASEAN Regional Haze Action Plan.

**Indonesia was not just engulfed in smoke: it was a country gripped by political and economic crisis. The economic turmoil which spiralled out of control through the region in 1997, led to the country's currency devaluation in mid-year, sparking growing civil unrest.**

**“There is a lot of activity going on, but it is far from being appropriate for a large fire event, like El Niño” argues Hartmut Abberger from the same project “It is expected in 2001 that there will be another El Niño and I am really afraid that we will not be prepared for such an event”**

Presently with the exception of project related activities (GTZ Integrated Forest Fire Management Project, European Union Forest Fire Prevention and Control Project and some others notably the JICA Project) there is no fire control program at provincial or district level. Critics argue that although there are phrases, statements and press releases, much of this remains a paper exercise and there is not much sign of improvement on the ground. “Fire management in Indonesia seems to have become a donor dominated area. Too much of its conferences workshops, expert missions, papers, reports are theoretical exercises” continues Ludwig Schindler, co-ordinator of the IFFM project in East Kalimantan, “but it is not enough and even futile by its own because it will have little or no impact in the field. What is the point of all the donor activities, when the real problems and underlying causes of the fires are not seriously addressed?”<sup>101</sup>. “There is a lot of activity going on, but it is far from being appropriate for a large fire event, like El Niño” argues Hartmut Abberger from the same project “It is expected in 2001 that there will be another El Niño and I am really afraid that we will not be prepared for such an event”<sup>102</sup>.

The authorities are taking steps to address the problems. There is ongoing work on sub-Regional Firefighting Arrangements in partnership under the ASEAN Haze Technical Task Force. On 11th December 1997, Malaysia and Indonesia signed a bilateral Memorandum of Understanding for collaboration in addressing the air pollution or “haze” problem from fires.

### **11.2.3.1 CAUSES OF THE INDONESIAN FIRES**

As the international media scrambled for quick-fix answers to the burning, El Niño was singled out for blame. The underlying message was that natural, not anthropogenic reasons, were the underlying causes. “The El Niño phenomenon has become the scapegoat for the government and companies to avoid taking responsibility,” argued Longgena Ginting from Walhi<sup>103</sup>. In contrast, WWF’s report, published in 1997, entitled, The Year the World Caught Fire, highlighted the role of anthropogenic causes of the fires.

While the dramatic dry conditions caused by El Niño exacerbated the problem, El Niño itself does not cause fires. “The fire problem in Indonesia can be summarised in one sentence” says Ludwig Schindler, co-ordinator of the Integrated Forest Fire Management Project (IFFM) in East Kalimantan, “Too many people light too many fires for a complex variety of reasons. And, to fight the fires, there are no crews, no tools and little motivation or incentive<sup>104</sup>.”

In compiling the jigsaw of blame as to the underlying causes of forest fires, different pieces fit into the overall picture. The vast majority of fires in Indonesia are caused by man for numerous reasons; arson, accidental fires caused by cigarettes or camp-fires, legal and illegal forest conversion by small-scale or large-scale users, shifting cultivation, transmigration, land use conflicts, illegal logging, hunting with fire, or land speculation.<sup>105</sup>

Research by WWF Indonesia and the Economic and Environment Programme for South East Asia has concluded that up to 80 per cent of the fires in Sumatra and Kalimantan were started by plantation outfits, using fire as a tool to clear land in the run up to the rainy season<sup>106</sup>. Although in South Sumatra it is believed that individual farmers were responsible for half the area burned<sup>107</sup>

### 11.2.3.1.1 PLANTATIONS.

Although the Indonesian islands of Kalimantan and Sumatra had already lost more than 50% of their original forest cover before the onset of the fires, Indonesia still has the third largest area of tropical forest. With deforestation rates at 1.5 million hectares per year, most of all the lowland forest in Sumatra and Kalimantan has been logged and less than 100 million hectares of forest remain<sup>108</sup>. Indonesia, which is one of the twelve “mega-diversity” countries, contains 12% of the global mammal species and 10% of plants - housing an estimated 10,000 tree species alone, of which some 250 are deemed to be threatened.<sup>109</sup>

Over the last three decades, deforestation rates have soared, as President Suharto’s corrupt regime opened up the forest to rampant unsustainable logging<sup>110</sup>. Following the loggers came the agricultural settlers and more recently tree and oil plantation companies. Over the last decade the government has strongly developed pulpwood and palm oil plantations, which have grown rapidly in response to government subsidies and a burgeoning domestic and international market, coupled by investor confidence<sup>111</sup>.

The demand for palm oil, widely used in cooking oil, soap, margarine and a host of other products is currently outstripping any other edible oil. Global consumption, which is growing at over 5% per year, is set to continue. Global production is also growing faster than any other edible oil and is predicted to increase from 18.3 million tonnes in 1998/1999 to 20.1 million tonnes in 1999/2000. Malaysia and Indonesia are by far the biggest producers: Of next year’s harvest, it is estimated that Malaysia will account for 50% and Indonesia for 32%. Indonesian exports of oil are mainly to China, India, Pakistan, Italy, Germany, Malaysia, the Netherlands and the U.K.<sup>112</sup>.

Given a near-guaranteed international market, Indonesia sees palm oil as a vital source of foreign exchange, and has been clearing land for production. After spectacular growth over the last five years, some 2.4 million hectares is now under palm oil. With some 5.5 million hectares of concessions already granted, it seems that a conversion rate of some 250,000 to 300,000 hectares of forest per year is set for the next few years. Palm oil is now regarded as the single largest driving force behind forest conversion and land clearance by companies using burning is the greatest fire risk in Sumatra and Kalimantan.<sup>113</sup> Once alight, there is little financial incentive for companies to suppress or stop the fires<sup>114</sup>.

Just as companies close to the deposed President Suharto have dominated the timber industry, so three generations of his family are involved in the palm oil business<sup>115</sup>. As well as causing deforestation, palm oil plantations also create social tension and destabilisation. Robbing local communities of traditional life-styles increases the likelihood of villagers actually using fire as a weapon to vent their frustration against the companies.<sup>116</sup>

Although Indonesia law should protect forests, the system is open to abuse and corruption. Evidence exists that palm-oil plantations are being grown not only on forest designated for them, called conversion forest, but also on land reserved for “permanent” forest use. This includes production forest where only selective logging is meant to take place, protected forest and even national parks.<sup>117</sup>

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**While fire is the main technique used to clear land in Indonesia, the Malaysians have adopted zero burning. Zero burning, as its name suggests, means that no burning takes place to clear the land. Any felled trees are just left to decompose naturally after being broken down into smaller pieces.**

Under the government's plantation scheme companies have been apply to establish plantations by gaining access to cheap loans from the Reforestation Fund. This meant that a logging company could over-log an area of "production" forest, and then argue that the forest was "degraded". Once degraded the forest could then be reclassified as "conversion" forest, which, as its name suggests, can be converted to agriculture, which often happens by burning. The company can apply for a cheap "reforestation" loan to put a plantation on it<sup>118</sup>. The government, it seems, had done little, if anything, to stop the misuse of the forest conversion system.<sup>119</sup>

Although conversion to plantation is a major source of forest fires and forest degradation, the companies clearing land for plantations neither need to actually clear further forest land or even use fire as a clearance tool. The predicted expansion of palm oil does not have to occur in forest. According to the government, enough grassland and shrub-land exists for there not to have to be further forest conversion<sup>120</sup>.

Although Malaysia and Indonesia both plan to create another 4 million hectares of palm oil plantations in the next decade, practices vary between the two countries as to their clearance methods. While fire is the main technique used to clear land in Indonesia, the Malaysians have adopted zero burning. Zero burning, as its name suggests, means that no burning takes place to clear the land. Any felled trees are just left to decompose naturally after being broken down into smaller pieces. Indonesian experts believe it should be introduced: "Zero-burning land clearing or techniques that produce less smoke must be explored and implemented by large operators" argues Daniel Murdiyarso, the Programme Head of the Southeast Asian Impacts Centre in Bogor<sup>121</sup>. Notably some of the companies operating plantations in Indonesia are based in other countries, mainly Malaysia and Singapore. National control, influence and intent can become dissipated to some extent through the mechanism of offshore controlling interests. Combined regional effort and transparency is called for.

Studies from Malaysia have shown that there are numerous agronomic and economic benefits of zero burning and that there is actually little reason to continue the practice of land clearance by burning. However many Indonesians see it differently and still believe in burning. The initial higher cost and perceived risk of increase in disease means that zero burning is not undertaken.<sup>122</sup> Despite this, the Indonesian government, under pressure from its neighbours, said that zero burning would be adopted in late 1998.

On the 4th June 1999, World Environment Day, the new President of Indonesia, Mr. B.J. Habibie, announced the "Zero Burning Policy". A Presidential decree is currently being prepared and is expected to be put forward for the newly elected President and Parliament to consider and declare before the end of the year. ASEAN has also adopted zero burning as its policy although the detail of definition and implementation has not been developed at this point. However the chances of zero burning actually being adopted on the ground are seen as extremely remote.

While zero burning, if it is ever implemented, may reduce the impact of plantations established using fire on forests, there could be further problems that have not yet come to fruition. Worldwide there has been a tendency for tree plantations to show a decline in yield for the second and subsequent rotations of the plantation on many sites. While most of this experience has been in wood fibre production there is potential for second round palm oil and other plantation trees to also demonstrate lowered output. If this were the case the pressure to continue conversion of forested lands to plantation would be extended beyond the current objectives for palm oil and other plantation areas.



A related issue is the perception that the large expanse of grassland available for plantation is unsuitable. Forest experts believe there is an urgent need to research and strongly question the conventional wisdom that grassland areas represent inferior land for plantations. It is undoubtedly technically possible to establish plantations of palm oil and other trees on these areas. Prohibitive factors include the relative cost of establishing the plantations on grasslands, with perhaps additional inputs such as fertiliser, which may be balanced by the higher costs to clear forests.

#### 11.2.3.1.2 OTHER CAUSES

Settlers practising slash and burn or swidden agriculture were also reported to be responsible for starting some of the fires. However, Andrew Vayda, a Professor of Anthropology and Ecology at Rutgers, the State University of New Jersey, who investigated the causes of the fires for WWF Indonesia, remarked after his trip to Indonesia that he had “not found in my own field research a single clear-cut case of a forest wildfire resulting from fires set by local people to clear plots for cultivation.”<sup>123</sup>

Vayda did however substantiate the use of fire to gain access to resources as another cause of burning. He identified illegal cutters of valuable Borneo ironwood (known in Indonesia as Ulin), as a “significant source” of fires in the areas in which they were operating, especially in the Sangatta region of East Kalimantan. Fires, concluded Vayda, were either started deliberately to facilitate removal of trees, or accidentally by cigarettes or campfires. He also established arson and fires being set by turtle catchers as a localised source of forest fires.

Another major source of fires and particularly haze was the controversial scheme to convert some 1,000,000 hectares of lowland peat-swamp into a major rice-growing province. The project is now on hold<sup>124</sup>.

#### 11.2.3.2 IMPACTS

The ecological, health, and economic cost of the 1997/98 fires will never known - we can only produce estimates and even these cannot fully express the damage caused and pain inflicted. But how do you truly cost the impact of fires and chronic pollution on agricultural and industrial production, on health, on tourism, on fishing, on loss of land, biodiversity and climate change?

As is the way with estimates, figures vary widely. A conservative estimate made by the Economy and Environment Programme for South East Asia (EEPSEA), at the International Development Research Centre and WWF Indonesia suggest that from August-December 1997 the cost of the fires was US\$4.469 billion, of which 85% of the cost was to Indonesia. This figure was broken down into US\$3.073 billion for fire damage and US\$1.396 for haze related damages<sup>125</sup>. The Indonesian environmental organisation WALHI calculates the cost of the 1997/8 fires to be some US\$8.8 billion<sup>126</sup>, whereas Johann Goldammer, from the GFMC, puts the figure at around US\$10 billion<sup>127</sup>. An interim report from the Planning for Fire Prevention and Drought Management Project in Indonesia calculated total losses of between US\$5.2 and US\$6 billion<sup>128</sup>.

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**It is understandable that those hit hardest by the fires are dependent on the forest for food and shelter. If your whole life, income, and source of food and water is totally dependent on the forest's physical integrity, and that forest burns, you have quite literally lost everything.**

### 11.2.3.3 AREA

Reliable totals of the exact amount of forest that were burned do not exist either. It also has to be stressed that it was not just forest that burned in South East Asia. Indeed at the height of the fires in 1997, the Centre for International Forestry Research (CIFOR) near Jakarta announced that the main fire problem was from uncontrolled peat burning. Peat once alight can burn underground for years, and fires lit during the 1983 fires are still said to be alight<sup>129</sup> The one million hectares of peat were in the process of being drained for a massive government rice building project which was halted by Indonesian Government Officials in 1998<sup>130</sup>.

According to CRISP, the Centre for Remote Imaging, Sensing and Processing, at the University of Singapore, some 7.5 million hectares burned<sup>131</sup>. Other estimates are higher in the region of 8-10 million hectares of land being affected, including 4-5 million hectares in East Kalimantan, alone.<sup>132</sup> Much of this area was not forest but swamp, agricultural land, grassland and shrub-land. Official figures estimate that some 800,000 hectares of primary forest, secondary forest, peat swamp forest, national parks and forest plantations burned during 1997 and 1998.<sup>133</sup> However, a recent estimate from an ADB Project identified a fire-affected area of 9.5 million hectares, of which some 49%, or 4,655,000 hectares was forested.<sup>134</sup>

It is understandable that those hit hardest by the fires are dependent on the forest for food and shelter. If your whole life, income, and source of food and water is totally dependent on the forest's physical integrity, and that forest burns, you have quite literally lost everything. Some 500 tribesmen of Irian Jaya were believed to have been killed by the drought and haze<sup>135</sup>. For those still alive, it was a struggle to survive. A survey undertaken after the fires found that the Dayaks in East Kalimantan were severely impacted by the fires - with villages losing some 2,000 forest gardens, containing rubber and fruit trees and rattan vines. Rattan plants especially take around seven years to reach harvest. In May 98, the Indonesian press reported that some 60-80,000 people in remote parts of East Kalimantan faced starvation because of the effects of the fires on wild game and drought on agriculture.<sup>136</sup>

### 11.2.3.4 WILDLIFE

Malaysia and Indonesia's forests are areas of extremely rich biodiversity, and therefore any fire episode will impact wildlife, but in 1997 and 1998, primates in particular were badly hit. Both countries have more than 100 threatened animal species, with Indonesia recording the highest number of threatened mammals and the second highest number of threatened birds globally.

In Indonesia, at least 19 protected areas, were affected by the fires, including the Kutai National Park, whose primary forest was all but destroyed<sup>137</sup>. These protected areas are home to some of Asia's most threatened animal species such as the grizzled leaf monkey, silvery gibbon, Sumatran rhinoceros, tiger, Asian elephant, Asian rhinoceros, proboscis monkey and orang-utan<sup>138</sup>. The proboscis monkey, which lives almost exclusively in riverine and coastal forest, lost the most habitat of any primate in Borneo in the fires<sup>139</sup>.

The orang-utan were also particularly badly affected by the fires in East and Central Kalimantan, forcing a sharp decline in their already decreasing numbers. If the adults were not burned to death in the fires, they were caught fleeing the forests in search of food and water. Many babies were caught and sold as pets. Some experts now believe that the orang-utan could soon be extinct in the wild unless radical measures are adopted<sup>140</sup>. A similar fate of forced displacement was also experienced by the sun bears, also in dire straits.

#### 11.2.3.5 ATMOSPHERIC POLLUTION AND HEALTH

Although the haze hit the global headlines just how bad was it? According to UNEP the emissions from the fires in Kalimantan and Sumatra not only “significantly exceeded the emissions from” the 1991 Kuwait oil fires, which were seen as a global catastrophe, but “were a significant source of gaseous and particulate emissions to the local, regional and global atmosphere.”<sup>141</sup> WWF and EEPSEA have cost the damage of the haze only in 1997 to be some US\$1.396 billion of which some US\$940 million was due to short-term health damages, US\$256 million in lost tourist revenue and \$US157 million in industrial production losses. Other smaller costs were from airport losses, fishing decline and cloud seeding.<sup>142</sup>

At the height of the fires, the smog stretched over one million square kilometres from the Philippines in the North to Australia in the South, smothering Indonesia, Brunei, Malaysia, Singapore and Thailand. At some times visibility was reduced to virtually nothing as dense smog blanketed millions of people attempting to go about normal life. Children were tied to parents to be taken to school in case they got lost. The haze caused numerous transport accidents, such as ship collisions and an air crash which killed over 200 people, literally because people could not see where they were going.

We will never know how damaging the pollution was, because the air quality monitoring systems could only measure certain types of pollution. In the worst affected areas air pollution levels far exceeded those deemed to be hazardous to health. Standard air pollution index (API) readings peaked at 849 in the Malaysian state of Sarawak, in late 1997 and over 1,000 in Jambi in Indonesia, compared to 100 being considered unhealthy, 300 deemed to be hazardous, and 400, “life-threatening”. Similar readings were recorded in East Kalimantan in 1998<sup>143</sup>.

The smoke itself contains a cocktail of some 100 chemicals that can cause harm - from hydrocarbons and small soot particles to carbon monoxide, nitrogen dioxide and benzene<sup>144</sup>. Put simply, at the height of the fires, these might have been the highest pollution levels ever recorded and breathing the air was the equivalent of smoking five packs of cigarettes per day<sup>145</sup>.

Chronic pollution levels like these are literally life threatening and can cause severe respiratory and eye problems, and can kill, especially the vulnerable: the populations-at-risk from air pollution, such as the old, young or people with cardio-vascular and respiratory conditions<sup>146</sup>.

Estimates vary considerably but between 20 to 70 million peoples’ health was adversely affected by the fires with some 40,000 people hospitalised for respiratory and other haze-related ailments. Indonesian authorities recorded an increase in incidence of respiratory problems such as asthma, bronchitis, pneumonia as well as eye and skin problems<sup>147</sup>.

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**With the end of the Suharto regime comes the chance of change. According to CIFOR, the Centre for International Forestry Research, near Jakarta “opportunities have never been greater for fundamental forestry policy change in Indonesia”.**

### 11.2.3.6 THE FUTURE

With no let up likely in the national, regional and international demand for palm-oil, coupled with low production costs, Indonesia looks set to use palm oil as a key foreign exchange earner in the future. The IMF and World Bank are also promoting this export production strategy. The \$43 billion IMF “economic rescue package” agreed in November 1997 stipulated that all formal and informal barriers to investment in palm oil plantation be removed<sup>148</sup>.

“I would not agree about the comments that the IMF made about forest conversion generally, to palm oil, in other words, pushing palm oil,” argues Hartmut Abberger from the IFFM project in East Kalimantan. Although it may be hard to prevent further palm-oil expansion, Abberger believes that “rather than convert forest which was not burnt into palm oil, they should rather look into areas where forests were burned or degraded<sup>149</sup>.”

The IMF agreement prompted a coalition of environmental and development NGOs, who represent over six million members to write to the IMF and Bank complaining that their promotion of the palm oil sector, “poses unacceptable environmental and social risks”, which “include widespread forest fires endangering regional environmental stability and health, significant economic losses entailing from these fires to the ASEAN region, and the forced displacement of indigenous and other forest-dwelling communities within Indonesia”. The groups called “for a halt to any direct or indirect encouragement by the Bretton Woods Institutions for the expansion of the Indonesian palm oil sector”<sup>150</sup>.

Western donors should share blame in the country’s deforestation. Over the last ten years the leading bilateral donors, such as the Consultative Group on Indonesia (CGI), a co-ordinating body chaired by the World Bank, and whose main members include Britain, Germany, Japan, and the United States<sup>151</sup>, have bailed out the Indonesian economy to the tune of \$4 billion a year. This is despite the fact that last year a World Bank internal report estimated that one-third of its project loans to the country had disappeared<sup>152</sup>.

In effect, the international community subsidised Suharto’s corrupt forestry regime, which has resulted in “rampant illegal logging, timber smuggling, tax and royalty evasion, flagrant violations of logging rules, and avoidance of reforestation duties<sup>153</sup>.”

With the end of the Suharto regime comes the chance of change. According to CIFOR, the Centre for International Forestry Research, near Jakarta “opportunities have never been greater for fundamental forestry policy change in Indonesia”,<sup>154</sup>.

Despite this, the international agencies, instead of leading the way on reform, continue to have a blinkered approach to forestry. For example, Mark Poffenberger, from IUCN argues that the IMF and World Bank continue to see corruption and deforestation as “being rooted in the poor implementation of forest policies, rather than questioning the basic viability of state forestry itself<sup>155</sup>.”

Although tackling corruption was one of the conditions of the new \$5.9 billion loan agreed in July by the CGI, it still increases the country’s foreign debt and increases the pressure to export, which in turn will put pressure on forests<sup>156</sup>. Indonesia’s total debt is estimated at US \$145-160 billion, which currently eats up 33% of routine state budget expenditure and 52% of export revenues<sup>157</sup>.

“I think the IMF is part of the problem, not the solution” says Frances Carr, from Down to Earth - The International Campaign for Ecological Justice in Indonesia, “As long as you have a forestry policy which is dominated by the need to exploit natural resources for export, you will continue forest destruction. Until the Indonesian government addresses the central issue of recognising forest people’s rights over their lands, the illegal logging, the forest destruction and the forest fires will continue.”<sup>158</sup>

### 11.3 THE AMAZON, GUYANA SHIELD AND ORINOCO

In 1997 and 1998, the extreme El Niño event exacerbated traditional deforestation and burning of forest and savannah by settlers and loggers and caused catastrophic fires on a huge scale - but this time in the Amazon. The fires started when the El Niño caused the dry season to start early in August 1997, with fires breaking out in the savannah areas in the Brazilian state of Roraima, which borders Venezuela and Guyana. They soon spread to open forest. In early 1998, Roraima was also a focus for fire and by March, fires threatened the dense forest surrounding the indigenous reservation of the Yanomami Indians, having reached “alarming” proportions, according to UNEP. Finally in April, heavy rains extinguished the major fires.<sup>159</sup>

What we do know is that satellite imagery seems to show an increase in fires in the last three years. NOAA satellites show that there were significantly more fires in the Brazilian Amazon in 1998 than there were in 1997 and there were more fires in 1997 than the previous year. Fires detected by NOAA in the Brazilian Amazon increased 86% in the months of June, July, August and September 1998 over the same period in 1997. The satellite recorded 45,596 fires in just 100 days in 1998 and 22,917 fires in 1997. Compared to 1996, though, the number of fires in 1997 increased by 50%, to over 44,734 fires for the July-November<sup>160</sup>.

Also in March 1998, fires burned elsewhere in the region: in the sub-montane and lowland forest on the Cordillera de Merida in Venezuela and the northern part of the Cordillera Oriental in Colombia. Fires also burnt in Venezuela in the lowland forests of the Llanos basin and the lowland moist forests and swamp forests of the Orinoco Delta. Fires also swept the lowland dense forests of Surinam and Guyana<sup>161</sup>.

#### 11.3.1 CAUSES OF THE FIRES IN THE AMAZON

As in South East Asia, fire is used to prepare the land in the run-up to the rainy season. Fires, which might be extinguished by the rains in a normal year, burn out of control as wildfires during an El Niño event. The United Nations Disaster Assessment and Co-ordination team (UNDAC) sent to Roraima after the local government declared a “State of Public Calamity”, concluded that the main reasons for the fires were:<sup>162</sup>

- “traditional deforestation and burning of vegetation to prepare the agricultural soil, especially in the savannah vegetation zones;
- fires and deforestation of open and dense forest areas, as part of the colonisation process and expansion of the agricultural frontier;
- Severe drought, as a result of the phenomenon El Niño.”

**“As long as you have a forestry policy which is dominated by the need to exploit natural resources for export, you will continue forest destruction. Until the Indonesian government addresses the central issue of recognising forest people’s rights over their lands, the illegal logging, the forest destruction**

**According to the scientists “the Roraima fires provided a wake-up call for far more extensive fires likely to occur in the rest of the Amazon- especially within the so-called “arc of deforestation” that extends along the eastern and southern edges of the region and where much of the region’s rural population is concentrated. Here logging is a widespread activity and leaves large amounts of debris on the forest floor, providing fuel for wildfires”**

Attempting to put precise numbers on the causes is difficult, but analysis does exist by the Brazilian organisation IPAM (Instituto de Pesquisa Ambiental da Amazônia) for 1995. IPAM researchers found that intentional fires were responsible for 52% of the area burned by fire and accidental fires for 48% of the area in five Amazonian regions. This means that over half the Amazon’s fire are started deliberately. The breakdown consisted of: Accidental fires in forested areas: 12 %, intentional fires in forested areas: 16%; accidental fires in agricultural areas and pastures 36%; and intentional fires in pastures and agricultural areas 36%<sup>163</sup>.

However, ground-breaking research by scientists from WHRC and IPAM reveals worrying trends about deforestation, El Niño and fire in the Amazon. The scientists found that up until 1997/98 fire had been largely confined to areas used for agriculture or grazing and had not posed a major threat to intact forests. However the “drought of 1998-which built on an earlier drought in 1997-signalled the effective penetration of fire into forest ecosystems across much of the region and the possible initiation of a positive feedback loop in which rainforests are replaced by fire-prone vegetation”<sup>164</sup>.

The researchers found that in two regions of the eastern Amazon, accidental fires have affected nearly 50 per cent of the remaining forest, and had caused significantly more deforestation than intentional clearing in recent years. They found that between 1993 and 1995 accidental fire-induced deforestation increased deforestation by 129%, and that correcting the deforestation estimate for this factor yields an intentional (i.e. slash and burn) deforestation rate of only 1.7%<sup>165</sup>.

The scientists believe that this means surprising result that the increase in estimated deforestation rates from 1993-1995 may have occurred largely due to the wide spread forest fires of 1992 and 1993. It was not caused by slash and burn agriculture<sup>166</sup>. The scientists concluded that current estimates of deforestation could actually only capture half the forest area being impoverished<sup>167</sup>. Moreover the scientists concluded in a letter to Nature that in certain survey areas that “we find that only about a tenth of the area classified as forest actually supports undisturbed forest”. They called it “cryptic” forest impoverishment<sup>168</sup>.

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### **11.3.2 IMPACTS**

#### **11.3.2.1 ECOLOGICAL**

Fire poses an extreme threat to the future of the Amazon. Moreover the ecological effects of fires in the Amazon are global in scale, as they influence both the chemical composition of the atmosphere and the reflectivity of the Earth’s surface<sup>170</sup>. The full extent of forest fires in the Amazon in 1997-98 remains unknown, but it is estimated that some 3.3 million hectares of land burnt, of which 1.5 million was rainforest.<sup>171</sup>

### 11.3.2.2 HEALTH IMPACTS

In April 1998, the UNDAC mission to the area identified some 12,000 people in the Amazon in need of immediate assistance, of which some 7,000 Indians were said to be in a “vulnerable” situation. The fires affected the Yanomami, Macuxi, and Wapixana Indians, reducing fruit and game harvests and subsistence crops. Both Indians and settlers were forced to walk extraordinary distances to find water, too. Wells and rivers dried up, leaving pools of stagnant water - ideal breeding grounds for vector-borne diseases, such as malaria and dengue fever - and increased incidence of these diseases was observed<sup>172</sup>.

In March 1998, the Brazilian NGO, CCPY, which supports the Yanomami Indians, reported that some 22,000 indigenous people had lost their sustainable agriculture projects, with subsistence crops such as manioc, banana and sugarcane being damaged. Vulnerable species such as monkeys, deer, boar, anteaters, sloths and tortoises were all badly affected by the fires too<sup>173</sup>.

The poor water supplies and inadequate access to food meant that malnutrition and diarrhoea increased amongst Indigenous and settler communities. So did skin, eye and respiratory infections. Respiratory problems increased rapidly, especially amongst children. The pollution from the fires was so bad that residents of rural Amazonia breathed air that was more polluted than the air in downtown São Paulo during the dry season. According to the Brazilian Ministry of Health, twice as many people were admitted to hospital during the burning season compared to other months of the year<sup>174</sup>.

The fires had other effects: More snakebites were recorded as snakes were forced to flee the flames and heat. Livestock and crops were also affected: some 14,000 cattle perished and an estimated 700 granaries for the storage of corn and bean seeds were also destroyed. Over 100 houses were also burnt down<sup>175</sup>.

### 11.3.3 THE FUTURE

“The challenge” argues Dr. Daniel Nepstad from Woods Hole Research Centre, “is to direct the large amount of money flowing into the region into processes that can eventually address the root cause of the fire problem, and not just view the problem as a fluke-of-nature catastrophe”. Dr. Nepstad believes that “the problem is a rural development model that is based on what we could term ‘mining’ rather than development. Natural resources are mined without a view to future harvests<sup>176</sup>.”

Another problem, according to Dr. Nepstad, is that forest is available in abundance and is therefore very cheap. “When forest is cheap and labour and capital are scarce, it is the forest itself that becomes the fertiliser, the pesticide, the herbicide, the plow”. Nepstad argues that a new model of rural development is needed, that restricts access to some 70% of the region’s forests<sup>177</sup>. “Unless current land use changes and fire use practices are changed,” argue the Woods Hole researchers “fire has the potential to transform large areas of tropical forest into scrub or savannah”. If this occurs, it could have global consequences<sup>178</sup>.

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**By October 1998, the UN, which had just sent an emergency mission to the region, said the fires were a global catastrophe. “Forest fires of such a scale fall in the category of world-wide ecological disasters”, said a UN spokesperson, “They bear consequences not only for the ecosystem of frontier countries with Russia but also for a large part of the Northern Hemisphere“**

#### **11.4 RUSSIA**

Thousands of miles away, fires burnt the taiga forest, which is twice the size of the Amazon and hosts nearly a quarter of global timber reserves, and which is vitally important as a carbon sink. The forest, made up predominantly of larch, pine, spruce, fir, birch and aspen, covers an area of over 1 billion hectares blanketing Russia, from the Bering Sea in the East to the Barents Sea in the West<sup>179</sup>.

Forest fires in Russia are an annual event, with on average between 12-30,000 fires in a year, increasing from some 18,000 in 1993, to 33,000 in 1996 and 31,000 in 1997.

1998 was an exceptional year, when drought created tinderbox conditions and coupled with deep economic recession caused Russia’s forests to be set ablaze. Once alight, the fires raged through the Russian Far East, affecting two thirds of the Pacific island of Sakhalin and large swathes of the forest in the Khabarovsk Krai and Primorye regions.<sup>180</sup>

The fires which started in May 1998 on the island of Sakhalin, were greater in number than any year previously and damaged some 100,000 hectares of the island. The other badly affected area was the Khabarovsk Krai, a forested and mountainous region with some 120,000 rivers and 55,000 lakes and over 52.5 million hectares of forest, of which 90% is said to be potentially exploitable. In July a state of emergency had been declared to fight the 1000 fires burning in the forests. At its height, some eighteen massive fires burnt each covering up to 350,000 hectares<sup>181</sup>.

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##### **11.4.1 CAUSES:**

Although fire has also long been used as a land-clearance tool in Russia, the underlying economic crisis squeezing the country was said to be the main reason why the majority of fires started and were allowed to burn out of control. The crisis drove many more people to the forest to hunt, fish and collect wild fruit and mushrooms, therefore causing many more fires, and once started, the authorities were not able to cope<sup>183</sup>. Russian authorities believe that the vast majority of fires, some 70-85% were the result of unintentional human activity such as dropping of cigarettes and neglecting cooking fires, whereas lightning caused 15-30% of fires. West of the Urals, in the European region of Russia virtually all fires are believed to be anthropogenic<sup>184</sup>.



Once alight the authorities had few resources to fight the fires. “The lack of food, clothing, fuel, equipment and salaries is severely hampering the ability of authorities to respond appropriately,” observed the UN. “There is little remaining capacity to respond to this and may other disasters that may occur in the regions”. It seems that over the last decade the situation has got remarkably worse. Communism may have been replaced by capitalism, but market forces have not been good news for Russia’s fire fighters. The Federal Forest Service reported how, in 1988, they had four times more resources than a decade later and in similar conditions only lost 300,000 hectares of forest compared to 2 million in 1998. The federal fire fighters, who had traditionally relied on airborne reconnaissance to cover the huge forests, did not have enough fuel or supplies to keep its fleet airborne.<sup>185</sup>

The UN concluded that the “root cause of these fundamental problems appears to be a combination of an inadequate resourcing of regional authorities by central government, inability of regional authorities to clear year-end debts, and late release of annual budgets in time for effective preparedness measures to be put in place prior to the fire season.”<sup>186</sup>

#### 11.4.2 ESTIMATES OF DAMAGE

According to the UN, the total area burned by fires in Khabarovsk Krai and Sakhalin was some 2 million hectares, comparable, they said, to areas burnt in Indonesia and Brazil. Given the extensive damage of the affected area, scientists believe it would be some 100-120 years before the forests return to their pre-fire state in the harsh taiga environment. Calling the fires “internationally significant”, the UN reported three main areas of concern:<sup>187</sup>

- The possible effects on global climate through the emissions of an estimated 30 million tonnes of carbon dioxide.
- Large-scale transboundary air pollution in many major Russian cities and as far away as China. In excess of one million people were affected by smoke and carbon monoxide pollution. The long-term effect or exact nature of the pollution will not be known, as the Russian authorities’ air monitoring equipment is inadequate. What the monitoring network did detect was that carbon monoxide readings reached 3-13 times the maximum permissible level for a number of weeks and up to 24 times the maximum permissible level on occasions.
- “Large-scale destruction” of biodiversity - the fires severely impacted important and rare habitats and endangered species such as the Amur tiger. They affected two Ramsar Wetlands of International Importance and two protected nature reserves, destroying unique landscape. On the island of Sakhalin, half the ground-nesting birds were believed to have been impacted and up to 20 % of mammal species.

**the “root cause of these fundamental problems appears to be a combination of an inadequate resourcing of regional authorities by central government, inability of regional authorities to clear year-end debts, and late release of annual budgets in time for effective preparedness measures to be put in place prior to the fire season.”**

**Without adequate resources to tackle forest fires, and the growing problem of illegal deforestation, the future looks bleak for Russia's forests. "Unless the authorities can respond accordingly, it is likely that even more significant, potentially catastrophic, damage will be caused by forest fires in future years"**

Greenpeace estimated the total material damage to be some US\$9 billion, although the official figure is some 8 times less<sup>188</sup>. On the island of Sakhalin, the authorities reported that the fires caused an estimated 670 million roubles worth of damage to the industry. Some 136 homes were destroyed, killing at least three people and leaving some 600 people homeless<sup>189</sup>.

Just like in Indonesia and the Amazon, the worst affected victims of the fires could well be the indigenous population. A significant proportion of the local population in the Khabarovsk Krai is of aboriginal origin, and relies heavily on subsistence hunting and fishing. Some twenty-five indigenous nations, representing an estimated 19,000 people were adversely affected by the fires due to the natural habitat and food sources being destroyed.<sup>190</sup>

In the Khabarovsk Krai region both the conventional hunting and fishing industries were also impacted with combined losses of an estimated \$US 800,000 per year. The timber industry reported some 15 million cubic metres of timber had been lost, with total damage to forest put at 500 million roubles. In total, the Russian Ministry of Emergencies estimated damage in the Khabarovsk region as US\$27 million.<sup>191</sup>

#### **11.4.3 THE FUTURE**

Without adequate resources to tackle forest fires, and the growing problem of illegal deforestation, the future looks bleak for Russia's forests. "Unless the authorities can respond accordingly, it is likely that even more significant, potentially catastrophic, damage will be caused by forest fires in future years" concluded the UN, after their mission there in 1998.<sup>192</sup>

As elsewhere, Russia's forests face the threat of climate change, but most climate models expect climate change to occur much more rapidly in circumpolar regions compared to the tropics. Increased drought conditions in the taiga could lead to prolonged fire episodes with much larger, more intense fires. Fire, the scientists predict, "may become the most important driving force in changing the taiga under climatic warming conditions"<sup>193</sup>. With the onset of climate change therefore it is predicted that increasing fire activity will result in large-scale loss of forests in Eastern Siberia. Fires coupled with droughts and the melting of the permafrost may release high amounts of carbon to the atmosphere, thus accelerating climate change<sup>194</sup>.

#### **11.5 CENTRAL AMERICA AND MEXICO**

The shock waves of El Niño were felt throughout Central America, with the region being badly affected by the worst fires in living memory. The region was quite literally ablaze: In Mexico nearly 600,000 hectares of land burned in 14,000 fires. In Nicaragua over 13,000 fires damaged 800,000 hectares of land. 51,500 hectares burned in Honduras in 1,800 fires. By May 1998, Guatemala, Costa Rica and El Salvador had all declared states of emergency in response to the fires<sup>195</sup>.

At the same time, the whole of Central America from Mexico, Guatemala, Nicaragua, Honduras, El Salvador and Costa Rica through to the Southern and Midwestern US was blanketed in smog, just like in South East Asia. Americans as far north as Denver and Chicago breathed the smoke and residents in Texas were advised to stay indoors if possible and avoid prolonged physical activity outside.<sup>196</sup>

Some of the worst fires were in Mexico where the forests consist of some 30 million hectares of temperate forest and 26 million hectares of tropical forest. Annually some 600,000 hectares of forest are burnt in Mexico, with the primary cause being forest conversion to agriculture, with forest fires causing only about 2.4% of deforestation each year. Over the ten year period 1987-1996, some 2.6 million hectares of land has burned, in some 80,000 fire episodes<sup>197</sup>.

In 1998 Mexico experienced its worst fire season on record with some 14,300 fires burning some 583,664 hectares, over twice the normal average. Some 151,753 hectares or 26 % of the fires were in forests. The areas most impacted were the Sierra Madre Occidental, the central Highlands and the tropical mountains of Oaxaca and Chiapa, where an environmental emergency was declared.<sup>198</sup>

### 11.5.1 CAUSES OF FIRES

Once again the combination of El Niño-induced drought conditions, high winds and people burning land as a clearance tool, caused widespread fires in the region. The majority of fires in Mexico have historically been anthropogenic. For example, the results of Mexico's 10 year Forest Fire Prevention and Control Programme concluded that the majority of wildfires (60%) are caused by agricultural activities such as grassland burning and shifting cultivation. Other major causes are: cigarettes and camp fires (18%); intentional (12%); forest operations (2%); and miscellaneous such as illegal activities, roads and railways and lightning (8%)<sup>199</sup>. In 1998 some 97% of fires were anthropogenic in origin with agricultural burning (47%) the main single cause, followed by campfires (20%), conflict (8%), land clearing (6%) and forest activities (3%).<sup>200</sup>

### 11.5.2 IMPACTS

As elsewhere, the full impact of the fires will never be known. Central America is home to some of the world's greatest biodiversity. In Mexico the biosphere reserve of Las Chimalapas, the most northerly rainforest in America, was severely damaged by the fires<sup>201</sup>. In Costa Rica some 3,600 hectares of the 43,000 Parque Nacional Guanacaste, renown for endangered wildlife and its biodiversity were damaged. Some 350 species of bird, reptile and mammals were believed to be threatened by the fires. In total over 40,000 hectares of park-land forests were burned. Overall it has been estimated that some 1,489,000 hectares of forest burned between December 1997 and May 1998<sup>202</sup>

Just as in South East Asia, the region was smothered in a toxic haze, affecting some 50 million Mexicans and hanging over Mexico City and other major towns, such as Villahermosa, San Cristóbal de las Casas and Veracruz. It also consumed Mexico's neighbours, spreading into the Southern US states of Texas, Georgia, Arizona, Florida and Louisiana and reaching as far north as Chicago and Denver<sup>203</sup>. In Mexico, some 50 people were killed in the fires.<sup>204</sup>

**Just as in South East Asia, the region was smothered in a toxic haze, affecting some 50 million Mexicans and hanging over Mexico City and other major towns, such as Villahermosa, San Cristóbal de las Casas and Veracruz. It also consumed Mexico's neighbours, spreading into the Southern US states of Texas, Georgia, Arizona, Florida and Louisiana and reaching as far north as Chicago and Denver**



**Instead of a policy of fire suppression, fire fighters have instead advocated “prescribed burning” “, planned and approved fires started by agencies and others, and salvage timber sales to reduce the build up of combustible forest debris. However in the United States, following catastrophic fires in the Yellowstone National Park in 1988, the related “let burn” policy formulated to permit naturally occurring fires to burn within planned limits was temporarily halted.**

## **11.6 NORTH AMERICA**

While the southern United States experienced smog from the fires in Mexico and Central America at the beginning of 1998, home-grown fires were beginning too. Although historically for the whole country, 1998 was not a bad year, the effects of El Niño were still felt. At the start of the year, the Northern US was drier and warmer than normal, whereas the southern states were wetter. Come spring these conditions reversed, with extremely dry conditions and below-average rainfall from New Mexico to Florida, and the increased rain and cooler temperatures in the north-western states. Alaska, meanwhile, and north-eastern Montana and the Great Lake were dry<sup>205</sup>.

In Canada too, fires were alight. Canada’s El Niño winter had fire-fighters worried with the low winter precipitation, and above normal temperatures and the fires started early, especially in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Northwest and Yukon territories. By July, increased lightning activity had the fires moving north and westwards, and in Northern Ontario, 1000 residents from remote villages had to be airlifted to safety. Communities were also evacuated in Alberta. In August the hot dry weather coupled with occasional lightning strikes caused over 400 fires in British Columbia in one weekend. But by the end of the month, cooler wetter weather had extinguished most of the fires<sup>206</sup>.

### **11.6.1 CAUSES:**

Data collected by the National Interagency Fire Centre for the years 1991 to 1997 show that lightning, debris burning and arson are consistently the three main causes of fires in the US. For 1997 the following were the main causes of fires: debris burning 31%; arson 19%; lightning 11%; equipment 8%; children 5%; cigarettes 4%; campfires 3%; railroad 3%; and miscellaneous 15%. However, three quarters of the land burned - 76% - was due to lightning.<sup>207</sup>

In Canada data collected from 1918 to 1995 indicate that lightning causes some 42% of forest fires. These 42% however, burn approximately 85% of the total hectares of forest burnt each year. The remaining 58% of fires are caused by cigarettes, camp-fires and other anthropogenic causes.<sup>208</sup>

Both the US and Canada have changed fire policy over the last few decades. Instead of a policy of fire suppression, fire fighters have instead advocated “prescribed burning” “, planned and approved fires started by agencies and others, and salvage timber sales to reduce the build up of combustible forest debris. However in the United States, following catastrophic fires in the Yellowstone National Park in 1988, the related “let burn” policy formulated to permit naturally occurring fires to burn within planned limits was temporarily halted.<sup>209</sup> Prescribed burning within the National Forest System is currently undertaken on some 360,000 hectares per year. Over the last few years in the US, there have been calls to for increased prescribed burns and the US Forest Service has set a goal of burning 1.2 million hectares per year by 2010<sup>210</sup>.

### 11.6.2 IMPACTS

For the year as a whole Canada experienced an above average fire year, with some 10,838 fires recorded up on a ten-year average of 8,937. The fires damaged some 4,710,775 hectares of forest, compared to the average of 3,202,613. Intense fires started in April, and by May, the largest mobilisation of personnel and resources had occurred<sup>211</sup>.

In total in 1998, there were 81,000 fires in the US burning some 940,000 hectares of land. Some states within the US fared extremely badly. Six of the largest 120 fires in the year were in Florida, where drought conditions meant that fires ripped through the country from May to July. Over 120 homes and 25 businesses were damaged, with a further eight businesses and 200 homes damaged. Over 130,000 people were evacuated from their homes, with 10,000 fire fighters tackling the fires. Some 2,280 fires affected an estimated 200,000 hectares of land. Timber companies owned a quarter of land burned, and timber losses were estimated in excess of US\$ 300 million. The cost to fight the fires was some US\$ 130 million.<sup>212</sup>

### 11.7 EUROPEAN MEDITERRANEAN

At present the Mediterranean experiences on average 50,000 fires a year, which burn an estimated 600,000 hectares. Both the number and area burnt are believed to be double the amount than in the seventies, though some of the increase is thought to be because of better and more accurate forest fire reporting.<sup>213</sup>

The authorities in Greece, Italy and Spain, called 1998 an “average” or slightly above “average” fire year. This said, Greece experienced intense periods of fire in the Peloponnesian and near Athens, which caused severe ecological damage, burnt hundreds of buildings and caused a number of fatalities.

#### 11.7.1 CAUSES

Scientists who have looked into the causes of fires in the Mediterranean believe that, some 95-99% of fires in the region are anthropogenic, which is extremely high compared to other parts of the world. Many are from unknown or accidental causes related to either agriculture or forestry.<sup>214</sup>

#### 11.7.2 IMPACTS

In Greece, according to the Fire Service, over the summer months some 8,748 fires burned an area of 95,570 hectares. In early July, strong winds and high temperatures caused over 100 fires from several sources to flare, with the region around Athens, called Attica, the worst hit. By the end of July, another major fire episode had erupted in the ecologically important forest on mount Targets near Sparta, an area of over 160 endemic plant species, and 36 rare or endangered species. By early August the fires reached the suburbs of Athens before being extinguished by the rains later in the month. At least ten people were killed and hundreds of houses and other buildings such as a hospital, restaurant, factory and school were destroyed in separate fire incidents<sup>215</sup>.

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Spain also experienced an “average” year; some 21,460 fires burned 121,490 hectares of land, of which 41,240 hectares were forested. The total area burned was lower than the average for 1994-97. Four people were killed in the fires. The worst woodland fire occurred in July when 20,000 hectares were damaged in the Cigar in the Ciudad Real<sup>216</sup>. In Italy, meanwhile, the Forest Service estimated that some 10,314 forest fires occurred up to the end of September, affecting some 140,843 hectares of which 63,145 hectares was wooded. The areas of Caldaria, Sicily, Sardinia and Lingerie were most severely affected, forcing the Italian government to declare a state of emergency<sup>217</sup>.

Overall for Greece, Italy, France, Spain, and Portugal it has been estimated that between the beginning of January and end of August in 1998 there were some 50,985 forest fires, which damaged 105,593 hectares of forest. In terms of woodland affected, Italy was the worst affected<sup>218</sup>.

## Global Review of Forest Fires

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