# THE ECONOMIC LOSSES TO EAST KALIMANTAN FROM THE 1997/98 FOREST AND LAND FIRES

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## *Executive Summary*

In 1997, a strong ENSO (El Nino Southern Oscillation) event led to drought and subsequent devastating fires in Indonesia. In most of Indonesia fires started in late 1997, but in East Kalimantan fire activity remained low during 1997. This was thanks to precautionary measures taken (Schindler, 1998). However, beginning February 1998, fire activity in East Kalimantan grew beyond suppression capability. Along with the fires came thick haze and extreme pollution levels affecting the whole region and drawing much international attention to the fires and Indonesia.

The time of the forest fires was turbulent for Indonesia and East Kalimantan: political unrest grew since 1996 and soon after the fires had started, in July 1997 the Asian economic crisis began with the devaluation of the Thai Bath. By early 1998, the Rupiah had suffered a devaluation of 80%. To adjust for the effects to Indonesia's economy from the Asian economic crisis, this report uses 1996 pre-crisis exchange rates of Rp 2, 500 per US Dollar and 1996 prices. The year 1998, when most fire-induced damage occurred is the base year for discounting purposes. Additional adjustments allowing for reduced number of tourists and less air traffic since the economic crisis are made.

A strong drought induced by the El Nino weather phenomenon made vegetation prone to fire and caused crop failure and damage to vegetation. More specific data and knowledge about East Kalimantan's ecosystem is needed to better estimate the impact of fire and haze while adjusting for drought damage. This report does not use general estimates or benefit transfer values, but only East Kalimantan specific data.

Data has been collected by questionnaires and interviews from government offices, private companies and NGOs to supplement official data. The lack of reliable statistical data proved to be problematic. When data was too scarce, losses are discussed qualitatively. The burned area estimates for East Kalimantan provided by IFFM-MoF-GTZ, are used in this report, as these are believed to provide the most complete estimate to date, combining remote sensing with surveys on the ground and from the air. According to this estimate 5.2 million ha land burnt[1] in East Kalimantan (Hoffmann, Hinrichs and Siegert, 1999).

The total costs for East Kalimantan from the 1997/98 forest fires estimated in this study are 5.7 billion US $ in 1996 prices. For comparison, in 1998 prices using the exchange rate of 8000 Rp assumed by the ADB-BAPPENAS report this amounts to 3.5 billion US $. This is about one third of the 9 billion US $ losses estimated for the whole of Indonesia by the ADB-BAPPENAS report for the province of East Kalimantan alone. While this may seem much, one has to keep in mind, that this estimate is not only very conservative, but also incomplete due to lack of data and knowledge specific to East Kalimantan at the time of writing. According to the estimates in this report, damage to timber, including future timber harvests, account for an estimated total of almost 56% of the whole fire costs. This however is over proportional, since timber estimates are more complete than other cost estimates. Qualitative health costs included for example cover only very basic routine medical care and do neither include stationary treatment nor complicated illnesses requiring more expensive drugs and specialist consultation. Costs of possible long-term health damage and loss of life are also not included. Biodiversity costs are included only for one species, and losses to airline companies only to two companies. Damage to local communities,

[1] For a discussion of other estimates, see: Hoffmann, Hinrichs and Siegert, 1999, Ruitenbeek 1999.

which could be included is also incomplete, since data for this part of society that only trades very few parts of its products could only be collected indirectly and incompletely. Due to lack of data, damage to forest plantations and increased number of accidents could not be included. Ecological functions are also not included in this estimate, since data and knowledge about East Kalimantan's ecosystem was still incomplete at the time of writing. Damages and costs occurring to other countries from haze should be mentioned at this point, which are important costs as shows the EEPSEA-WWF study, but which at the time of writing could not be disaggregated for the damage caused by haze resulting from fires in East Kalimantan. Therefore the 4.9 billion US $ have to be understood as a lower border estimate.

While the fires of 1997/98 are were exceptionally destructive and thus costly, only 15 years earlier, in 1982/82, similarly destructive fires occurred and the situation at the time of writing suggests that similar catastrophic fires could reoccur in the future: Forests are increasingly disturbed by logging activities, population pressure and fire, which renders them increasingly prone to burning (Siegert et al., 2001). At the same time El Nino events are more frequent and stronger, further increasing the likelihood and risk of unwanted fires, which in turn further opens up the forest and leads to increased fuel accumulation, which increases the likelihood of the forest burning, even in non-El-Nino years. In this cycle every fire event paves the way for the next fire. If no dramatic action is taken soon, it is justified to expect that damage from forest and land fires will increase in the future until ecological change has reached a point where the remaining forest ecosystems have shrunk significantly or even disappeared.

## *1. Introduction*

The year 1997 is known as "the year the world caught fire". A strong ENSO (El Nino Southern Oscillation) event led to drought and subsequent fires in many places. Indonesia was undoubtedly the hardest hit. Most fires started in Indonesia in late 1997. In East Kalimantan however, fire activity remained low during 1997. This was thanks to precautionary measures such as the temporary revocation of all timber use licenses taken in view of the drought and resulting high fire risk (Schindler, 1998). During the months of November and December seasonal unusual light rain fell, dousing most of the fires. When dry weather condition resumed beginning February 1998, fire activity in East Kalimantan grew beyond suppression capability. The fires caused thick haze affecting the whole region and drawing much international attention to the fires and Indonesia. Extreme pollution levels with visibility less than 200m in the interior of East Kalimantan were reported (Schindler, 1998).

Increasing population pressure on East Kalimantan's forests, degradation of forest areas from logging and other exploitative practices, as well as more frequent and stronger ENSO events and droughts have severely increased fire incidents and intensity. The fires of 1997/98 were the strongest and most destructive ones ever recorded. Since the catastrophic 1982/83 fires numerous efforts from foreign donors and Indonesian government and non-governmental organizations have attempted with various methods and approaches to control and prevent fires.

This study estimates the ecological, social and economic impact of the 1997/98-fire catastrophe. It is hoped that this study will provide input in the decision-making and resource allocation process. At the time of writing studies disaggregating the economic toll of forest and land fires to the sub-national level or for various stakeholders were still largely absent in the literature. The geographic limitation to one province allows for more detailed and precise estimates than could be done on the national level. However, many areas still remain where more research and data is needed before reliable quantitative estimates can be made. Such areas are identified to guide future research. This report also takes a close look at the economic estimates of losses from the forest fires, by presenting the different approaches and applying them where possible to the East Kalimantan situation. In the process the assumptions being made are compared and discussed for their usefulness and accuracy to the East Kalimantan case. So far, the available economic reports have been widely cited but remain largely unquestioned (Gouyon and Simorankir, 2002).

### 1.1. Adjustments for Economic Crisis

The time of the forest fires was turbulent for Indonesia and East Kalimantan: political unrest grew since 1996 and went on after Suharto had stepped down in Mai 1998. Soon after the fires had started in July 1997, the Asian economic crisis began with the devaluation of the Thai Bath. By early 1998, the Rupiah had suffered a devaluation of 80%. To adjust for the effects to Indonesia's economy from the Asian economic crisis, this report uses 1996 pre-crisis exchange rates of Rp 2, 500 per US Dollar. Generally East Kalimantan was less affected by the economic crisis (Sunderlin et al., 2000) than most of Indonesia and certain sectors even benefited from the devaluation of the Rupiah, since large portions of East Kalimantan's exports are sold on the basis of US Dollar contracts (A. Hinrichs and Solichin, 1999).

A strong El Nino induced drought damaged and dried out vegetation making it prone to fire and caused crop failure. To adjust for drought damage is difficult. Data and knowledge is lacking that would allow to disaggregate the costs for drought damage. Adjustment is rendered even more complicated, when the negative effects of drought and economic crisis interact: "… the economic crisis and the drought that caused crops to fail have added to people's hardship and caused fire to

become a large-scale hunting tool. People would set forests a blaze with the objective to catch turtles or hunt dear" (Schindler, 1998). For this reason damage to annual crops as well as the resulting need to import food and provide food aid is attributed to the drought and therefore not included in this report. Drought damage to perennial crops and forests is trusted to be accounted for by choosing conservative estimates.

## 1.2. Literature Review

At the time of writing, three major reports on the 1997/98 fires and their economic impact were available[2]. The Economy and Environment Program for Southeast Asia (EEPSA) and the World Wide Fund for Nature (WWF) estimated in their 1998 study the economic toll to be 9,500 billion Rupiah for the year 1997 alone[3]. The strength of this study is that it takes a regional perspective, also including costs to Singapore and Malaysia, two neighboring countries that were strongly affected by the haze.

The Environmental Emergency Project (EEP) by the State Ministry for the Environment (MoE) in cooperation with the United Nations Development Program (UNDP) presented a two-volume study in 1998. This study estimates the nation wide economic losses from the fires in 1997 alone at 5,591 billion Rupiah. While all reports use conservative estimates, the MoE-UNDP study is based on very low assumptions, using the lowest estimate for the area burned and because of the scarcity of data, the figures for health, transportation, tourism and transmigration sectors only include the eight provinces most affected by the fires leaving the other provinces and costs occurring to them aside. The strengths of his study is that it is very transparent in its calculations and damage estimations.

The BAPPENAS-ADB report from 1999 estimates the total losses of the fires in 1997/98 between 8.8 and 9.7 million US $ with a mean of 9.3 million US$. This report builds on the two earlier reports mentioned above supplemented by primary research on the socio-economic impacts in Riau and East Kalimantan and where available by data for the second fire episode at the beginning of 1998. The World Resource Institute (WRI)-WWF report on the fires in Indonesia published in 2000 uses the cost estimates from the BAPPENAS–ADB report.

## 1.3. Type of Data Used and Presentation

This analysis will provide estimated costs of the 1997/98 forest fires for the East Kalimantan province. Data has been collected by questionnaires and interviews from government offices, private companies and NGOs to supplement official data. The burned area estimates for East Kalimantan provided by IFFM-MoF-GTZ, are used in this report, as these are believed to provide the most complete estimate to date, combining remote sensing with surveys on the ground and from the air. According to this report 5.2 million ha land burnt[4] in East Kalimantan (Hoffmann, Hinrichs and Siegert, 1999).

To adjust for the effects of the Asian economic crisis this report quotes all values in pre-crisis prices, using 1996 prices and the pre-crisis exchange rate of 2,500 Rp to the US Dollar. The base year for the purpose of discounting is 1998, the year in which most damage occurred. Due to

[2] For an overview over economic literature about the Indonesian fires see also: Gouyon and Simorangkir, 2002.
[3] The book version of this report is published under the name "Indonesia's Fires and Haze–The Cost of Catastrophe" edited by David Glover and Timothy Jessup.
[4] For a discussion of other estimates, see: Hoffmann, Hinrichs and Siegert, 1999, Ruitenbeek 1999.

exchange rate fluctuations of the Rupiah, the BAPPENAS-ADB report calculated losses in US $ assuming a conversion rate of 8,000 Rp to the US Dollar. The MoE-UNDP and EEPSA study both calculated damages in Rupiah using the pre-crisis exchange rate of 2,500 Rp to the US Dollar. All previous reports assume a discount rate of 10% when estimating future losses. In 1996 the net interest rate[5] based on IMF data for 1996 is 8.3% (IMF, 1997). This however, is low, since normally the higher long-term interest rate is used, which does not exist in Indonesia. For these reasons it seems sensible to also assume 10% discount rate. Since forest fire management is a public program designed to preserve natural resources for the general society it is judged acceptable to consider all costs and reduced benefits together regardless to whom they accrue to.

The lack of reliable statistical data about the 1997/98-fire episode proved to be a major problem when compiling data for this report. Statistics were incomplete, wrongly classified, lacked clear definitions and changed the base unit without notice, thus preventing the development of historic trends. From 1998 onwards health care statistics for example missed data for people aged between 4 and 60 years. Generally it seemed that while good periodical reports exist unfortunately these reports are often not compiled into a final report and thus finding these reports often remains a question of luck. Generally, the availability of data and information seems to depend more upon people than upon information systems. This makes it very difficult to obtain data when major personal changes had taken place since the fire event. In the provincial bureau of tourism for example no data could be found from pre 1991 since this was under the previous Kepala Dinas (head of provincial bureau). In some cases the absence of data is surprising. The difficulty to get fighting costs are such an example. As in the cases of all avertive expenditures this could be related to the unpreparedness for such catastrophe and the subsequent improvising to mitigate the effects. The split responsibilities between various government agencies could also play a role. Data collection from private companies proved even more difficult, since data was not kept as far back as the fires, even though they had only happened 4 years earlier, and employees were hesitant to give out financial data. Sometimes it seemed that people did not remember the fires and the impact they had.

For comparison fire damage to East Kalimantan has been calculated where applicable based on methods and assumptions made in previous reports and supplemented by new estimates based on East Kalimantan specific data where available. As a study on the province level with a smaller area to cover than a national level study, this study does not use benefit transfer or other general estimates, but is only based on data from East Kalimantan. Not using benefit transfer values results in lack of estimates where specific knowledge about Borneo's ecosystem was not yet available at the time of writing such as in the case of indirect ecosystem services. Despite the resulting lack of estimates in some areas, it was judged preferable not to include estimates that were not derived from data originating from East Kalimantan or verifiable to fit the specific East Kalimantan situation.

For the purpose of overview and comparison a table at the end provides all estimates for East Kalimantan calculated in this report by sector. In the last column those cost estimates that seemed most appropriate and reliable for the East Kalimantan case are noted.

[5] Real interest rate is the nominal long-term interest rate minus inflation rate, divided by one plus rate of inflation. In this case: Nominal interest rate: 18% and inflation rate: 9% (IMF, 1997).

## *2. Damages from the 1997/98 Fires*

### 2.1. Forestry

According to the IFFM-MoF-GTZ estimate, the total area affected by fire in 1997/98 is 5.2 million ha or about 25% of the entire province. Almost half the province area (9.7 million ha) is natural forest concessions. Out of this area 2.3 million ha or 24% burnt. 23% of East Kalimantan (or 4.6 million ha) is protected forest of which about 10% or 0.4 million ha were fire affected (Hoffmann, Hinrichs and Siegert, 1999). This report will join the other reports in defining forest as land covered by natural forest, without distinguishing between logged and unlogged areas. If not otherwise specified, forest area will mean HPH (natural timber estate logging concession) and protection forest area, which is a total area of about 14 million ha of which 2.8 million ha burned. The protected forest areas will in the first part be treated equal to HPH areas before additional benefits from protected forest area will be discussed in a separate section below.

#### 2.1.1.Timber Losses

Timber losses are the first damage that comes to mind when talking about forest fires. The estimates vary according to timber stocking rates and timber prices assumed. Since forest burns in a patchy way, assumptions need to be made about the average burn rate.

Alexander Hinrichs, expert for forest planning and economics, estimates based on a study of four fire-affected recently logged cutting blocks in HPH PT. Limbang Ganeca, that on average 15 cbm/ha of commercially valuable timber burnt. After deducting the utilization factor (fe) of 0.8, Hinrichs assumes very conservatively 10 cbm/ha stocking value. The blocks surveyed were more severely impacted by fire than the average area of East Kalimantan. Hinrichs assumes an average price value per cbm timber of 85 US $ or 212,500 Rp. Based on these assumptions the total mature timber value lost in the 1997\98 fires is about 6 trillion[6] Rp.

Based on GOI-MoF (Government of Indonesia – Ministry of Forestry) averages, the EEPSEA-WWF report assumes a net price of US $ 50 per cubic meter with US $ 50 cost of cutting and transport, which amounts to gross price of US $ 100 per cubic meter. Kalimantan specific typical stocking rates reported in this report are 49 cubic meters per hectare in the commercial >50 cm class, about four times the stocking rate assumed by A. Hinrichs in Limbang Ganeca. The total losses according to this estimate are net 17 trillion Rp.

The MoE-UNDP study assumes values for various vegetation and land use types which are then multiplied by the corresponding vegetation area burnt. The vegetation types chosen seem to be geared more towards the Sumatran ecosystem and would demand additional assumptions to become applicable to East Kalimantan. Certain land use categories and their valuation are questionable, such as equating HPHs and HTI with the same value. Also, after years of collecting maps and data on land use data for only one province, it remains a difficult exercise for IFFM (Integrated Forest Fire Management Project) to estimate actual vegetation stands on specific areas. This raises questions about the feasibility and reliability of such an approach on the national level.

The ADB-BAPPENAS report bases its estimate on timber value estimates from the national forestry inventory, which distinguishes between lowland, swamp, mangrove and submontane forest. For Kalimantan values are only given for the first two, which means that burnt areas of

[6] One trillion= 1.000.000.000.000

Mangrove forest of which 91.729 ha were fire affected (Hoffmann, Hinrichs and Siegert, 1999) and forests in mountainous regions, mainly highland dipterocarp of which 213.194 ha burnt (Hoffmann, Hinrichs and Siegert, 1999) are not taken into account. Stocking values provided in the national forest inventory are averages from logged and unlogged forest areas, but the large majority of forest burnt in 1997/98 in East Kalimantan was logged over forest and in many cases even previously burnt forest. Indeed it has been found that recent logging activities may increase fire susceptibility of tropical forests (Siegert et al., 2001). Based on a burnt forest inventory in Sumatra an average burn rate of 30% is assumed. The lost timber is valued at different rent models ranging between 28 US $/ cbm and 43 US $/ cbm.

This report will assume the very conservative estimate by Hinrichs of 5.9 trillion Rp losses since this estimate is based on findings from East Kalimantan and is therefore believed to represent the reality from this province more accurately than it is possible for a national level report. The higher estimates in timber stocks reported in other analysis presented above are partly due to reports not restricting their estimates to logged over forest as does Hinrichs. He also calculates the wood that will actually be used, while other reports work with the standing volume, which is naturally larger.

### 2.1.2. Future Timber losses

The section above estimates losses in harvestable timber at the time of the fires. This section estimates future timber losses based on the age class over 20 cm. This estimate of course entails more insecurity as always when making future predictions for natural processes. Especially in cases like this one, since the risk of once burnt forest to burn again is increased. The estimates below are only valid if no fire catastrophe happens within the next cutting cycle. Future timber losses are based on the age group between 20 and 50 cm, which is assumed to mature from in time for the next cutting cycle.

The EEPSEA-WWF report assumes 74 cubic meters stocking rate for East Kalimantan in the >20>50 cm age class. The immature age stock is assumed to grow into commercially harvestable timber within a decade. Discounted at 10% per year and harvested over a 25 year period every cubic meter of immature wood has a present value of 0.386 cbm[7]. The assumed 10 years for the >20 cm age class to grow above 50 cm class is too fast to be realistic, based on a general accepted average growth rate of 8 mm per year (A. Hinrichs personal communication).

The ADB-BAPPENAS report assumes stocking rates from the national timber inventory[8]. The burnt forest inventory referred to in the previous section showed that 65 % of all trees in the immature age class have been killed by the fires or so heavily damaged that they will die as a result of the fires. It is further assumed that losses will be reduced linearly over 35 years, since less competition for light favors the growth of young trees. The discount rate is 10% and the cutting cycle assumed 25 years.

Based on the burnt forest inventory from PT Limbang Ganeca, 56.4 cbm/ha of dead trees in the > 20 and < 50 commercial tree class are assumed in this report. Furthermore the average growth rate assumed is 8 mm per year, which means that the burnt trees could have been harvested within 37 years, which corresponds approximately to the logging cycle of 35 years. This report will assume the legal prescribed logging cycle of 35 years since this is well and strictly monitored by

[7] no estimate for East Kalimantan is calculated on the base of these assumptions since the calculations were not clear.

[8] No estimate calculated due to problems of applicability of timber inventory for East Kalimantan, see section on timber losses.

authorities and not much room for deviation is left in this respect (A. Hinrichs personal communication). Due to lack of more precise information on growth rates it is assumed that all trees will be harvested in 35 years. 56.4 cbm/ha times the utilization factor 0.8 and the burnt are of 2.7 million ha calculated at 212.500 Rp / cbm, discounted at 10 % over a period of 35 years amounts to a total loss of 1.114.636 million Rp.

### 2.1.3. Rehabilitation Costs

Hinrichs assumes that the heavily fire affected forest area and 50% of the moderately fire affected area (see table by Hoffmann, Hinrichs and Siegert, 1999) have to be rehabilitated. The reason why only the BAPPENAS-ADB report includes rehabilitation costs, even though rehabilitation is crucial in reestablishing the forests productivity and securing sustainable timber production in the future is probably the low realization of forest rehabilitation to date. This report will include rehabilitation costs firstly because it is mandated by law (Government Regulation of the Republic of Indonesia No. 4/2001) and secondly because rehabilitation is an investment preventing even greater costs in the future by reestablishing forest productivity and securing sustainable timber production.

Recognizing the low realization to date, by the end of 2001 only 15, 000 ha rehabilitated and the fact that many moderately affected forest areas have naturally recovered well (Hinrichs, personal communication) only the heavily affected areas are taken into account in this report. For natural forest concession and protected forest areas combined this is a total area of 438, 254 ha.
To rehabilitate an area of this size takes about 10 years. Average rehabilitation costs in 1996 were 1.5 million Rp /ha (Heriadi, SFMP rehabilitation specialist, personal communication). Rehabilitation of $1/10^{th}$ every year over a 10-year period, discounted at 10% amounts to total rehabilitation costs of 404,003 million Rp.

### 2.1.4. Forest Plantations - HTI

From the total area of forest plantations of 1.4 million ha 64% or 0.9 million ha burned in the 1997/98 fires (Hoffmann, A. A., A. Hinrichs and F. Siegert, 1999).While the current and future losses in this sector can be substantial, no estimate could be generated within this study[9]. The land use classification survey by A. Hoffmann, Hinrichs and Siegert indicates type of land use and degree of burning, but does not give information about actual vegetation stands. This means there is no information available on what burned. Information indicating whether or not a plantation was ‘active’ in 1997 allows to say whether or not a plantation had planted plots at the time of fire, but there still remains uncertainty about type and age of crop, which makes for great variations in value. Similarly, if a plantation was ‘non-active’ at the time of fires this could mean just as well that the crops were already harvested, that the land was still natural forest stand, or even that the fires were set to clear the land for planting. In this respect it is interesting to note, that 70% of area of the non-active HTI was fire affected, and only 62% of active HTI burned. The opposite would have been expected, since active HTIs burn easier (Nicolas and Beebe, 1999)

Based on field observations in East Kalimantan, the EEPSEA-WWF, and the ADB-BAPPENAS report found that plantations less than 3 years old were completely destroyed, while plantations older than three years were only 30% destroyed. Based on private sector data the ADB-BAPPENAS report estimates plantation establishment, maintenance and tending at US $ 504 per ha. For plants older than three years a lost profit of 15% discounted to present day terms at 10% is assumed. This is based on the rotation for fast growing pulpwood, which is 8 years. The MoE-UNDP study used the same assumptions for HTIs as for HPHs as discussed in the section on

[9] Similar problems occurred when estimating the losses to the estate crop sector. Refer to that section for a further discussion of the data situation.

timber losses. None of the above cited reports include potential downstream losses such as shortfall of wood for pulp, paper and plywood industry, which might lead to substitution from illegal sources.

## 2.2. Other Forest Benefits

Forests provide many direct and indirect benefits to communities at the local, national and global level. Besides an array of important ecological functions, forests play an important role in some local communities' livelihoods. While non-timber forest benefits are tangible, it is difficult to assess their monetary value. The benefit transfer approach tries to bridge this gap by adapting findings available for one area to another, less studied area. This approach is used by the EEPSEA-WWF and UNDP-MoE reports. The BAPPENAS-ADB report tries to avoid using benefit transfer values but resorts to them in a few cases for lack of other data. Benefit transfer values are judged too inaccurate for the purpose of this study. The discussion of rattan production below shows the large and many differences that can occur in one sector within one country making it difficult to apply the same assumption for the whole of Indonesia. This makes it questionable to use the same values for tropical forests around the world, as provided by Constanza (1997). The EEPSEA-WWF uses estimates by Constanza escalated 5% per year from 1994 to 1997. It is further assumed, that the forest services would recover in a linear fashion over a five-year period. The MoE-UNDP report uses estimates by Pangestu and Ahmad.

### 2.2.1. Non-Timber Forest Products

Non-timber forest products (NTFP) found in the forests of East Kalimantan include rattan, sago, damar, cajuput oil, tengkawang seeds, gharu, resin, candle nut, cinnamon, copal resin, bamboo, latex, edible bird nests and any kind of game meat. For local Communities NTFP allow to supplement and diversify their livelihoods. Very little is traded, which means that production and price statistics are largely unavailable. While some studies suggest that the potential of commercial exploitation and marketing of NTFPs is not yet fully realized and some even suggest that the value of NTFP could surpass the value of sustainable timber production, an increasing number of studies reject this hypothesis (Grossmann, 1997). This debate about the potential of NTFP is reflected in the wide range of estimates concerning the value of and potential losses from fire damage to NTFP.

Based on her work in two predominantly Dayak villages in the proximity of PT. Limbang Ganeca HPH in East Kalimantan (Long Laland and Ritan Baru), Carol Grossmann estimates that the average annual replacement value for all NTFP consumed was 471,100 Rp per year or 20% of the household's cash income. Game meat was identified as the most important NTFP providing 30% of all protein. According to this study income from NTFP gradually looses importance as it is increasingly substituted by income generated from other more profitable legal and illegal activities. According to official statistics in 1997, about 1.2 million people were living in rural areas of East Kalimantan (BPS, 1997). Since the large majority of fires is human caused, fire incidences will be concentrated to where people are. Therefore it will be a conservative estimate to assume that since one fourth of the province burnt, one fourth of rural people were negatively affected by fire. Based on these assumptions, the damage to rural communities from burnt NTFP is assumed in this report to be 141,330 million Rp in the year immediately following the fires.

The EEPSA-WWF study uses the estimated value of NTFP provided by Constanza (1997) of 401 US $ (1,002,500 Rp) /ha/year. In an attempt to stay conservative this estimate is only applied to an area of 1 million ha. The MoE-UNDP study based on Pangestu and Ahmad estimates the value of NTFP at US $ 35 (Rp 175,000) per ha and assumes an average of 50% damage. Both reports use the benefit transfer approach.

A socio-economic survey of 249 people undertaken in East Kalimantan for the BAPPENAS-ADB report found that households living in fire affected areas suffered average losses equivalent to Rp 6,138,000 (US $ 722) for the year immediately following the fires. The BAPPENAS-ADB report considers this a maximal value and uses a lower estimate assuming a value of 28 US $/ha/year (in 1998 prices) which is about 184.000 Rp in 1996 prices for total NTFP production. This estimate is based on a study undertaken in the Danau Senatrum Wildlife Reserve in East Kalimantan. Further assumptions made are that 75% of NTFP production has been destroyed in the burnt areas and that production resumes linearly over a 20-year period, discounted at 10%. This adds to a total loss of 2.158.321 million Rp at household level.

With respect to the 1982/83 fires, Schindele, Thoma and Panzer (1989) estimate a value of US $ 50 ha/year on all NTFPs in a moderately to heavily disturbed forest in East Kalimantan. The value of Rattan, the most valuable NTFP alone is about 40% of this estimate. Since it takes 7-9 years for Rattan to grow back losses are conservatively assumed to occur over a 5-year period and are only calculated for protection forest areas.

Besides different views of the importance and potential of NTFP, the above presented wide range of estimates also reflects different livelyhood systems varying in the kind and intensity of usage of NTFP. Research done by CIFOR in peat swamps in the middle Mahakam area suggests that forest and land fires might have profited local communities (Chokkalingam, 2001). This variety explains the absence of studies on the value of NTFP allowing extrapolation to the whole area of East Kalimantan province. Based on data available at the time of writing it even proved impossible to include losses from rattan, which is the most widely traded and therefore best documented as well as the most important NTFP in Indonesia [10](Haury and Saragih, 1996).

Rattan production and processing in East Kalimantan differs in many ways from the rest of Indonesia. Rattan occurs in primary and logged over natural forest, the origin of about 90% of national production. In East Kalimantan however up to 50% is produced in rattan gardens, even though East Kalimantan is very rich in rattan resources with over 30% of forests covered with rattan. The large majority of rattan gardens are in the Pasir district and the middle and upper reaches of the Mahakam river and its tributaries (Haury and Saragih, 1996 and 1997). These areas coincide with the area affected by the fires in 1997/98. Therefore it can be assumed that large amounts of rattan were lost. Since it takes 7-9 years for rattan to grow back, farmers will suffer the loss of their rattan resources and will have to find other activities during this period. The same is the case with burnt fruit trees. While the data situation does not allow for quantitative estimates of losses from burnt fruit trees, evidence points to substantial losses (Kieft and Nur, 2001; Rio Tinto, 1998). As an example, 2001 was the first year with a sizable durian season since the fires in 1997/98. The impact on local communities will be discussed in a separate section below.

### 2.2.2. Recreational Value

The MoE-UNDP report assumes US $ 112 per ha for the burnt forest area, assuming 50% fire damage and the EEPSEA-WWF report assumes US $ 129 per ha for actual area burnt. The overwhelming majority of Indonesians will not go into the forest for recreational purposes and the communities in East Kalimantan have a fearful respect of the forest believing that spirits reside in

10 The official forestry department statistics of rattan production fluctuate widely and therefore do not allow to draw conclusions. The distribution of rattan in the forest is not known and consequently no conclusion can be drawn from the area burnt to an estimate of rattan resources lost. Furthermore there was no data available about the area of rattan gardens burnt. It is also not known what part of NTFP losses would need to be attributed to the severe drought situation and what loss was caused directly from fire. Therefore the data situation does not allow estimates about NTFP damaged by the fires.

the forest trying to lead the visitor astray. Therefore it is believed that there has been no major loss in recreational value to the population of East Kalimantan. For the global community this might be different. Kutai National park for example has lost its appeal and recreational value to tourists after it was ravaged by flames twice[11].

### 2.2.3. Indirect Forest Services or Ecological Functions

Erosion control, disturbance regulation, water supply and regulation, soil formation, nutrient cycling, waste treatment and carbon absorption are commonly grouped as indirect forest services. Benefits from ecological functions are not limited to the forest ecosystem, but can have far reaching positive social impacts, such as providing water for agriculture and consumption to communities close but also to those far from the forest (Virza, 1999) and even to the global community by absorbing and storing carbon.

A full discussion of ecosystem valuation is beyond the scope of this report, therefore the complexities in estimating ecosystem functions in monetary terms will be discussed on the example of erosion control and flooding. While flood protection and erosion control are neither the most important, nor the most valuable ecological services provided by forests, only these two are included in the BAPPENAS-ADB report. This is most likely due to perception and knowledge about erosion and flooding: other ecological processes such as nutrient cycling and soil formation are more obscure and seem less immediate in their effects on humans.

The reduction in tree cover after fires is commonly believed to reduce the benefits from ecological forest functions. While the link between forest cover loss or forest degradation and increased incidences of flooding, erosion and siltation is so well established, that it has become almost common knowledge, there are a few convincing studies claiming that this is more a myths than reality (Kaimowitz,(unpublished))[12]. Even if the link between forest cover loss and increased run off could be made, additional data and research would be required to allow for disaggregation of the impacts from drought, increased ecological transformation from urban development, extractive activities and additional stress from fire. The state of knowledge at the time of writing does not allow to adjust for changing weather patterns with more frequent and more powerful El Niño cycles often followed by the La Niña weather phenomenon bringing extreme wet weather conditions to Borneo, which could also be the cause for reported flood incidences following the fires. The two catastrophic fire incidents in 1982/83 and 1997/98 were both followed by what was each time described as “unprecedented floods”. In both cases this is thought to be related to a large part to the burnt peat forest, which looses much of its water absorbing capability when it burns, but also when it dries out (Prof. Dr. Edzo Veldkamp, University of Goettingen, personal communication). Carol Colfer also reports heavy flood incidences after droughts without previous fire incidences (Colfer, 1993). Soil erosion is caused by increased water run off. Forest Canopy, any kind of vegetation cover, roots and leaf litter, all protect the soil and thus prevent erosion. When forests burn, leaf litter burns away and the forest canopy is thinned out letting more water through. A soil erosion experiment in the Belalong forest on Borneo has shown that on a 30° angled plot where only leaf litter has been removed erosion was increased 20 fold (Cranbrook and Edwards, 1994). However, these erosion in one place does not mean that all the soil is necessary washed away and lost, most of the soil removed is likely to settle not far from where it has been removed and thus does not constitute a loss (Prof. Dr. Edzo Veldkamp, University of Goettinge, personal communications).

[11] The monetary losses due to reduced numbers of visitors will be discussed in the section on tourism.
[12] Using the flood problem in Bangkog Enders shows that flood causes can be unrelated to forest cover.

In Kutai National Park a comparison of soil erosion rates in burned and unburned forest showed that erosion had increased more than ten times in the burned areas (Schweithelm, 1998). These two studies show that forest soil in East Kalimantan might be easily eroded and fire can cause great damage. The burnt area so far was mainly on relatively flat terrain in the Mahakam basin area. In the future, erosion is likely to increase when mountainous terrain further inland is affected by fire. On the other hand it must be taken into account that the fertility of the tropics allows for very fast vegetation regrowth. In order to avoid erosion it is enough to have some sort of ground cover (Prof. Dr. Edzo Veldkamp, personal communication). In East Kalimantan the ground is covered with vegetation within one year after a fire event, often already after three months and in two years the canopy is closed again (Prof. Dr. Chandra Boer, personal communication). As illustrated on the example of erosion and flood control, the state of knowledge at the time of writing did not allow for reliable damage estimates from ecological function losses due to fire. Due to the lack of knowledge concerning the causal relationship of forest cover, run off and thereof resulting siltation and erosion described above, this report will not estimate nor include losses from indirect ecosystem losses.

The MoE-UNDP report assumes values from Pangestu and Ahmad, which are applied to the entire area burnt for the period of one year. A value of 30,000 Rp/ha is attributed to the forest's water regulation function and 1,225,000 Rp/ha for erosion control. The EEPSEA-WWF report uses estimates from Constanza et al. and assumes forests to recover their indirect ecosystem functions in a linear manner within a two-year period.

BAPPENAS-ADB report assumes the value of flood protection afforded by forests at $91.60/ha/ year. This estimate is based on a detailed report from 1996/97 covering 39 river catchments in Indonesia. It is assumed that the fires destroyed 63 % of the forest cover and that 35% of the forest land would be completely bare after burning. The ground cover and with it the protective function is assumed to grow back over a 5-year period. This last assumption seems high, since as discussed above, the ground is covered within a year, often after three months. With regards to erosion control the BAPPENAS-ADB report bases its estimate on research by Whiteman and Fraser, who estimate the erosion control function at 6,040 US $/ha, when lost forever. From this, the report derives values of 550 US $/ha in the first year and 500 US $/ha in the second year. Further assumptions are that this applies to 35% of the burned forest area and that the erosion control function will be replaced within two years. The table below summarizes damage estimates from fire on ecological functions based on values assumed in the reports on fire damage and applied to the burnt area in East Kalimantan .

| Indirect Ecosystem Losses | | | | | | |
|---|---|---|---|---|---|---|
| | EEPSEA-WWF | | MoE-UNDP | | ADB-BAPPENAS | |
| Ecological function | Value (Rp/ha/year) | Total Losses in (million Rp) | Value (Rp/ha/year) | Total Losses (in million Rp) | Value (Rp/ha/year) | Total Losses in million Rp |
| Disturbance regulation | 25000 | 69702 | 12500 | 52277 | N.I. | N.I. |
| Water supply/regulation | 70000 | 195167 | 30000 | 84000 | 532800 | 163246 |
| Erosion control | 1225000 | 3415420 | 707500 | 2958869 | 4400000/ 4000000 | 2342003 |
| Soil formation | 50000 | 139405 | 27500 | 115009 | N.I. | N.I. |
| Nutrient cycling | 4610000 | 12853132 | 2667500 | 11155877 | N.I. | N.I. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Waste treatment | 435000 | 1212823 | 250000 | 1045537 | N.I. | N.I. |

Source: Ruitenbeek, 1999; MoE, 1998; BAPPENAS, 1999.

**2.2.4. Biodiversity**

The effects from fire on biodiversity are twofold: Firstly, species are affected directly by fire. Secondly, the resulting fire caused habitat destruction and changed species composition with the prevalence of pioneer species after forest fires (Zakrit and Latiff 1996) threatens the animals that escaped the fires. Protected orangutans were killed by the fires, but it also became increasingly difficult to reintroduce orangutans into the wild, since their habitat, lowland forest, is intensively exploited and affected by fire (The Balikpapan Orangutan Survival Foundation, BOS, 1999; Carey, 1999). The rare sun bear is another example that even when animals survive the fire, habitat destruction from fire continues to threaten their survival. Radio tracking of collared sun bears has shown that sun bears rarely go into burnt forest areas and with respect to food resources two years after the fires underground termites remained virtually absent in the burnt forest area and three years after the fire above ground termite nests remained rare (Fredriksson, 1999). In the search for food, sun bears and orangutans raided gardens, increasing the incidence of human induced death (Frederickson, 2001).

The valuation of biodiversity is complex, since it is a global common good with many components of which a large part is currently not marketed and therefore does not carry real market prices. Another difficulty is the lack of knowledge about the role and benefits of some organisms and in some cases even of their existence. Some benefits from biodiversity will and can only be derived in the future. These are called option values. In other cases knowledge about the ecosystems and the organisms within remains incomplete. The quasi-option value estimates the value of preserving the ecosystem for potential future uses once the knowledge has become available. The quasi-option for pharmaceuticals for example is estimated between US $ 0.04 and US $ 75 per ha (BAPPENAS-ADB, 1999). One example for potential medical uses is illustrated by the *Galophyllum lanigerum* plant found in Indonesia's forests, that is being studied in the USA for its ability to cure AIDS. Local communities also use traditional medical knowledge to cure illnesses with plants and other species from the forests. The Apo Kayan tribe in East Kalimantan for example uses the medical properties of 213 species (MoE-UNDP, 1998).

There is also the pure valuation of the existence of a certain ecosystem or animal species. This value is "unrelated to any actual or potential use of those goods" (Pearce and Turner, 1990 cited in BAPPENAS-ADB, 1999) and can only be explained by "an intrinsic and altruistic value" placed by society on the existence of these habitats and species (BAPPENAS-ADB, 1999). Kersik Luwei Nature Reserve a unique orchid- rich forest near Melak in the Kutai Barat district in East Kalimantan is a case in point. This forest is one of the few place where the black orchid can be found naturally. After parts of this protected forest burnt in 1982/82 biological diversity declined. After the fires, only 70 species of wild orchids were registered against 80 species identified species before the fires (MoE-UNDP, 1998). To assess the value of the pure existence of an organism the willingness to pay approach is commonly used. In this approach individuals are asked how much they would be willing to pay for the preservation of habitats and animals. Depending on the animal or habitat to be preserved and depending on the culture and living standard of people questioned, common values for tropical rain forest preservation range between US $ 2.18 and US $ 2.82 billion per ha **(**BAPPENAS-ADB, 1999). Global benefits derived from biodiversity further complicate the value assessment since preservation has to be done locally and when done properly, this is costly to the country in which the resources are found. While the willingness to pay for biodiversity preservation can be expected to be low in Indonesia[13], the

[13] For more details and explanations see section on recreation value of forests and protection forest.

willingness to pay for biodiversity conservation is higher in countries with a higher GNP (BAPPENAS-ADB).

The capturable biodiversity approach estimates potential income from international conservation expenditures (Glover and Jessup, 1999). This approach has the advantage that less assumptions need to be made, since it shows how much money is made available for biodiversity conservation, but it is based on donors' willingness to pay for biodiversity conservation, dependent on the availability of money, perception of the donor community as well as the perception of the donor's constituency, people often half-a world away and highly influenced by media reports. As with the other methods the range of estimates is wide, reaching from 300 - 3,000 US $ per ha. The EEPSEA-WWF, using the capturable biodiversity approach, and MoE-UNDP report using the benefit transfer approach, both estimate the value of biodiversity in Indonesia at 300 US $ (750.000 Rp) per ha. This is a total of 2.091.074 million Rp biodiversity loss.

In its 1994 country report on Indonesia the World Bank quotes a 1987-90 analysis on foreign funding for biodiversity projects. This analysis concludes that the willingness to pay (WTP) for the preservation of ecologically important and diverse ecosystem such as rainforest could reach US $ 30 / ha / year to prevent degradation with typical values around US $ 15 per ha. It would be unrealistic to assume such an estimate for all of Indonesia's reserves, however, the fact that Indonesia is recognized to be extremely rich in biodiversity, and the fact that East Kalimantan has one of the largest frontier rain forest left in Indonesia, makes it safe to assume that willingness to pay would be comparatively high. But the World Bank report also notes that the willingness to pay is reduced, as the likelihood of success is lower. Therefore forest fires can have a twofold negative impact on biodiversity by reducing biodiversity as well as the general global community's willingness to pay for biodiversity conservation efforts in Indonesia.

In view of the wide range of estimates presented above and the lack of location specific data and knowledge, it is believed that at the time of writing a complete quantitative cost estimate of biodiversity losses is not feasible. The only reliable monetary values found were on orangutans. According to Peter Karsono from the orangutan survival foundation the fires victimized about 600 orangutans in Sebulu Separi. The organization values one orangutan at 4.500 US $ (11,230,000 Rp) based on the costs of feeding and training an orangutan until it can be released. This biodiversity loss from a single species alone amounts to 2.7 million US $ or 6,750 million Rp. This is a very low estimate as it only includes partial valuation of damage done to one single species. It also uses a low value for an orangutan, which achieve up to 25,000 USD per animal on the illegal market in the United States. Zoos sell their surplus orangutans for about 30,000 US $ (The Balikpapan Orangutan Survival Foundation, BOS, 1999).

However, it is trusted that qualitative descriptions provide good snapshots of the impact of fire on biodiversity. Research by Oka (1997) at Kutai National Park 1982-1983 before the fires of 1997/98, has indicated that it takes about eleven years for forests to return to original levels of biodiversity (MoE-UNDP, 1998). This is compounded when an area burns again, as was the case in Kutai National Park. If a forest area burns repeatedly without leaving enough time for recovery forest and biodiversity will be lost. Even though at the time of writing it was not possible to provide a complete estimate of the value of East Kalimantan's biodiversity, it is clear that East Kalimantan is one of the world's richest places in biodiversity and its value and the potential losses are correspondingly high.

### 2.2.5. Carbon Release

Carbon dioxide emissions from fossil fuel combustion is the main cause of greenhouse gas buildup in the atmosphere believed to be the leading cause for the warming of the earth's atmosphere commonly known as global warming. Forest ecosystems have a recognized capacity to store carbon and therefore reduce carbon in the atmosphere. When forests burn previously stored carbon is released into the atmosphere. The fires in 1997/98 made Indonesia one of the largest polluters of carbon in the world (BAPPENAS-ADB, 1999).

It is generally recognized that carbon emissions from biomass burning generate about 20% of yearly carbon output, going up to 40% in a severe fire year (Rowell and Moore). The WWF study estimates that about 75% of carbon was released by burning peat. While the area of peat swamp forest burnt in East Kalimantan is known to be 311 098 ha (Hoffmann, Hinrichs and Siegert, 1999), there remains uncertainty about the depth of the peat, which would be needed to more accurately estimate the amount of carbon released and the future capacity of carbon release from this peat swamp area. The carbon absorbing capacities and consequently the carbon release through fire vary widely between vegetation and soil types, just as the amount of carbon released varies depending on degree burned. F. Pearce for example assumes up to five times the amount of carbon burnt estimated by the ADB-BAPPENAS report. This would make carbon release the single most important damage from the fires (BAPPENAS, 1999).

At the time of writing uncertainty remained about the carbon storing capacity of different ecosystems. As agreed on in the Marrakesh accords there will be no certificates for the prevention of deforestation during the first commitment period 2008-2012, but only for afforestation and reforestation of land that was not forest at the beginning of 1990 (www.unfccc.de/cop7, 1/2002). As the carbon sink capacity of old growth forest is better understood premiums for preserving these forests and preventing carbon from being released into the atmosphere, might appear after 2012. Even though old growth forest is not included in the Kyoto mechanism it can be said that, if forest and land fire incidences are not soon controlled, Indonesia´s chances to gain money through this mechanism diminish. Even though old growth forest is not included in the protocol as it stands at the time of writing, the costs of storing the same amount of carbon in forest plantations as was set free in the fire events can be estimated. Since this is a new mechanism market prices were not yet established at the time of writing.

International values for stored carbon are usually given with a range of US$ 10-20 in global benefits per tone of carbon. According to Ruitenbeek in previous studies for the Intergovernmental Panel on Climate Change, the value has been put up to US$ 30 per ton of carbon. The EPSEE-WWF study estimated that for 5 million ha burned a loss of 272 million US $ was incurred. The MoE-UNDP report estimated that every hectare of forest could absorb 154 tons of carbon at a value of US $ 10 each. Based on greenhouse gas emitting companies' willingness to pay for reforestation projects to offset their emissions production the ADB-BAPPENAS report assumes a mean of US $ 7 per ton of carbon. This report will assume the lower EEPSEA-WWF estimate.

| Climate Regulation / Carbon Sink | | | | | |
|---|---|---|---|---|---|
| Report | ton carbon per ha | value of ton carbon US$ | value of carbon per ha in US$ | Total value in million US$ for 2.7 million ha burned forest | Total value in million Rupiah |
| EEPSEA-WWF | | 10 | 54.4 | 147 | 367,500 |
| MoE-UNDP | 154 | 10 | | 4,158 | 10,395,000 |

| | | | | | |
|---|---|---|---|---|---|
| ADB-BAPPENAS | | 7 | | cannot be calculated | |

Source: Ruitenbeek, 1999; MoE, 1998; BAPPENAS, 1999.

Besides the above presented potential monetary incentives, having signed the Kyoto protocol Indonesia should have a strong interest in keeping carbon emissions low, but also since emissions increasing global warming are believed to cause great future damage, for example, from rising sea levels, which would affect a country like Indonesia composed of islands especially harsh.

### 2.2.6. Protected Forests

Sungai Wain protection forest is about 10.000 ha of lowland dipterocarp forest situated 15 km outside of Balikpapan. The importance of this little forest is immense. Sungai Wain protection forest is a water catchment area for the Wain and the Bugis rivers, supplying 26% of Balikpapan's water needs. Pertamina in Balikpapan, the second largest oil refineriy in Indonesia also depends on water from Sungai Wain. The value of the water has been estimated at 43,362 million Rp a year (Badang Pengekola Hutan Lindung, 2001). Because of its good accessibility Sungai Wain is an important research forest. Last but not least from extinction threatened animals live in Sungai Wain such as sun bears and oranguntans. For orangutans Sungai Wain is very important, since it is one of the few protected lowland dipterocarp forests in East Kalimantan with the large majority of protection forests being in locations too elevated for orangutans (Balikpapan Orangutan Survival Foundation, 1999). In 1997/98, 55% of Sungai Wain was burnt. Currently there is no data available that would allow estimating the monetary losses of these fires, besides anecdotal reports of water flow in the rivers becoming more erratic and cloudy. Of course the fires had a negative impact on rare animal species living in Sungai Wain[14].

The example of Sungai Wain protection forest shows the immense importance a protection forest can have, reaching far beyond timber values. The example of Sungai Wain also shows how dependent on the forest type and its location the benefits and thus the values are and last but not least, even though research teams are constantly working in and on Sungai Wain, it remains impossible to assess its value in monetary terms and even less the monetary value of fire damage. In view of these problems there seems no other possibility than to assume lost timber values as the cost for damage caused to protection forests. Sungai Wain might have more direct benefits for people due to its location and resulting intensive use, but all protection forest areas will have a higher value than the timber value since the prerequisite for engaging in the management and protection of forest areas is that the existence of this forest area is valued higher than the net return from commercial exploitation. While this holds true for industrialized western countries with very little forest areas left and a high degree of awareness about the important role of forest ecosystems, experience in East Kalimantan and especially the Buckit Soeharto area, where encroachment and forest conversion go on, suggest that parts of society value the immediate and often short-term income from forest exploitation and conversion higher than forests conservation. This shows the need for more education and awareness building programs, but also for developing sustainable livelihood alternatives.

## 2.3. Agricultural Sector

The agricultural sector in East Kalimantan has three main components: Small holders and subsistence farming, large estate crop plantations and transmigration areas. The separate discussion of transmigration areas is a purely administrative distinction that follows the official practice. Losses in the agricultural sector are difficult to estimate, since it needs to be known with what intensity an area burned, what crop was planted in this area at the time of fire and how

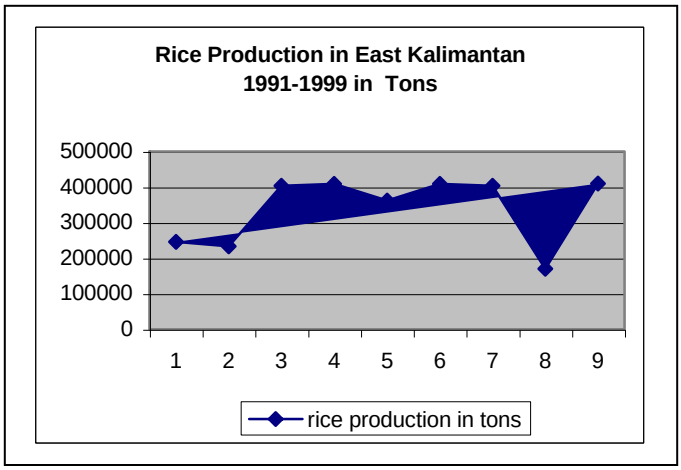
[14] For additional information, please refer to the section on biodiversity.

susceptible this crop is to fire in order to adjust for losses from drought[15]. For perennial crops it is also necessary to know the age of the crops. According to several accounts the drought was strong enough to destroy harvests from annual as well as perennial crops for 1997/98 (Rio Tinto, 1998; Johan Kieft, CARE international, personal communication). Therefore, only destruction to perennial crops will be attributed to damage from fires. For reasons of data availability[16] this report will include losses to plantations and transmigration sites only.

Based upon historic trends the ADB-BAPPENAS report found a significant drop in rice production while cassava, soybean, maize and sweet potato production remained stable. The official statistics for East Kalimantan, provided in the graph below, show a decline in rice production for 1997 and especially 1998. However, this report will neither include the cost of lost rice harvest nor the cost of importing rice since this is believed to be in large parts the result of the drought.

| Rice Production in East Kalimantan 1991-1999 | |
|---|---|
| year | production (Ton) |
| | |
| 1991 | 245958 |
| 1992 | 233248 |
| 1993 | 403768 |
| 1994 | 408969 |
| 1995 | 362193 |
| 1996 | 408969 |
| 1997 | 403768 |
| 1998 | 170256 |
| 1999 | 409884 |

Source: BPS 1995-1999




The EEPSEA-WWF report proposes a judgmental average land value of US $ 1,000 per hectare for all agricultural land uses from small holder to large-scale plantations. This estimate is justified by current land values of palm oil plantations with a value of about 1,000 US $ per hectare in Indonesia with rising tendencies and typical land values quoted for small holders of about US $ 400 per hectare. But as discussed in the section on local communities, the impact on these communities is felt much stronger than would suggest the Dollar value, since a large part of their land serves subsistence purposes. The estimate is further justified by assuming a near equilibrium between the value of forest and agriculture, which allows for forest and agricultural land to coexist. From the land value of U $ 1000 an annual net value of 100 US $ is derived. It is further assumed that full agricultural productivity could resume within a three-year-period. The discount rate is 10%. This amounts to 340,000 million Rp. From empirical observations in East Kalimantan it seems that the average difference in value between forest and agricultural land favors agricultural land in East Kalimantan. Where the forest is accessible encroachment and conversion is ongoing ( Hackel, 1999 in: FAO, 2001) and even protection forest can be converted to production or conversion forest for large-scale resource exploitation.

[15] The same difficulty was encountered for forest plantations.
[16] Please refer to section on local communities for a discussion of difficulties in data collection from smallholders and subsistence farmers. See also: Rio Tinto, 1998.

One has to keep in mind that fire does not always have negative impacts. In some cases fire can be beneficial. This is the case when fire burns over land waiting to be burnt in preparation for new crops. Some farmers also manage to mitigate negative effects from fires by quickly harvesting their plots before the fire reaches them (Butt, 1995). But since it is the timing that decides whether fire is beneficial or devastating, cases where fire burns a plot just at the right moment are rare and the risk associated with uncontrolled forest and land fires remains, even if one takes into account the numerous examples where villagers have proven their capability to protect their land and settlements from fires when their interests are threatened.

**2.3.1. Estate Crop Plantations - Perkebunan**

In the 1997/98 fires 0.4 million ha of estate cropland was burned. This is 57% of the total estate crop plantation area of 0.7 million ha (Hofmann, Hinrichs and Siegert, 1999). As for timber plantations it is not possible to estimate the losses from the fires without making wide ranging assumptions, as the value of one ha plantation land varies enormously according to the crop planted and the age of the crop. The effect of fire on the crop also differs by crops and by age of the crops with young crops being typically more vulnerable to fire damage than mature crops. For old plots or forested areas needing clearing in preparation of (re-)planting the fires even had a positive effect.

Detailed data on the areas planted by crop types and production state (four groups: not yet productive, productive, no longer productive and damaged) as well as detailed data on the area burnt was available. Unfortunately the two data sets could not be connected to reveal how many ha of which crop at what production state burnt.

| Product | Area | Value in Rp per ha assumed in ADB-BAPPENAS report | Establishment costs for one ha in Rp based on 1996 values (Data from: Dinas Perkebunan Kalimantan Timur) | Yearly maintenance costs in Rp per ha based on 1996 values (Data from: Dinas Perkebunan Kalimantan Timur) |
|---|---|---|---|---|
| Oil Palm | | 62.456.000 | 7.000.000 | 1.850.000 |
| Rubber | | 4.240.000 | 2.750.000 | 1.100.000 |
| Coconut | | 1.480.000 | 2.500.000 | 1.100.000 |
| Coffee | | 2.488.000 | 3.000.000 | 1.550.000 |
| Sugar | | 10.552.000 | - | - |
| Cocoa | | 40.976.000 | 3.000.000 | 1.650.000 |

The values quoted from the BAPPENAS-ADB report include establishment costs and costs of lost production. It is not clear from the report at what age and production state the above values are assumed. Using the values provided by the plantation service of East Kalimantan, the value of oil palm given by BAPPENAS-ADB would be based on 30 years maintenance, while the value given for coffee does not cover the initial establishment costs. The values given in US $ in the report were converted into Rp using the exchange rate given in the report of one US $ to 8.000Rp. The area burnt given by the ADB-BAPPENAS report did not allow disaggregation to the province level.

The MoE-UNDP study assumes that fire caused 50% damage to the plant population and that plants burnt were at their productive age. Losses are calculated only for the year of the fire. Based on these assumptions losses for rubber are estimated at around 1.050 million Rp and losses for Coconut at about 40 million Rp for the year 1997 only. At the time of writing the data provided by the MoE-UNDP study about losses to estate crop plantations was the best estimate available

and its values will be used in this report twice: once for the fire episode in 1997 and once for 1998. It needs be noted that the real costs are much greater since the MoE-UNDP study this estimate is based on 1997 figures, when the fires then remained relatively tame in East Kalimantan and the most destructive fires burnt in 1998. The substantial future damage from production losses are also not included. On burnt plots there will be no or reduced harvests and after replanting it will take two to seven years, depending on the crop, until the first harvest.

Additionally to direct losses from burning of crops, those that were not fire affected were affected by haze. The ADB-BAPPEDAL report estimates 6.6 tones production loss per ha in the haziest areas. The MoE-UNDP study cites an article from Republica (11, November, 1997) according to which "haze and fires reduced production in Jambi by 55% for three years after the fires". When rubber trees are no longer productive, the timber is sold. Rubber trees are typically planted with a density of 450-525 trees per ha and two to three trees provide on $m^3$ timber. Conservatively it can be assumed that every ha produces 150cbm timber which can be sold at around 150.000 Rp per cbm. (Dinas Perkebunan Kalimantan Timur, 2000). The losses described so far do not include such damages as possibly resulting problems in program planning, cash flow problems, infrastructure destroyed, or erosion resulting from reduced vegetation cover.

### 2.3.2. Losses to Transmigrant Areas

Damage to transmigrant areas in East Kalimantan can be estimated at 720 million Rp (data calculated from ADB-BAPPENAS and MoE-UNDP report). ADB-BAPPENAS report mention losses of 2,400 million Rp to East Kalimantan in 1998 only. These are losses to burnt down transmigrant houses and gardens, damage to enterprise land and local infrastructure. Since transmigration areas are typically connected to either a plantation or mining areas as source of income for the transmigrants and labor source for remote production sites, losses to transmigrant areas will not be included in the total cost estimate to avoid double counting.

### 2.3.3. Production Losses to Local Communities

Most damage assessments focus on macro-level losses, since these interests are more influential in the political arena, but also because these losses can easier be collected and quantified. Therefore most studies report only fire-induced qualitative changes in livelihoods. Even though there are increasing numbers of studies about local livelihood systems and fire, data that would allow extrapolation to the province level was not available at the time of writing. Therefore, it was hoped, that the losses occurring to local communities would to the greater part be covered by the estimated losses in NTFP and agriculture. However, it proved impossible to reliably estimate losses to small holders and subsistence farmers, as explained in the section on agriculture. The section on emergency relief provides a glimpse at the hardship caused to local communities especially since the damage is felt more directly when affecting subsistence agriculture. For these reasons this report will not provide a quantified value for losses to local communities since it is difficult to assess market prices for mostly not traded products as well as the difficulty arising when relying on people's memories for harvest levels as well described by Rio Tinto (Rio Tinto, 1998).

In 1989 Mayer did an extensive interview study over the period of three weeks of village leaders in East Kalimantan. The aim of this study was to estimate the impact of the 1982/93 drought and fires on local communities. Besides short-term impact of fire and haze she found that the secondary effects on water, wildlife, fisheries, crops, and income extended for a year and half after the fires. The 12 villages were chosen to be in the area severely affected by fire and to represent various ethnic groups, but all lead a more "traditional" lifestyle.

Due to the scarcity of data, the MoE-UNDP study commissioned a 20-day fieldwork in a total of three villages: two (Batu Tajam and Kekura') in Central Kalimantan and one (Tanjung Jaan) in East Kalimantan. A total of 53 households were surveyed accounting for 10% of total village population. This data was supplemented by interviews conducted with government officials at different levels and community members from six villages.

Despite the different set up of the studies and the very different situations found in the communities and their particular livelihood system that is more or less resilient to fire episodes and the consequences thereof, the findings of the reports differ in detail, but point in the same direction. All note the threatening food shortage (see also: Rio Tinto, 1998; Kieft and Nur, 2001) leading in some cases to malnutrition in formerly self sufficient communities. Many reports (Mayer,1989; MoE-UNDP1998; CARE, 2001) list pests as a problem reducing harvests in the seasons following the fires. While it could be that fire intensifies the problem, this phenomenon has also been witnesses after droughts without fire as for example in 1972/73 (Colfer and Dudley, 1993). Some reports also point to the societal and psychological impact of the fires as a sense of loss of security and harmony (MoE-UNDP, 1998) and the adoption of a fatalistic attitude that stands in the way of initiatives to improve livelyhood situation (CARE, 2001) as well as the loss of cultural heritage and spiritual values often connected with the forest (BAPPENAS-ADB, 1999) especially for the local Dayak communities.

Each of the studies only provide snapshots, which form to an idea of the impact on communities which can also be substantial in monetary terms and which has a greater impact on community members directly affected in their livelihood. In some cases, survival strategies chosen were dangerous and caused causalities, such as improvised mining activities or further destroyed the natural environment, such as the use of fire as a hunting tool or illegal logging or people sold their land for rice, which increases future poverty and dependence (MoE-UNDP, 1998). All these survival strategies have a mid- to long-term not-yet-quantifiable negative impact on Indonesia's development. For the communities living close to the major rivers however, fishing has been extremely easy as discussed in the following section. As animals came to the major streams for water hunting has also become easier in some regions (Colfer, Dennis and Applegate, 2000).

But effects on rural communities depend on their livelihood systems and the above discussed studies do not mention that while fires created hardship for many communities depending on forests for their livelyhood, some communities also profited from the fires. In the peat forests, where local communities appear not to depend very much on forest products, but more on fishing, fire seemed to better their livelihood situation (Chokkalingam, Tacconi and Ruchiyat, 2001).

The BAPPEDAL-ADB final report provides data from a study that undertook a socio-economic survey in 1998. In this study Riau and East Kalimantan were chosen as the two target provinces because of the intensity of the fire in these two provinces. This study combines first-hand data from the village level, field interviews and data from provincial institutions. Primary data was collected from a total of 434 members of 23 communities. The communities were selected to ensure there was at least one community in each province represented in one of the six community categories (forest concessionaires, industrial forest plantations, estate crop plantations, transmigrants, sedentary agricultural area, and shifting cultivation areas). This report does include, but not distinguish between rural, more traditional communities and is the only report to provide quantified estimated losses; Rp 21,490 for each community member. According to official statistics in 1997, 1, 205, 910 people were living in rural areas of East Kalimantan. This would amount to a total loss of 25915 million Rp. However, to avoid double counting these values, which are also judged not specific enough for this report, will not be included in the final estimate.

## 2.4. Fishing

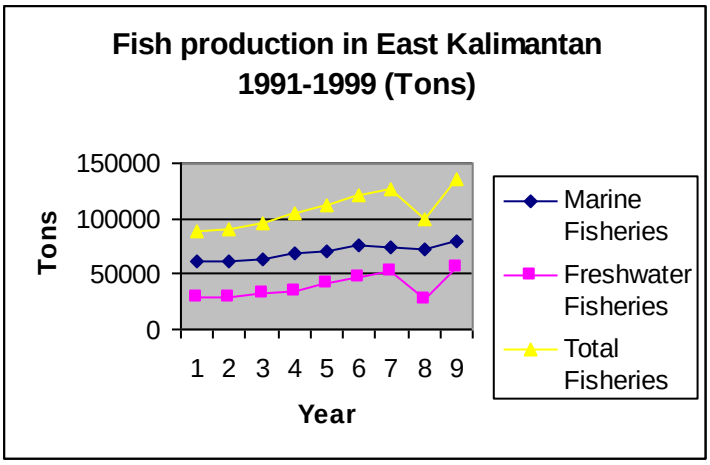
In some parts of East Kalimantan fishing is an important source of income. This is especially true for the middle-Mahakam area, which was heavily fire affected in 1997/98. While in the fire year 1983 fish catches have been reported to have dropped (Sarwono, 1989), the findings after the 1997/98 fires are opposite. According to reports from RASI (Danielle, personal communication), fresh-water fish landings have increased during the fires. Fires on the Mahakam River banks and around the lakes made fish fled into the main stream in which the drought had reduced water levels considerably. How easy fishing was at that time is illustrated by numerous anecdotes of fishes jumping into boats or people standing in knee-deep water catching fish with their bare hands (see also Colfer, 2000). Fishing seemed to have helped numerous families to overcome food shortages from fire and drought. Whether this lead to an over fishing with long term decline in fish population and a consequent reduction in fishermen's income was not clear at the time of writing. Contrary to local observations, the ADB-BAPPENAS report, holds that the fires had a negative impact on marine environment due to increased sediment from burned water catchments.

Contrary to accounts from the 1997/98 fires and in line with the report after the 1982/83 fires statistic data from the Statistical office board of East Kalimantan below shows a significant drop in fresh water fish landings that recovered in the year after the fires. Maritime fisheries recorded an insignificant reduction in fish landings, which could be attributed to normal variability. The difference between accounts and statistical data could be explained by the transport difficulties during the drought and haze time and the food shortage in the villages. Both could have considerably reduced the amount of fish arriving on markets and in cities and therefore not appear in statistics. For both, maritime and fresh water fishing it is very difficult to get data from private sources, since to date there is no large organized fishing company. This might be the reason, why no other reports include a quantitative estimate of losses for fisheries.

Fish Production in East Kalimantan 1991-1999 (Tons)

| Year | Marine Fisheries | Freshwater Fisheries | Total |
|---|---|---|---|
| 1991 | 60948 | 28212 | 89160 |
| 1992 | 61802 | 28510 | 90312 |
| 1993 | 63586 | 32098 | 95684 |
| 1994 | 69509 | 34789 | 104298 |
| 1995 | 70901 | 40890 | 111791 |
| 1996 | 75470 | 46215 | 121685 |
| 1997 | 74690 | 52100 | 126790 |
| 1998 | 72809 | 26323 | 99132 |
| 1999 | 78912 | 55874 | 134786 |

Source: BPS, 1995-1999




## 2.5. Avertive Expenditures

While the costs listed in this chapter are not in terms of costs from resource destruction or damage, this chapter provides such fire and haze related expenses that could have been used otherwise, in a more productive way, for example for development efforts or sustainable resource management projects. Like other disasters, fires have a negative effect on a country's development. Since there is no budget allocated for fire operations, periodically reoccurring large scale fires have to be fought with funds taken out of other accounts, such as the contingency account, or "on call budgets" as was the case in East Kalimantan in 1997/98. This has the potential to undermine the government's financial planning and budgeting, both important instruments of social development. This can lead to the failure to fulfill long-term development goals due to ad hoc reallocation of money and can create or increase the public deficit with negative effects on the balance of payments (Arnold, Gilbert and Fried, 1998).

### 2.5.1. Fire fighting

Government Regulation number 4/2001 stipulates that private landowners are responsible for fire management on their property. Therefore government agencies are responsible for protected forest areas, while individual concession holders and plantation owners are responsible for their land. The fire fighting responsibility is shared in a functional manner by government agencies and bureaus, which proved a major problem for data collection about fire suppression costs. BAPPEDA lists the following domestic government agencies that took part in the effort to put out the fires: Kanwill Kehutanan, Dinas Kehutanan, the military (*Korem 091 Aji Suryanta Kesuma*), and the city fire service of Samarinda (PMK Samarinda). While there are reports about the fires and the suppression efforts, most of these reports are of technical nature listing number of people and type of equipment used, but do not provide monetary values. The fact that there were no budgets allocated for fire operations further complicates data collection. Therefore, the money for suppression efforts was taken out of an on call fund of which the spending does not seem to have been recorded. Data made available by Kanwill Kehutanan indicates that for fire suppression efforts in Kutai National Park and Buckit Soeharto recreational forest 30.1 million Rp have been spent. Most money was spent in 1998 on fire suppression or at the end of 1997. Due to lack of more detailed data, where nothing else is mentioned fire suppression costs will be assumed to have occurred in 1998 and will be converted into 1996 prices.

When the haze covered large parts of Southeast Asia, this attracted international attention to the fires and international aid followed. According to BAPPEDA, the agency in charge of coordinating fire fighting efforts, aid from the following countries was received in East

Kalimantan: Japan, the People's Republic of China, Sweden and Germany. BAPPEDA has detailed inventory lists of help received from these countries, but does not have the monetary values of this aid. Aid given by Germany is considered to be part of the IFFM project and will therefore not be mentioned here to avoid double counting. It was difficult to get the monetary value of aid given to East Kalimantan, since the donor countries did not differentiate by province. Therefore it was only possible to get the cost of aid given by Sweden, that shipped equipment equivalent to 171,3 million Rp to East Kalimantan.

Besides government agencies, forest concession companies (HPH), forest plantation companies (HTI), estate crop companies (Perkebunan), mining and oil companies as well as community members contributed to fire fighting efforts. Unocal, a major oil company in Balikpapan for example estimates their contribution to the fire fighting effort at about 7,4 million Rp. They offered 4 people and a fire truck. Such interventions from private companies seem frequent, but as a private uncoordinated and unregistered effort it is difficult to estimate the total amount of aid from private company sources. There were also private initiatives such as the successful one lead by Gabriella Fredrikson in Sungai Wain who effectively saved 45% of the 10 000 ha large protection forest close to Balikpapan. This fire suppression effort cost about 74 million Rp (Fredrikson, 2001).

The most costly fire suppression effort was still ongoing at the time of writing, which is the extinguishing of coal seam fires that have been lit by the fires in 1997/98. Once lit, coal seam fires continue to smolder and constitute a permanent fire hazard. In the 5000 ha burnt forest area in Sungai Wain protection forest 73 coal seam fires have been inventoried. In Pusselhut, a 1000 ha area in Buckit Soeharto recreation forest, 30 coal seam fires have been found. Coal seam fires can be found all over the lower part of east Kalimantan, which allows extrapolation of the above findings (based on soil data from: MacKinnon et al., 1996 and Fredrikson personal communication). If one assumes the lesser number of coal seam fires found in Pusselhut this and extrapolates this to the whole area burnt, this amounts to 156,000 coal seam fires. In Sungai Wain 8 out of 73 coal seam fires went out by themselves. If one conservatively assumes that about 15% of all coal seam fires lit will go out by themselves, 132,600 are left to be put out. From her experience in Sungai Wain Gabriella Fredrikson estimates that it cost about 3 million Rp to extinguish a small coal seam fire and 9 million to extinguish a large one. By October 2001, 61 coal seam fires had been extinguished in Sungai Wain protection forest at a total cost of 213,377,500Rp, which amounts to an average 3.5 million Rp per coal seam fire. Ministerial Decree No. 1539 K/20/MPE/1999 puts the responsibility to extinguish coal seam fires with the Ministry of Mining and authorizes the use of Coal Royalty Fund to extinguish coal seam fires (EAPEI SEA, 12/14/01). Since coal seam fires were only put out after the fires were doused in 1998 and the majority is still burning in 2001, but the exact number of fires is not known, it is assumed that all coal seam fires were put out in 2002. The costs are converted in 1996 prices and then discounted from 2002 to 1998. The cost of extinguishing all coal seam fires will, based on the above assumptions is 348,685 million Rp.

Based on data collected total costs to extinguish fires lit in 1997/98 are 2,864,692 million Rp in 1996 prices, which has to be considered a conservative estimate, since only a small part of the fire suppression costs was recorded. On the other hand this total amount includes costs for extinguishing coal seam fires has not yet been done. The costs of extinguishing coal seam fire have however been included, since law prescribes that coal seam fires must be extinguished. Furthermore, coal seam fires present a constant risk of causing new fires and even greater damage. In Buckit Soeharto recreation forest 83% of fires in 1997/98 were started by coal seam fires (Abberger, 1998).

### 2.5.2. Emergency Disaster Relief

Emergency disaster relief during and immediately after the fires is described as sporadic, localized and largely uncoordinated. This complicates the monetary assessment of the relief efforts. Most aid focused on food aid with a few aid schemes going beyond short-term emergency aid distribution. None of the reports available at the time of writing includes any type of aid. In line with what has been said in the agriculture section, aid schemes giving out of rice will not be included, because the rice shortage can mainly be attributed to the drought. This is a very conservative approach, since fire has aggravated the drought situation, destroying alternative food sources relied on in drought years such as forest fruit and vegetables. Bioma is the only source known to the author that has provided aid beyond immediate food aid[17] at a total cost of 1,237 million Rp. The cost for relief efforts compiled in this section do not estimate the hardship encountered by local communities affected by fire, which is obviously much higher than the sporadic relief efforts. However, it provides an idea of the impact of the fires on otherwise self sufficient communities.

### 2.5.3. Health

During the time of the fires, not only East Kalimantan but a large part of Southeast Asia was covered with a blanket of haze reducing visibility in some cases to less than 100 meters. The haze affected the whole population. In East Kalimantan these were 2.5 million people in 1997 (BPS, 1999). A large number of chemicals, many with potential adverse health effects are contained in biomass smoke, but increased particulate matter is most consistently associated with burning biomass (Bauer, 1999). Therefore the drastic reductions in visibility paint a picture of the severity of pollution during the fires. In April 1998 for example, an API[18] of 1,000 was recorded in the interior of East Kalimantan. This is 10 times what is considered hazardous (Schweithelm, 1998). Smoke from peat and coal seam fires emitted high amounts of sulfur ($SO_x$) and nitrogen ($NO_x$) compounds.

Using Haze Index (HI) mapping the EEPSEA-WWF report estimates the affected population for the different haze levels. A dose response function adapted from Malaysia is used to estimate the induced health damage that corresponds to a certain haze level. Since people in Malaysia were better informed about pollution from haze and the corresponding health risks precautionary measures where taken, while the majority of Indonesians went about their daily lives without taking appropriate precautionary measures. On the other hand Malaysians seem to go to physicians or the hospital earlier and more frequent than people in East Kalimantan, which raises medical costs.

The table below presents and compares the studies introduced above with regard to number of patients and treatment costs assumed. The studies by MoE-UNDP and EEPSEA-WWF provide data only for the 1997 haze episode only. According to the ADB-BAPPENAS report the haze episode in March and April 1998 “affected the provinces in Kalimantan for approximately the

17 The following was provided to 3,000 families or 15,000 people: 39,900 kg of seeds of five different food crops, 65,420 seedlings of nine different forest tree crop species, 1,000 kg fertilizer, one set of forest fire control equipment per village, 80 villagers trained as fire guard cadres, and fire breaks have been planted. The cost of rice giving out over a period of 6 months was deducted from the total cost presented.

18 The studies use different measurements for pollution. TSP (Total Suspended Particles), which is synonymous with SPM (Suspended Particulate Matter) measures the totality of particles suspended in the air independent of size in µg per m3. PM10 only takes into account particles smaller than 10 µm, since the smaller a particle the further they can intrude into the human body. About 90% of TSP are smaller than 10 µm. PSI (Pollutant Standard Index) measures TM10 and the highest concentrated pollutant of the following: Carbon monoxide (CO), sulfur dioxide (SO2), nitrogen dioxide (NO2) and ozone (O3). API measured the same as PSI (GTZ Haze Guide).

same period and to the same intensity" (BAPPENAS-ADB, 1999) as the haze episode from September till the end of November the previous year. While this seems to be true for most of Indonesia, East Kalimantan is an exception where the 1998 haze episode was more severe than the previous one in 1997. Due to lack of data for 1998 all reports assume equal damages to the haze episode 1997, which will provide a conservative estimate.

| Haze Related Health Costs for 1997/98 in Rp | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Death[19] | | | Asthma | | | Bronchitis | | |
| Study | exposed population | No of cases | value | total damage | No of cases | value | total damage | No of cases | value | total damage |
| EEPSA-WWF | 1.633.536 | | | | | | | | | |
| MoE-UNDP | 118.000 | 10 | 480.000.000 | 4.800.000.000 | 5.692 | 15.000 | 85.380.000 | 1.110 | 14 | 15.984 |
| ADB-BAPPENAS | n.a. | | 134.856.000 | | | | | | | 0 |
| This Study | | | | | 25.219 | 49.360 | 1.244.809.840 | 1.110 | 9.010 | 10.001.100 |
| | | | | | | | | | | |
| | | ARI | | | Limited activities (days) | | | Self-treated | | |
| Study | exposed population | No of cases | value | total damage | No of cases | value | total damage | No of cases | value | total damage |
| EEPSA-WWF | 1.633.536 | | | | | | | 271.992 | 50.000 | 13.599.600.000 |
| MoE-UNDP | 118.000 | 27.612 | 30.000 | 828.360.000 | 90.860 | 2.500 | 227.150.000 | n.a | n.a | n.a |
| ADB-BAPPENAS | n.a. | | | | | | | | 160.000 | |
| This study | | 20.128 | 1.485 | 29.890.080 | | | | | | |
| | | | | | | | | | | |
| | | Outpatient | | | Hospitalization | | | Work days lost | | |
| Study | exposed population | No of cases | value | total damage | No of cases | value | total damage | No of cases | value | total damage |
| EEPSA-WWF | 1.633.536 | 17.309 | 5.000 | 86.545.000 | 7.417 | 812.500 | 6.026.312.500 | 775.551 | 15.000 | 11.633.265.000 |
| MoE-UNDP | 118.000 | 696 | 102.500 | 71.340.000 | 302 | 1.662.000 | 501.924.000 | 46.710 | 20.000 | 934.200.000 |
| ADB-BAPPENAS | n.a. | | 160.000 | | | 2.600.000 | | | 48.000 | |
| This study | | | | | | | | | | |

Sources: see next page.

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[19] The value of death is calculated as lost productivity.

| Study | exposed population | Total medical costs in million Rp | Total costs including lost productivity in million Rp | including WTP in million Rp |
|---|---|---|---|---|
| **EEPSA-WWF** | 1.633.536 | 19.712 | 31.346 | 62.691 |
| **MoE-UNDP** | 118.000 | 6.514 | 7.448 | not included |
| **ADB-BAPPENAS** | n.a. | n.a. | n.a. | n.a. |
| **This study** | | 1.285 | not included | not included |

Source: Summary of table above. For "Total medical costs" of this study to the total medical costs from the table above 203 cases of conjunctivitis (official data from Kanwil Depkes East Kalimantan, 1998 provided in the MoE-UNDP report 1998) with treatment costs of Rp 20,000 each (average 1996 prices for treatment in Puskesmas) were added.

Source table previous page: as marked in headers. For "This study" medical values for outpatient treatment in a Puskesmas in 1996 prices are assumed. For ARI and Asthma, No of cases is taken for 1997 from UNDP estimates for East Kalimantan and for 1998 no of excess patients are only taken for the period February to March from official data from Kanwil Depkes East Kalimantan, 1998 provided in the MoE-UNDP report ( 1998). The other estimates for number of patients are taken twice the numbers for 1997 estimated by MoE-UNDP

Values for treatment of health induced illnesses from Puskesmas (local health centers) for 1996, are given in the table on the previous page. The patient pays 1000 to maximum 3000 Rp per visit everything inclusive, the rest is government subvention. Difficult cases are transferred from Puskesmas to hospitals, where treatment costs are higher. Asthma patients for example are transferred to hospitals after three days of treatment from Puskesmas, should problems persist. The more wealthy part of society often goes directly to hospitals or to private doctors. Therefore the medical costs assumed in this report of 1.285 million Rp are very conservative. It does not neither include treatment costs for complicated or longer health problems nor the treatments from the better off part of society, nor the costs for stationary treatment. That the health cost estimate assumed here is too low, since incomplete also becomes obvious in the comparison in health costs assumed in the other reports, which is presented on this page.

All reports include costs for lost production from increased sick leaves due to haze-related illnesses. None of the companies interviewed (Indonesian and foreign) noted a significant increase in sick leaves during the haze period and no company felt their production level decrease significantly due to increase in absent employees. Doctors confirm that the large majority of patients they saw with haze-related illnesses could continue to work. This is supported by toxicological studies noting that while people will feel the negative effects from increased pollution, children, the elderly, and those with a preexisting disease such as asthma will feel most strongly the impact of the haze (Brauer, 1999). The group of people at risk belongs mainly to the non-working part of society . This is why this report will not include productivity losses due to an increase of haze induced sickness.

Doctors interviewed at all levels of East Kalimantan's health system (from Puskesmas in remote rural areas to city hospital and private foreign company doctors) confirm that most patients suffered from sometimes strong irritation-type eye and upper respiratory problems which will have affected people's well being, but disappeared again with the haze[20]. The exception are already weakened patients such as asthma patients, who had to be about twice as often

[20] The "Guide for treatment of breathing problems caused by forest fire and air pollution" by the Indonesian Association of Pulmologists (PDPI) gives a good summary of possible health problems and treatments.

hospitalized than normally (according to observations from the General hospital in Balikpapan personal conversation Dr. Garder, the company doctor of TOTAL-FINA-ELF who studied the health effects of the haze) people with chronic pulmonary problems and heavy smokers. There was also no increase in the cases of infections with fever. In some cases the symptoms were increased by anxiety and depression due to the decrease in sunlight from the haze. It does also not seem appropriate to transfer results from willingness to pay approaches used in other countries, because of the lack of comparability.

With respect to long term health effects, doctor Garder, pointed out, even when the observable haze was impressive, concentration of carcinogenic aromatic combinations such as the Benzopyren was comparable to levels routinely achieved in Europe (also shown in GTZ, 1998). According to Dr. Garder these aromatic combinations are the main long-term threat from air pollution. Analysis by GTZ and TOTAL show, the ratio of carcinogenic components is low compared with pollution resulting from fossil fuels. Also, one has to keep in mind, that the duration of the haze period was less than a year. Calculated for a year the carcinogenic components concentration of the haze is comparable to an area close to an industrial area in Germany. But uncertainty remains about health impacts from different air pollution sources. A WHO study holds that there is no evidence that would allow to assume that "airborne particles from different combustion sources have different impacts on health" (Schwela et al., 1999). This same study notes that "The limited data on biomass smoke and cancer do not indicate an increased cancer risk, even at very high levels of exposure. ... However, while biomass smoke clearly is potentially carcinogenic, it is much less so than motor vehicle exhaust" (Schwela et al., 1999).

Dr. Garder's assessment is based on his study on 120 expatriates working for the French petrol company TOTAL-Fina- Elf, during the haze episodes he found increased upper respiratory problems, irritations of the eyes and throat and a strong increase in anxiety related health problems. Contrary to expectations an accentuation of conditions with asthma patients was not observed by Dr. Garder, while Dr. Emil, pulmologue at the regional civil hospital in Samarinda (rumah sakit Umum Darah – RSUD) remembers increased numbers of asthma patients during the haze episodes. In the literature contradictory study results concerning the susceptibility of asthma patients to air pollution also remain unresolved. Respiratory function test after the haze incident for the whole community did not show any significant decrease in capacity. While in this case there seem to be no or no immediately observable long-term effects, the observations from TOTAL have to be put in perspective. Only healthy people will leave Europe for a tropical country and in this case, all possible preventive measures had been taken: air cleaners were installed in houses and office buildings, masks distributed and outdoor or physical activity avoided. Additionally, haze levels in Balikpapan were lower than in the interior of East Kalimantan, due to its location on the coast with the sea breeze blowing away the haze in the afternoon. Since the fires of 1982/83 with a similar haze impact there has been no increase of broncho-pulmonary cancer increase detected by the General Hospital of Balikpapan. An American study about the long-term health impact of the burning oil fields in Kuwait during the Gulf war did also not find any statistical relevant increase in incidences of bronchial cancer (personal conversation Dr. Garder).

## 2.6. Infrastructure

Reported direct and immediate damage from the 1997/98 fires to infrastructure is surprisingly small and not included in any of the major reports about the damage of the 1997/98 fires, which could be explained by infrastructure still needing development, especially where it burnt, in the

areas outside the major cities along the coast. Schindele, Thoma, Panzer mention with respect to the 1982/82 fires that the "fires sometimes reached such an intensity, that bridges consisting of large logs of heavy hardwoods were completely burnt". This was certainly the case, but it seems that damage to infrastructure was neither a major concern nor a major cost factor.

## 2.7. Production Cost Increase

From interviews conducted with major domestic and foreign companies in the main production sectors of East Kalimantan it seems that no company had to close down production for a longer period of time as was the case elsewhere in the region. However, some companies had expenditures.

Eastern Marketing for example, one of the five biggest sawmills in East Kalimantan had according to his manager Mr. Feroz Rajabali no significant problems due to the fires. While he remembers that suppliers were slower than normal, supply problems did not go as far as preventing production from lack of raw material. Most of his logs came from the coast at that time, and were therefore likely to cause less delays than had they come from upriver. But generally the times of the fires are remembered in the wood industry as a time of great activity during which many companies with contracts in US Dollars paid off their debts taking advantage of the devaluation of the Indonesian currency due to the Asian crisis.

Companies with large expatriate communities had additional costs for monitoring health risks to their employees and additional medical treatment in company owned clinics. Fina-Total Elf seems to have been particularly active commissioning a report by a French doctor about the possible health risks of the haze, air cleaners have been installed in every office building and house, a particle monitor device has been bought, masks distributed and additional medicine to ease the irrational effect from the haze has been imported. This effort cost the company approximately 400 million Rp (Dr. Garder, Fina-Total-Elf company medical doctor, personal communication).

The most common loss was in terms of time, since transport took longer and was more complicated. Companies with far off production sites such as oil and mining companies using helicopters to transport their personnel were most affected. But all companies describe the cost incurred from the fires as not very important. Nevertheless one has to keep in mind, that reoccurring disasters will decrease investor confidence and increase the requirements for high rates of return to compensate for real and perceived risks. In this context, Brian Johnson speculates, that in the past the destructiveness and risk of damage from the 1982/83 fires might have been the final straw for Georgia Pacific Indonesia to pull out of Indonesia (Johnson, 1994).

## 2.8. Tourism

Pollution and haze deter tourists. Transportation is slower, more difficult and hazardous, the air is potentially poisonous and landscapes hidden in the haze. Even though tourism is less important in East Kalimantan, than in other parts of Indonesia, it remains an important source of foreign exchange.

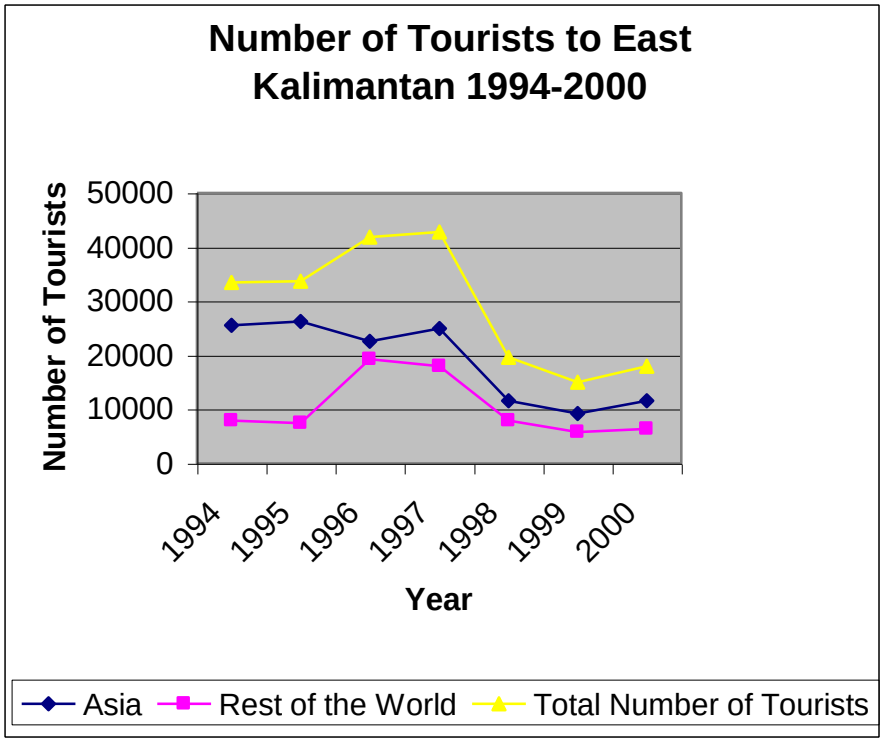
The ADB-BAPPENAS report is the most elaborate in its estimations. Trends based on tourist arrivals in the years 1991 to 1996 are dissagregated by region of origin and compared to tourist arrivals in 1997 and 1998. The difference between actual and predicted number of tourists is multiplied by the average expenditure per tourists and then adjusted for economic crisis and

political unrest based on the assumptions that all reductions in tourists from Europe and the Americas for the entire haze period were caused by the fires and half the reduction in tourists from Europe and America for the second part of 1998 after the haze had gone continued to be caused by the fire incident. Concerning tourists from ASEAN and Asia Pacific countries half the reduction in tourists is assumed to be cause by fire during the 1997 haze period. For 1998 and the second haze period none of the reduction in tourists from ASEAN and Asia Pacific countries is assumed to be caused by fires (BAPPENAS-ADB, vol. II, 1999). The ADB-BAPPENAS report also points out that since holidays are generally booked the preceding winter, the negative effects of the fires will most likely have extended until the end of 1998 when the haze had long dissipated.

The EEPSEA-WWF report takes a similar approach and calculates the shortfall of tourists based on historic data, which is then multiplied by the average expenditure per tourist to be expected from September to November. The reduction in tourists in the region ranged from 10 to 30%. This was transferred to Indonesia and using a "high low" sensitivity range it was established, that the reduction in tourists ranged in Indonesia between 30-45%. Since about half the tourists to Indonesia are assumed to be from ASEAN countries, this was further adjusted, so that 15-22.5% reduction in visits is attributable to the haze. As average expenditure per tourist US $ 1,250, a number provided by the Ministry of Tourism, is assumed. This estimate is also used by the MoE-UNDP study.

| | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
|---|---|---|---|---|---|---|---|
| Asia | 25473 | 26209 | 22534 | 24905 | 11625 | 9258 | 11586 |
| Rest of the World | 7949 | 7505 | 19284 | 17912 | 7965 | 5796 | 6412 |
| Total number of Tourists | 33422 | 33714 | 41818 | 42817 | 19590 | 15054 | 17998 |

Source: Dinas Pariwisata Provinci Kaltim Seksi Analisa Pasar (Provincial bureau of tourism)




The graph above shows clearly a steep drop in number of tourists in 1997/98 which recovers only slowly. In Tanjung Issuy in East Kalimantan the Longhouse of Akung, a popular tourist spot and guest house counted about 2000 guests in 1996. In 1998 this number dropped sharply to well below 200 guests. In 1996 room and board cost about 3 US $. While this does not add up to an impressive amount, the impact was felt strongly in the area. Additional income from selling of souvenirs and food were equally reduced (Christian Gönner, personal communication).To adjust for the Asian economic crisis reduction in number of tourists from Asian countries is not included. Based on an average tourist numbers from the years 1994 to 1997 the reduction of number of tourists from non-Asian origin believed to be a reaction to the fires is calculated for the years 1998 until 2000. The official statistics from the East Kalimantan Tourism bureau calculates with 129 US $ expenditure per tourist per day and an average stay of eleven days. This seems high and the officials spoken to, admitted that the way their statistics are compiled, tourists might be counted more than once. To stay conservative, the official numbers will be reduced approximately by half, assuming 60 US $ daily expenditure per tourist and an average length of stay of five days. With these assumptions the losses from tourism for the East Kalimantan province amounts to 5.2 million US $ (13,105 million Rp) for the years 1998 to 2000.

To attribute the reduction in numbers of tourists to the fires two years after the fires have gone, can be justified, since fire is the major cause mentioned by travel agents, tour guides and officials from the provincial tourism bureau for reduction in number of tourists. Kutai National Park used to be one of the main tourist attraction in East Kalimantan. After the national park burnt for the second time in 1997/98, its attraction had gone and so have the tourists. Only slowly are boat and trekking tours on the upper reaches of the Mahakam river becoming better known and attract tourists back to East Kalimantan. One has to keep in mind, that the choice of a vacation spot far away is to a large part based on perception. Therefore East Kalimantan has to be careful to limit fires in order not to destroy its ‘off the beaten track’ nature tourism aura, that East Kalimantan and the whole of Borneo are known for.

## 2.9. Transport

Only lost revenue is accounted for in this section and not the costs from reported increased numbers of accidents which is shown most dramatically in the ship collisions in the straits of Malacca or the plane crash in Sumatra believed to have been caused by reduced visibility from haze. The transport ministry in Samarinda confirmed that accidents were more frequent. Unfortunately no quantitative data could be provided. As discussed at the beginning of this report it was extremely difficult to gather data from private companies. Therefore losses to shipping, trucking, and bus companies could not be included.

### 2.9.1. Air

**Airport**

The airport in Balikpapan is the biggest airport and the only international as well as privately run airport in the province. While Balikpapan has the most air traffic and therefore also the highest potential losses, it is the only airport in East Kalimantan that is equipped with an electronic landing devise. Other airports in the province are small and highly government subsidized. After Balikpapan, Samarinda und Tarakan are the most important airports.

The MoE-UNDP report lists for 1997 alone 65 airport closures in East Kalimantan. According to approximations by the MoE-UNDP study an average daily income to airports in Indonesia is between Rp 30 to 100 million a day. Based on these estimates the costs for 1997 would have been between 1,950 and 6,500 million Rp from airport closures in East Kalimantan. The other studies' estimates do not allow disaggregation for the province level.

The airport in Balikpapan had to be closed a total time equivalent to 99 days during the fire and haze period. Since most of the airport closures were not full, but half-days with operations resuming in the afternoon not all flights during this time had to be cancelled, but some could be delayed later into the day, when the haze had dissipated. Direct losses from the fire and haze incident to the Balikpapan airport company from airport closures and flight cancellations are listed below.

| Type of revenue foregone | Amount in Rupiah |
|---|---|
| PJP4.U (landing and parking fee) | 28.780.320 |
| PJP (Route charge) | 9.229.200 |
| PJP2.U (passenger service charge) | 253.701.000 |
| Counter fee | 11.986.120 |
| Total revenue foregone | 303.696.640 |

Source: Data prepared by Balikpapan airport company

Besides the data for Balikpapan and Samarinda airport the data provided by the transportation bureau does only include losses for 1998 for Samarinda airport, where a paper was found hdetailing the losses incurred in 1998. From discussion with officials and airport companies it seems that 1998 was worse than 1997. This is also confirmed by data for Samarinda airport. Therefore it seems reasonable that where no cost estimates are available for 1998 the costs from 1997 are assumed.

Losses to East Kalimantan Airports from the haze

| Name of Airport | Time frame for which data available | Losses in million Rp |
|---|---|---|
| Sepinggan Balikpapan* | | 303.7 |
| Juwata Tarakan | 21.08.-15.09.1997 | 49 |
| Termindung Samarinda* | 22.08.-23.09.1997 | 80 |
| | 02.02.-20.03.1998 | 90 |
| Kalimarau Kab. Berau | 14.09.-19.09.1997 | 15 |
| Nunukan | 18.08.-18.09.1997 | 10.4 |
| Tg. Harapan Tanjung Selor | 11.09.-19.09.1997 | 34.2 |
| Long Apung | 22.08.-23.09.1997 | 22 |
| Datah Dawai | 22.08.-23.09.1997 | 20 |
| Melak | 22.08.-23.09.1997 | 18 |
| Total loss in million Rp | | 642.3 |
| Total losses in million Rp counting twice the losse without * to account for losses in 1997 and 1998 in millionen Rp | 811 million Rp | |

Source: Harsono, 1997. For Samarinda: Harsono, 1998. For Balikpapan, see table above.

In 1996 prices the above value is 706 million[21] Rp. Additionally to the above-presented direct losses, there are indirect losses from services around the airport such as ground handling, catering, porters and private transportation which have no income when airports are closed. At Balikpapan airport PT Kuka Pura does the main ground handling. According to an employee at Kuka Pura his company makes Rp 200 000 revenue on a B737-200. With 4 flights a day (since some flights have been delayed, in a conservative estimate only two per day are assumed to have been cancelled) for a period of 99 days the total losses are: Rp 39,6 million Rp (34,5 million Rp in 1996 prices). Losses from passenger service charge indicate that 28.189 passengers less arrived. About 20% of all passengers use porter services and carry on average 2 packs per person with 1Rp charge per pack. This amounts to a total loss of income of Rp 11.276.000 to the 20 porters working at the airport in 1996. Corresponding to their size indirect losses will be much smaller for the other airports in East Kalimantan, but still exist.

Before the economic crisis the airport had about 100 movements each day. Since the economic crisis this number has decreased to 70-80 movements (data prepared by Balikpapan airport). To adjust for the effect of the Asian economic crisis, this report assumes only 70% of the total losses estimated above to be losses due to haze, which is a total of 526 million Rp in 1996 prices. While the still incomplete and therefore conservative cost estimate above is high, the haze impact from the 1982/83 fires, which also caused airport closures, is reported by the interviewed airport officials at Balikpapan and Samarinda airport to have been worse than in 1997/98.

## Airlines

As for other private companies it was difficult to obtain data from airlines. While it is known that all airlines operating in East Kalimantan had losses, only two, Garuda and Merpati provided data. Garuda has only two flights to Balikpapan airport, one in the morning and one in the afternoon. The morning flight was mostly delayed during the haze episode, but had to be cancelled only

[21] For this whole section on transportation, half the damage is assumed to have occurred in 1997 and the other half in 1998.

once, while Merpati had to cancel five flights from Balikpapan to Tarakan. The table below shows losses to Garuda and Merpati airlines from haze. Assumed that half the costs detailed below occurred in 1997 and the other half in 1998, the total loss to the two airline companies discussed here is 283 million Rp in 1996 prices.

| Losses to airlines from haze in 1997/98 in Rp | | |
|---|---|---|
| | Garuda | Pt. Merpati Nusantara |
| Lost revenue from cancelled flights | 156078000 | 27500000 |
| Additional costs due to flight cancellations and delays (e.g. hotel, food, etc.) | 51690000 | 85225835 |
| Telephone hotline | 5000000 | no |
| Total losses | 212768000 | 112725835 |
| Grand total | | 325.493.835 |

Source: Questionnaire filled out by Mr. Gusti, the head of Garuda branch office in Balikpapan and Mr. Jaya Budi Santoso, sales manager for Merpati.

**2.9.2. Sea**

While reports exist that during the 1982/83 fires shipping had to be stopped at Balikpapan port (Schindele, Thoma, Panzer, 1989; Johnson, 1984), according to official data and port officials at Samarinda and Balikpapan port no haze-related problems were experienced in 1997/98. According to statistics from the Samarinda port the amount of ships and cargo loaded and unloaded in the port stayed constant, just as did the time needed for operations. This is surprising, considering the fact that port operations were thought to be affected not only by haze, but also by the economic and political crisis that occurred at the same time. In an attempt to find an explanation, a port official was asked, if more or different goods were transported by ship due to the financial crisis and the problematic air transport situation, but this proposition was refused.

## *3. Discussion of Total Costs of 1997/98 Fires*

The table below shows the estimated total losses for East Kalimantan in 1996 prices based on the data presented and discussed above. The areas marked in grey are haze costs, while the others are direct fire costs. For comparison fire damage to East Kalimantan has been calculated where applicable based on methods and assumptions made in previous reports and supplemented by new estimates based on East Kalimantan specific data where available. The table below provides all estimates for East Kalimantan by sector. In the last column those cost estimates that seemed most appropriate for East Kalimantan and reliable are noted.

| Sector | EEPSEA-WWF | MoE-UNDP | ADB-BAPPENAS | This report |
|---|---|---|---|---|
| **Forestry (2,788,098 ha burnt)** | | | | |
| Timber losses | 17.077.000 | not applicable | not applicable | 5.924.708 |
| Future timber losses | not applicable | N.I. | not applicable | 1.114.636 |
| Rehabilitation | N.I. | N.I. | N.I. | 404.003 |
| Forest Planatations (HTI) | not applicable | not applicable | not applicable | N.I. |
| **Direct Forest Services** | | | | |
| Non-Timber Forest Products | 1.002.400 | 234.959 | 2.158.321 | 141.330 |
| Recreation | 899.161 | 390.333 | N.I. | N.I. |
| Spiritual and Cultural Losses | N.I. | N.I. | qualitative | N.I. |
| **Indirect Forest Services** | | | | |
| water regulation/supply | 3.415.420 | 84.000 | 2.043.120 | N.I. |
| Erosion Control | 195.167 | 2.958.869 | 8.200.000 | N.I. |
| Disturbance regulation | 69.702 | 52.277 | N.I | N.I. |
| Soil Formation | 139.405 | 115.009 | N.I | N.I. |
| Nutrient Recycling | 12.853.132 | 11.155.877 | N.I | N.I. |
| Waste treatment | 1.212.813 | 1.045.537 | N.I. | N.I. |
| Biodiversity | 2.091.074 | 2.091.074 | qualitative | 6.750 |
| Carbon Release | 367.500 | 10.395.000 | not applicable | 3.791.813 |
| Protected Forest | N.I. | N.I. | qualitative | qualitative |
| **Agricultural Losses (1,543,683 ha burnt)** | 561.339 | | 340.000 | |
| Estate Crop Plantations | included above | 1.090 | included above | 2.180 |
| Shifting and smallholder Agriculture | included above | N.I. | included above | N.I. |
| Transmigrant Areas | not applicable | not applicable | 2.400 | N.I. |
| Local Communities | N.I. | case study | 25.915 | N.I. |
| **Fishing** | N.I. | N.I. | N.I. | N.I. |

| Sector | EEPSEA-WWF | MoE-UNDP | ADP-BAPPENAS | This report |
|---|---|---|---|---|
| **Avertive Expenditures** | | | | |
| Fire Fighting | not applicable | not applicable | not applicable | 2.864.692 |
| Emergency Disaster Relief (2.5 million people affected) | N.I. | N.I. | N.I. | 1.237 |
| Medical Costs | 19.712 | 6.514 | not applicable | 1.285 |
| Production Losses due to Haze | 11.633 | 934 | not applicable | N.I. |
| Total Health Cost (including WTP) | 62.691 | N.I. | not applicable | N.I. |
| **Infrastructure** | N.I. | N.I. | N.I. | N.I. |
| **Production Cost Increase** | N.I. | N.I. | N.I. | N.I. |
| **Tourism** | not applicable | not applicable | not applicable | 13.105 |
| **Transport** | | | | |
| Airport | not applicable | 1950 - 6500 | not applicable | 526 |
| Airlines | not applicable | not applicable | not applicable | 283 |
| Sea | N.I. | N.I. | N.I. | N.I. |
| Port | N.I. | N.I. | N.I. | N.I. |
| Shipping companies | N.I. | N.I. | N.I. | N.I. |
| Land | N.I. | N.I. | N.I. | N.I. |
| **Total Losses in million Rp** | | | | **14.266.548** |

*1 genetic resources included in MoE-UNDP report are kept out by all the other reports to avoid double counting

NI means that this type of loss was not included in the report

Not applicable: the calculation could not be reproduced

Included above: this value is part of a bigger aggregate value in this report

The total costs for East Kalimantan from the 1997/98 forest fires estimated in this study are 5.7 billion US $ in 1996 prices. For comparison, in 1998 prices using the exchange rate of 8000 Rp assumed by the ADB-BAPPENAS report this amounts to 3.5 billion US $. This is about one third of the 9 billion US $ losses estimated for the whole of Indonesia by the ADB-BAPPENAS report for the province of East Kalimantan alone. While this may seem much, one has to keep in mind, that this estimate is not only very conservative, but also incomplete. In some areas data was not available, because it was neither included in available statistics nor could it be provided by official or private sources. In some cases more specific knowledge about East Kalimantan's ecosystem is required or the causal relationship could not be determined beyond reasonable doubt. Costs from smoke damage (marked grey in the table) are an example, since smoke affects a larger area reaching far beyond the area of direct fire damage and affecting many people. The causal relation to a specific area burnt however remains difficult to establish. This is firstly due to the difficulty of tracing specific amounts of haze back to its source and secondly due to the difficulty in tracing certain illnesses back to a specific haze event.

According to estimates in this report, damage to timber, including future timber harvests are almost one third of total fire damage. This however is over proportional, since timber loss estimates, are more complete than other cost estimates. Health costs included cover only very basic routine medical care neither including stationary treatment nor complicated illnesses requiring more expensive drugs and specialist advise, nor private doctor consultations or the costs of self-treatment. Possible long term health damage is also not included. Biodiversity costs are included only for one species, and losses to airline companies only to two companies. Due to lack of data, damage to forest plantations, increased number of accidents and loss of life had to be left out. Ecological functions are also not included in this estimate, since data and knowledge about East Kalimantan's ecosystem was still incomplete at the time of writing.

While it is impossible to quantify all losses, an economic impact valuation is still valuable, since it points to often not directly perceived and therefore neglected costs, such as long-term or future damage or damages to public goods and remote rural communities. However, one problem inherent to cost benefit analysis (Kopp, Krupnick and Toman, 1997) remains. The costs and benefits to the further developed and consequently better off parts of society strongly dominate this cost estimate. This is due to the problem of collecting reliable data from often remote communities spending much of their time with subsistence agriculture and handicrafts sold mainly on local markets without a means of comparison of income or costs but often distorted and subjective recollection (Riot Tinto, 1998). Even if this data was available it would need to be adjusted with a factor to compensate for the fact that the losses to rural communities might not be much expressed in monetary values compared to losses of a major companies, but the impact of the losses are much more severely felt, since it affects directly people's livelyhood with the potential to threaten their survival. Survival strategies chosen might reverse development achievements as discussed in the section on local communities, which might lead to rural populations being worse off in the long term.

Despite the lack of knowledge and data in some areas preventing to include all costs caused by the 1997/98-fires, this report provides a reliable lower border estimate of the costs that accrued to East Kalimantan from this fire catastrophe. As a study on the province level with a smaller area to cover than a national level study, this study does not use benefit transfer or other general estimates, but is only based on data from East Kalimantan.

## Fire costs in the future

The fires of 1997/98 are considered exceptional, caused by the coinciding of two severe weather phenomena: severe drought and strong El Nino-ENSO. This does however not mean that the 1997/98-fires were unique and unlikely to reoccur. Only 15 years earlier, in 1982/83 a similarly destructive fire event occurred. While the burnt area was smaller then, haze effects were worse and losses for example from the Balikpapan airport were higher in 1982/83 than in 1997/98 (personal communication Mr. Asrori from Pelaksana Pendapatan Aeronautika, Balikpapan Airport management).

With forests increasingly disturbed by logging activities, population pressure and fire, they become increasingly prone to burning. At the same time El Nino events increase in frequency and strength, further increasing the likelihood and risk of wild land fires, which in turn further opens up the forest and leads to increased fuel accumulation which increases the likelihood of the forest burning, even in non-El-Nino years. This positive feed back cycle with every fire event paving the way for the next fire justifies the expectation that damage from forest and land fires will increase in the future (Rowell and Moore, 1999). What Rowell and Moore write with respect to the Amazon rain forest also applies to East Kalimantan: “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, no least for global climate” (1999).

While the scientific community is still debating the relationship between climate change and the increased El Nino events, some hold that the enormous amounts of CO2 emissions released by forest and especially peat fires contribute to and accelerate global warming and in turn increase the frequency and strength of El Nino. While the correlation between El Nino events and global warming was still subject of debate at the time of writing, it seems uncontested that El Nino events have increased beyond natural variability (Rowell and Moore, 1999).

Additionally it has been found that when fires return they causes more ecological damage than the first time around with the potential of completely eliminating forest cover if the intervals are too short between fire events to allow the forest to recover (Rowell and Moore, 1999). This would irreversibly increase ecological damage from fires. At the same time damage from haze would be reduced as less biomass is left to burn.

The losses calculated in this analysis do not capture the economic impact of fire and haze damage in its entire scope. Conservative cost estimates have been made throughout and some costs could not be quantified due to lack of data and knowledge. Damages and costs occurring to other countries from haze should be mentioned at this point, which are important costs as shows the EEPSEA-WWF study, but which cannot be disaggregated for the part of East Kalimantan. The cost estimate presented here is consequently to be understood as a lower boundary. For the reasons discussed above increasing costs with every major future fire event can be assumed, until ecological change has reached a point where the remaining ecosystems have shrunk significantly or even disappeared.

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