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Working Group 4 on Wildland Fire (WG-4)

Position Paper of the ISDR-IATF Working Group on Wildland Fire for the World Summit for Sustainable Development (WSSD)

Theme: Wildland Fire and Sustainable Development

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1. Rationale

The increasing incidence, extent and severity of uncontrolled burning globally, together with its many adverse consequences, has brought fire into the international environmental policy arena, with growing calls for international action leading to greater control of burning, especially in tropical countries. Despite this concern, there is a paucity of accurate and timely information on the numbers of fires, area burned and phytomass consumed annually at national, regional and global scales, and on the social, economic and environmental costs. Given that fire is also an important natural process in many ecosystems, and that people have traditionally used fire for millennia as a land-management tool, the challenge is to develop informed policy that recognizes both the beneficial and traditional roles of fire, while reducing the incidence and extent of uncontrolled burning and its adverse impacts.

As suggested in the early stage of the formation of the ISDR Inter-Agency Task Force Working Group on Wildland Fire the World Summit for Sustainable Development (WSSD) (Johannesburg 2002) will provide an opportunity to increase the visibility of wildland fire

problems and encourage the most important conventions and programmes to evaluate their responsibilities related to wildland fire issues. The WG-4 chair emphasized that the most important conventions (UN Convention on Biological Diversity [CBD], Convention to Combat Desertification [UNCCD], United Nations Framework Convention on Climate Change [UNFCCC]) and the UN Forum of Forests (UNFF) explicitly mention fire as an important problem to be addressed.

WG-4 felt encouraged by the ISDR-IATF Strategy for Action of the World Summit for Sustainable Development (WSSD) (ISDR-IATF Doc.#TF4/2) and the initiative of the German Committee for Disaster Reduction within the ISDR to become involved in preparing a statement to be submitted to PREPCOM-3 (March 2002).

2. Introduction

Fire is a prominent disturbance factor in most vegetation zones across the world. In many ecosystems it is an essential and ecologically significant force - organizing physical and biological attributes, shaping landscape patterns and diversity, and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle. In some ecosystems, however, fire is an uncommon or even unnatural process that severely damages the vegetation and can lead to long-term degradation. Such ecosystems, particularly in the tropics, are becoming increasingly vulnerable to fire due to growing population, economic and land-use pressures. Moreover, the use of fire as a land-management tool is deeply embedded in the culture and traditions of many societies, particularly in the developing world. Given the rapidly changing social, economic and environmental conditions occurring in developing countries, marked changes in fire regimes can be expected, with uncertain local, regional, and global consequences. Even in regions where fire is natural (e.g., the boreal zone), more frequent severe fire weather conditions have created recurrent major fire problems in recent years. The incidence of extreme wildfire events is also increasing elsewhere the world, with adverse impacts on economies, livelihoods, and human health and safety that are comparable to those associated with other natural disasters such as earthquakes, floods, droughts and volcanic eruptions. Despite the prominence of these events, current estimates of the extent and impact of vegetation fires globally are far from complete. Several hundred million hectares of forest and other vegetation types burn annually throughout the world, but most of these fires are not monitored or documented. Informed policy and decision-making clearly requires timely quantification of fire activity and its impacts nationally, regionally and globally. Such information is currently largely unavailable.

The primary concerns of policy makers focus on questions about the regional and global impacts of excessive and uncontrolled burning, broad-scale trends over time, and the options for instituting protocols that will lead to greater control. Other key questions involve determining in what circumstances fires poses a sufficiently serious problem to require action; what factors govern the incidence and impacts of fires in such cases; and what might be the relative costs and benefits of different options for reducing adverse impacts?

3. Fire-Atmosphere Interactions

Research efforts under the Biomass Burning Experiment (BIBEX) of the International Geosphere-Biosphere Programme (IGBP), International Global Atmospheric Chemistry (IGAC) and a large number of other projects in the 1990s were successful in sampling and determination of fire emissions and the identification of emission factors. However, global

and regional emission estimates are still problematic, mostly because of uncertainties regarding amounts burned. Most recent estimates indicate that the amount of vegetative biomass burned annually is in the magnitude of 9200 Teragram (dry weight), i.e. 9.2 billion tons.

These vegetation fires produce a range of emissions that influence the composition and functioning of the atmosphere. The fate of carbon contained in fire-emitted carbon dioxide (CO_2) and other radiatively active trace gases is climatically relevant only when there is no regrowth of vegetation - e.g., deforestation or degradation of sites. NO_x, CO, CH_4, and other hydrocarbons are ingredients of smog chemistry, contribute to tropospheric ozone formation and act as "greenhouse gases". Halogenated hydrocarbons (e.g. CH_3Br) on the other side have considerable impact on stratospheric ozone chemistry and contribute to ozone depletion.

Fire-emitted aerosols influence climate directly and indirectly. Direct effects include (a) backscattering of sunlight into space, resulting in increased albedo and a cooling effect, and (b) absorption of sunlight which leads to cooling of the Earth's surface and atmospheric warming. As a consequence convection and cloudiness are reduced as well as evaporation from ocean and downwind rainfall. The key parameter in these effects is the black carbon content of the aerosol and its mixing state.

Indirect effects of pyrogenic aerosols are associated with cloud formation. Fire-emitted aerosols lead to an increase of Cloud Condensation Nuclei (CCN) that are functioning as seed for droplet formation. Given a limited amount of cloud water content this results in an increase of the number of small droplets. As a first consequence clouds become whiter, reflect more sunlight, thus leading to a cooling effect. As a second indirect effect of "overseeding" the overabundance of CCN coupled with limited amount of cloud water will reduce the formation of droplets that are big enough (radius ~14 µm) to produce rain; consequently rainfall is suppressed.

In conclusion it can be stated that

- The fire an atmospheric science community has made considerable progress at determining emission factors from vegetation fires
- Global and regional emission estimates are still problematic, mostly because of uncertainties regarding amounts burned
- Fire is a significant driver of climate change (as well as a human health risk)
- Fire, climate, and human actions are highly interactive
- Some of these interactions may be very costly both economically and ecologically

4. El Niño, Transboundary Transport of Smoke and Human Health

The fire and smoke episodes in the tropical and subtropical belt during the last El Niño-Southern Oscillation (ENSO) in 1997-98 were largely the result of increasing fire application in land use and land-use change. Most smoke produced in South East Asia during that episode was generated by planned ignition of vegetation for converting forests and other wildlands to agricultural and plantation systems. Wildfires escaping the planned ignitions affected large areas of primary and secondary forests, particularly in the second phase of the ENSO phenomenon.

Severe near-ground smoke pollution, often carried over long distances and crossing national borders, affected several hundred million people in tropical Asia and the Americas. The

consequences of fire-generated air pollution on human health are well known. However, there are almost no efficient policies and technical measures in place to protect people from short- to long-term effects of vegetation fire smoke pollution. Despite the efforts of the WMO in forecasting and monitoring smoke transport, and the work of the WHO in assisting decision makers to reduce the negative impacts of smoke pollution on human health, the local populations are still entirely unprotected. Severe smoke pollution affects human health, thus affecting local and national economies.

5. Forest Fires, Climate Change and Carbon Storage in Boreal Forests

Global boreal forests, which cover close to 12 million square kilometres at northern latitudes, and contain ~35% of global terrestrial carbon stocks, have become increasingly accessible to human activities, including natural resource exploitation and recreation, over the past century. The export value of forest products from global boreal forests is currently ~47% of the world total.

Growing exploitation of the global boreal zone cannot be accomplished without a reconciliation, and compromise, with the fact that the boreal forest is dependent on periodic natural disturbance (fire, insects, disease) in order to exist. Forest fire is the dominant disturbance regime in boreal forests, and is the primary process which organizes the physical and biological attributes of the boreal biome over most of its range, shaping landscape diversity and influencing energy flows and biogeochemical cycles, particularly the global carbon cycle since the last Ice Age. Human settlement and exploitation of the resource-rich boreal zone has been accomplished in conjunction with the development of highly efficient forest fire management systems designed to detect and suppress unwanted fires quickly and efficiently. Over the past century people throughout northern forest ecosystems have, at times somewhat uneasily, coexisted with this important natural force, as fire management agencies attempted to balance public safety concerns and the industrial and recreational use of these forests, with costs and the need for natural forest cycling through forest fires. Canadian, Russian, and American fire managers have always designated parts of the boreal zone, usually in northern regions, as "lower priority" zones that receive little or no fire protection, since fires occurring there generally have little or no significant detrimental impact on public safety and forest values.

While humans have had some influence on the extent and impact of boreal fires, fire still dominates as a disturbance regime in the boreal biome, with an estimated 5-20 million hectares burning annually in this region. Canada and Alaska, despite progressive fire management programs, still regularly experience significant, resource-stretching fire problems, with 2-8 million hectares, on average, burning annually. In contrast, Scandinavian countries do not seem to have major large fire problems, probably due to the easy access resulting from intensive forest management over virtually all of the forested area of these countries. Russian fire statistics are available over the past four decades but, until recent years, these statistics are considered very unreliable. However, based on recent remote sensing data, it appears that the annual area burned in Russia can vary between 2 and 10 million hectares/year.

Boreal forest fires are, most often, crown fires - high-intensity events that combine high spread rates with significant levels of fuel consumption to generate significant fire intensity and energy release rates. When sustained over an extended afternoon burning period each day,

this results in the development of towering convection columns reaching the upper troposphere/lower stratosphere, with significant long-range transport potential.

Recent Intergovernmental Panel on Climate Change (IPCC) reports have emphasized the fact that climate change is a current reality, and that significant impacts can be expected, particularly at northern latitudes, for many decades ahead. Model projections of future climate, at both broad and regional scales, are consistent in this regard. An increase in boreal forest fire numbers and severity, as a result of a warming climate with increased convective activity, is expected to be an early and significant consequence of climate change. Increased lightning and lightning fire occurrence is expected under a warming climate. Fire seasons are expected to be longer, with an increase in the severity and extent of the extreme fire danger conditions that drive major forest fire events. Increased forest fire activity and severity will result in shorter fire return intervals, a shift in forest age class distribution towards younger stands, and a resultant decrease in terrestrial carbon storage in the boreal zone. Increased fire activity will also likely produce a positive feedback to climate change, and will drive vegetation shifting at northern latitudes. The boreal zone is estimated to contain 35-40% of global terrestrial carbon, and any increase in the frequency and severity of boreal fires will release carbon to the atmosphere at a faster rate than it can be re-sequestered. This would have global implications, and must be considered in post-Kyoto climate change negotiations.

Increased protection of boreal forests from fire is not a valid option at this time. Fire management agencies are currently operating a maximum efficiency, controlling unwanted fires quite effectively. There is a law of diminishing effects at work here though, as increasing efficiency would require huge increases in infrastructure and resources. While it is physically and economically impossible to further reduce the area burned by boreal fires, it is also not ecologically desirable, as fire plays a major and vital role in boreal ecosystem structure and maintenance. Given these facts, it would appear that, if the climate changes as expected over the next century, northern forest managers will have to constantly adapt to increasing fire activity. The likely result would be a change in protection policies to protect more valuable resources, while permitting more natural fire at a landscape scale.

5. Fire and Sustainable Development

One of the driving reasons for the formation of WG-4 is the fact that sustainable development in rural societies in many countries with different natural vegetation types and land-use systems is often jeopardized by wildfires that devastate valuable vegetation resources (forests, farmlands, pastures, plantations, etc.), in both the short-term (economic losses and humanitarian problems due to destruction of crops and other values at risk) and the long-term (degradation of stability and productivity of ecosystems and land-use systems).

These fires often occur as consequence of extreme weather situations, e.g. interannual climate variability such as droughts caused by El Niño, coupled with application of fire in land-use systems that escape control. The underlying causes of damaging wildfires are deeply rooted in the problems of rural societies that are undergoing rapid demographic changes, experiencing the loss of traditional knowledge and skills due to the trend of globalisation, and confrontation with external pressure on limited vegetation resources.

Secondary effects of destructive wildfires include the loss of vegetation that protects the soil. As a consequence the fire-affected sites are often degraded due to wind and water erosion.

Increased water runoff also leads to disastrous floods and landslides, affecting drinking water availability and quality, or leading to siltation of reservoirs.

Community Involvement in Fire Management

Wildland fire risk, hazard and danger are determined by humans (ignition sources), ecosystem properties (presence of fuels that determine fire intensity and severity) and weather (desiccation of the vegetation). Fire prevention at the community level traditionally involves instruments such as awareness raising, public information and incentive (participatory) elements (e.g. participation in advantages gained by successful prevention of destructive fires).

Integrated fire management measures include manipulation of the fuel complex, thus enabling people to proactively work in fire prevention.

On the other side, weather as the natural driver of fire danger is the only element that cannot be manipulated. However, it can be predicted. Early warning systems of fire danger have been developed for many climate and vegetation types. They are mainly designed or operational at national or regional levels and are of low resolution. Some pilot products have been designed for application at the community level. Widespread application or technology transfer, however, is still in its infancy stages.

Challenges

The greatest challenges ahead are transfer of knowledge and adapted technologies to the grassroot levels of those population groups that are dependent on using the ecologically beneficial effects of fire in their land-use systems, while at the same time becoming increasingly vulnerable to the destructive effects of uncontrolled wildfires. These population groups cannot take advantage of sophisticated fire warning and information systems or the theories and practical approaches of Integrated Fire Management that are available, but outside their reach.

It is suggested that an action programme is needed which facilitates the transfer of knowledge in fire management to the most vulnerable population groups, land-use systems and ecosystems.

Due to its nature and impacts the fire problem in many countries cannot be addressed by single administrative bodies. Local to national Round Tables in Fire Management must be used as an instrument to build consensus on national to local approaches in Integrated Fire Management.

An action programme could include the development and / or transfer of:

- Integrated Fire Management (Community-Based Fire Management) Systems
- Locally applicable fire management information systems including early warning components
- Fire management training for local application.

6. Conclusions and Recommendations

The challenge of developing informed policy that recognizes both the beneficial and traditional roles of fire, while reducing the incidence and extent of uncontrolled burning and its adverse impacts, clearly has major technical, social, economic and political elements. In developing countries better forest and land management techniques are required to minimize the risk of uncontrolled fires, and appropriate management strategies for preventing and controlling fires must be implemented if measurable progress is to be achieved. In addition, enhanced early warning systems for assessing fire hazard and estimating risk are necessary, along with the improvements in regional capacity and infrastructure to use satellite data. This must be coupled with technologies and programs that permit rapid detection and response to fires.

A better understanding by both policy-makers and the general population of the ecological, environmental, socio-cultural, land-use and public-health issues surrounding vegetation fires is essential. The potential for greater international and regional co-operation in sharing information and resources to promote more effective fire management also needs to be explored. The recent efforts of many UN programs and organizations are a positive step in this direction, but much remains to be accomplished.

In the spirit and fulfilment of the 1997 Kyoto Protocol to United Nations Framework Convention on Climate Change and the UN International Decade for Natural Disaster Reduction (IDNDR), there is an obvious need for more reliable data on fire occurrence and impacts. Remote sensing must and should play a major role in meeting this requirement. In addition to the obvious need for improved spaceborne fire-observation systems and more effective operational systems capable of using information from remote sensing and other spaceborne technologies, the remote sensing community needs to focus its efforts more on the production of useful and meaningful products.

Finally, it must be underscored that the traditional approach in dealing with wildland fires exclusively under the traditional forestry schemes must be replaced in future by an inter-sectoral and interdisciplinary approach. The devastating effects of many wildfires are an expression of demographic growth, land-use and land-use changes, the socio-cultural implications of globalisation, and climate variability. Thus, integrated strategies and programmes must be developed to address the fire problem at its roots, at the same time creating an enabling environment and develop appropriate tools for policy and decision makers to proactively act and respond to fire.