Forestry Department

Food and Agriculture Organization of the United Nations

Fire Management Working Paper

FAO at the Vth International Wildland Fire Conference

Sun City, South Africa
(9-13 May 2011)

Rome, Italy, 2011

Forest Resources Development Service
Forest Management Division
Forestry Department

Working Paper FM/27/E
FAO, Rome, Italy

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INTRODUCTION

Living with Fire: Addressing Global Change through Integrated Fire Management

The protection of the world's environment cannot be effective without national and international fire management policies for natural, semi-natural and cultural landscapes and ecosystems that constitute an essential part of the habitable landscape, contributing to the functioning of the global 'life support' system. National and international policies must be designed to meet the specific local and the common global threats from wildfires, to curb excessive application of fire in land-use change and to promote the ecologically sound and sustainable application of fire in ecosystem management and land use. These policies must take into consideration the cross-cutting issues such as emissions from vegetation fires and their impacts on atmosphere, climate, human health and human security, and must be developed cooperatively with all the stakeholders involved in the sustainable use and protection of the environment and humanity. The 5th version of the International Wildland Fire Conference in Sun City, South Africa, 9-13 May 2011 aimed to address all these issues by bringing together interested and affected parties from various backgrounds (http://www.wildfire2011.org/).

The conference was conducted under the auspices of the United Nations' International Strategy for Disaster Reduction (ISDR) and the Food and Agriculture Organization of the United Nations (FAO), and convened by the regional sub-Saharan Wildland Fire Network, AfriFireNet. Around 500 people from over 60 countries participated at this event.

Building on the outputs of the previous International Wildland Fire Conferences (Boston 1989, Vancouver 1997, Sydney 2003, Seville 2007), the objectives of the 5th conference were to:

- Provide a forum for fire management leaders, politicians, professionals, researchers and practitioners worldwide to discuss critical fire issues affecting communities, resources and ecosystems and work co-operatively on the consolidation of a global wildland fire management strategy.
- Strengthen the effectiveness of the Regional Wildland Fire Networks and support their links into the UNISDR Global Wildland Fire Network.
- Strengthen international cooperation and exchange in Fire Management practice.
- Provide a platform for the fire management industry, research organizations and fire specialists to display innovations, new technologies, products and methods for wildland fire management, as well as interact with the conference participants (http://www.wildfire2011.org/).

In order to stimulate participation from the fire management community, especially from developing countries, FAO sponsored several participants who wrote a paper for the conference. These papers together with other papers dealing with FAO fire management activities presented at the conference are bundled in this working paper. In total 15 papers and an opening address were prepared and presented in this document, see the table of content.

Among them are two plenary papers which were developed at the request of FAO. One paper by Dr Kilahama regarding Integrated Fire Management and Reduced Emissions through Deforestation and Degradation Programs (REDD plus) which highlights the potential and need for REDD plus programs to include more fire management including Community Based Fire Management. The other plenary paper by Dr. Williams et all. Is a survey of so called megafires, analyzing contributing factors. This paper established a relation between droughts and vegetation management on one hand and on the other the occurrence of megafires. This indicates that we can expect more megafires with climate change and need not to limit our efforts fire suppression, but also to forest and landscape management.

The table of contents of this document with the thematic and regional session papers represent many different aspects of fire management in different places of the world and as such represent the Integrated Vegetation Fire Management approach which FAO through the Fire Management Voluntary Guidelines tries to promote. Many of the papers deal also with Community Based Fire Management (CBFiM) and the links between fire and poverty alleviation, issues of high importance for the many developing countries FAO is assisting. FAO also supported two papers on indigenous fire management considering it to be a neglected field which needs more attention.

Support to papers for the regional sessions was concentrated in the regions where the Forestry Department helped establish regional networks: Mediterranean, Near East and South America.

The papers represent the diversity and unique contexts of Fire Management activities supported by FAO around the world, as well as the interdepartmental cooperation at FAO between the Departments of Forestry and Nature Resources (paper by Davis et al); the Emergency group of the Technical Cooperation Department (paper by Chavez), with the National FAO representations and sub-regional offices (papers by Phiri, Helal, Chavez and Truesdale), and with other institutions like NASA and the University of Maryland (See paper by Davis et al).

The stand at the conference was designed together with the Department of Natural Resources to demonstrate FAO's collaborative approach in Fire Management (Figure 1: Wall poster design of boot).

Figure 1: Wall poster design of boot

design by Roberto Cenciarelli and Ane Gaudert


GFIMS
Global Fire Information System
Global monitoring of satellite-derived (MODIS) active fires and burned areas
FAO's Global Fire Information Management System (GFIMS) for data and information dissemination.
Fire early warning service
Free near-real time E-mail fire alerts for registered users and areas of interest.
What's burning where
Assessment of fires by land cover types, integrating the historical archive of fires (2001-current) with global (Globcover 2005) and national (Africover) land cover databases.
www.fao.org/nr/gfims

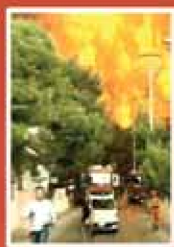

CarboAfrica
Carbon cycles and fire in Africa
International consortium of 15 institutions, including FAO, funded by the European Commission. It aims to improve the understanding of the carbon cycle in Sub-Saharan Africa, considering also fires.
Quantification of the African fire-related emissions Fire
is the main contributor to the Africa's carbon emissions. Fires release in the atmosphere almost one gigatonne of carbon per year, which is around half of the global fire emissions.
Integrated methodological approach
Combination of remote sensing and process-based modelling adapted to the African context for monitoring fires at different spatial and temporal scales.
Fire and humans
Detection of relative importance of climate and human components in determining fire regimes.
www.carboafrica.net


Strategy to Enhance International Cooperation
To enable implementation of fire management programs and reduce the detrimental impact of fires:
Fire Management Voluntary Guidelines
including the Principles and Strategic Actions developed with multiple stakeholders
Fire Management Actions Alliance
for implementing the Voluntary Guidelines
Global Assessment 2006
Review and analysis of fire management, incidence and impact in all regions, with global analysis
Review of International Cooperation 2006
Review of priority themes, key actors activities and scope for future international cooperation in fire management

Integrated Fire Management

Integration of:

- All fire management related activities, from prevention, preparedness, suppression, moni toring, to restoration etc
- All involved actors (forest service, land and forest managers, policy makers, civil defense, fire fighters, policy makers etc)



- All kind of vegetation fires (forest, peatland, agriculture land, savannas, wildland urban interface etc)
- Wildfires and management fires

Challenge:

- Integrating fire management in forest and landscape management
- Fire management and climate change
- Traditional fire knowledge and practices

Capacity Development at Country Level

Main FAO project elements:

- Awareness raising
- Policy review
- Legal framework review
- Early warning
- Community based fire crews

Training workshops on:

- Community based fire management
- Integrated Fire Management
- National Fire Management Action plans
- Use of the Global Fire Management Information System

OPENING ADDRESS

Jose Antonio Prado
Director of Forest Assessment, Management and Conservation Division
Forestry Department
Food and Agriculture Organization of the United Nations (FAO)

Dear colleagues

On behalf of Eduardo Rojas Briales, Assistant Director General of the Forestry Department of the Food and Agriculture Organization of the United Nations, FAO, I want to express our sincere gratitude for this opportunity to address you in the opening of the 5th International Wildland Fire Conference.

First of all I would like to thank the organizers of this event, Afri-firenet, Working on Fire, the Government of South Africa and all the members of the International Liaison Committee.

For FAO this a great opportunity to confirm our commitment in supporting developing countries in their efforts to develop appropriate programmes of wildland fire management, a problem that is becoming more complex, due to population growth, to climate change, changed fuel management, and other factors, generating negative environmental and social impacts.

Fire has a critical role to play in nature and in land management. On the one hand, in maintaining fire dependent ecosystems and providing an important and cost-effective land use tool, while on the other, in causing deforestation, forest degradation, emissions of greenhouse gases and taking lives and destruction of livelihoods, biodiversity and infrastructure.

There are many indications that the African continent is the most affected by wildfires, but the information is, in most cases, incomplete and inaccurate. This is a common situation around the world. FAO and other organizations, particularly UNISDR and GFMC, are undertaking important efforts to obtain more complete and reliable information on the occurrence and damage produced by wild fires around the world.

To obtain better information on the occurrence, scope and damage generated by wild fires is one of the key challenges to attract more resources to reduce the negative impacts of fires across all vegetation types, including forests, woodlands, shrublands, grasslands, agricultural lands and the rural-urban interface. Politicians and policy makers are more likely to accord the necessary priority and resources when presented with clear and indisputable data and information. If we look at the Forest Resources Assessment (FRA 2010) that FAO produces every 5 years, we can note that fire information provided by countries is very scarce. In Africa, for instance, more than 40 countries do not provide information on areas affected by fires. This situation must be improved.

During the last decade, mega fires are affecting different parts of the world. Climate change is generating conditions that favour the expansion of uncontrolled fires, producing enormous economic and environmental damages, affecting directly and indirectly the livelihoods of millions of people. Human activities even in tropical forests, that use to be almost immune to fires, have generated important changes, with unpredictable but clearly negative consequences from the occurrence and intensity of forest fires point of view. Megafires and the increasing occurrence of fires in tropical regions impose new challenges to the wildfire management community.

New and more holistic approaches are needed, connecting a whole range of related activities: adapting our policies and management planning and practices to climate change in land management; sustainable natural resources management (including sustainable forest management); agricultural and pastoral activities as well as the mechanisms being developed under the UNFCCC to reduce deforestation and forest degradation. REDD+ mechanisms may play an important role in reducing fire occurrence and damage in many countries of the world. Fire management policies, plans and practices from early warning, early detection, prevention, preparedness, early response for suppression and restoration of burned areas have to be inserted in a broader framework at local, national and international levels. To face this problem, a far greater investment is needed in addressing the causal factors for fire and designing appropriate prevention and preparedness interventions, working with fire management authorities; involving other sectors; community organizations and the general public. Mega fires also impose new challenges in terms of forest management, silvicultural interventions and prescribed burnings, in order to reduce risks and vulnerability to major fires.

There is a real need and a clear opportunity for increasing and strengthening international collaboration and cooperation including the exchange of technologies, experiences and information, and operational harmonization allowing for more effective trans-boundary collaboration.

FAO, being an UN organization dealing with wildfires has been supporting countries in different ways in their efforts to organize their fire management programmes and to reduce the occurrence of wild land fires and their impacts. Besides assisting developing countries in capacity building, piloting and demonstrating integrated fire management and community based fire management approaches FAO is taking the lead in addressing the root causal factors for megafires, along with its continuous effort to promote cooperation and collaboration at different levels. This conference could consider establishing an international, intersectoral task group to continue this work to further analyse the causes and to develop strategies and the adaptive management needed to address the megafire phenomenon. Mr Chair, FAO commit to work with interested partners towards this end.

From the normative point of view, FAO has produced guidelines aiming at both the technical and policy making levels, and in collaboration with the UNISDR Global Wildland Fire Network has been promoting a strategy to enhance international cooperation, in order to stimulate improved fire management and reduce damage from fire worldwide. Like in Sevilla 2007, FAO makes a call to countries, organizations and communities to continue to adopt the guidelines that were prepared by the most influencing forest fire experts of the world, with support of FAO. These guidelines, translated to 10 languages, have been already adopted by many countries as the bases for their fire management policies and programmes.

These non-binding, voluntary guidelines provide an international framework of key principles for the formulation of policy, legal, regulatory and other enabling conditions and strategic actions, allowing countries to establish more integrated approaches to fire management, including early warning, prevention, preparedness, suppression and restoration after fires.

FAO makes a call to countries and the wildfire community to consider this integrated approach as a way to reduce the impact of fire on local communities' livelihoods; as a way to reduce extreme poverty and hunger and to ensure environmental sustainability.

Ladies and gentlemen,

FAO has actively participated in the organization of this 5th International Wild fire conference being certain that it will provide an excellent forum to further advance more effective and efficient ways to reduce unwanted fires and to further promote collaboration in disaster reduction at national and international levels.

To finalize, I just want to reaffirm FAO's commitment to support developing countries in strengthening their fire management capacities. One of FAO's priorities is to reinforce its fire management programme. FAO counts on richer member countries and organizations to support the countries with high needs of capacity development to reduce occurrence and damage of wild fires.

Dear colleagues, I wish you a very successful conference.

PLENARY PAPERS

PLENARY PAPER 1

INTEGRATED FIRE MANAGEMENT AND REDUCED EMISSIONS THROUGH DEFORESTATION AND DEGRADATION PROGRAM (REDD PLUS)

By

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EXCECUTIVE SUMMARY

Reducing Emissions from Deforestation and Forest Degradation in developing countries (REDD) is a global effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD Plus" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. The paper briefly outlines the REDD Plus Program and explains how fire (good and bad) impacts (positively and negatively) greenhouse gas emissions from deforestation and forest degradation and contributes to wider land-use management. It highlights how the integrated fire management and community based fire management approaches as detailed in the Fire Management Voluntary Guidelines are assisting Tanzania to achieve the aims of REDD Plus and lessons to be learned for other countries. The paper outlines examples of where fire is being used to achieve REDD Plus outcomes in Tanzania and potentially in the Southern Africa (SADC region).

Key words: *Forests, fire reduction strategy, management regimes, carbon stocks, livelihoods, Miombo woodland, Southern Africa, REDD plus and local communities.*

1.0 Introduction

Tanzania is among the tropical countries which are endowed with forest resources. Forests and woodlands cover about 33 million hectares, which is about 40% of the total land area (MNRT, 1998). According to Campbell (1996) the Miombo woodlands (wet and dry) is estimated to be the most extensive tropical seasonal woodlands covering about 2.7mil km^2 (270mil ha). In Tanzania almost 75% of the mainland area is characterised by the dry Miombo woodlands and savannah grasslands although some wet Miombo species also exist especially in the western part of the country.

The forests are undergoing various deforestation and degradation at the rate of 420,000 ha per annum (FAO, 2005). The average annual rate of woodland loss in the Miombo Region varies between 0.2 per cent and 1.7 per cent a year. The main reasons for such land-use change apart from conversion to agriculture and settlement (Williams *et al*., 2008), include the extraction of fuel-wood to meet rural household energy needs (Chidumayo, 1995;) and charcoal making for urban consumption. In these processes substantial amount of CO_2 is added into the atmosphere. According to FAO (2005) in year 2000 about 9,200mil tones of biomass globally were gutted by fire and 42% being in Africa. In the process about 3,431mil tones of CO_2 as well as other emission gases were released into the atmosphere

It is also estimated that wildfires destroyed more than 65,000 ha of forests and other wooded areas (Aloo, 2001) with an annual loss forest resources of about 7 billion shillings. Most of these wildfires occur in Miombo woodlands (75%), followed by forest plantations (20%) and least in high forests (5%). These percentages indicate that forest degradation from uncontrolled fires alone contribute significantly to the total causes of forest land degradation on Tanzania mainland. On the other hand, there have been no deliberate systematic efforts to determine the type and extent of bushes and forests related fires including forest-based risks in Tanzania (Hall and Gwalema, 1985; Madoffe *et al*., 2000). Although Burgess *et al*. (2005) and MNRT (2005) ranked uncontrolled forest and woodland fires as the most devastating factor in the Eastern Arc Mountain area, still there has been no sufficient data that could help to design an integrated fire management strategy for that matter. Experiences show that the fires are causing devastating effects to water sources, biodiversity, loss to property and sometimes to humans and wildlife.

2.0 Forests and Carbon Sequestration

Forests & woodlands cover about 30% of the total land areas worldwide however, these forest & woodland resources account for about 50% of the terrestrial carbon stocks and provide capacity to sequester around 33% of the human activities caused GHG emissions especially CO_2. Deforestation and forest degradation through fire does not only transfer CO_2 directly to the atmosphere by combustion, but also destroys a valuable mechanism for controlling atmospheric CO_2 (Jeffrey *et al.,* 2001) through ecological services such as carbon sequestration. In the savannas woodland the carbon sequestration rate (net ecosystem productivity) may average to 0.14 Gt C ha^{-1} $year^{-1}$ or 0.39 Gt C $year^{-1}$, hence if it were to be protected from fire and grazing, most of them would accumulate and carbon sink would be larger (Grace *et. al.,* 2006). In principle this is what REDD+ mechanism aim to achieve by avoiding human activities that would lead to destruction of carbon stocks. Generally it is anticipated that global deforestation rate is about 13mil hectares $year^{-1}$. How to reduce such significant rate of deforestation becomes a global challenge. Therefore, it is a global concern whether **Reduced Emissions from Deforestation & forest Degradation (REDD+)** mechanisms would produce tremendous differences by making avoided deforestation and forest degradation an achievable outcome within the foreseeable future?

3.0 Reduced Emissions from Deforestation and Forest Degradation (REDD Plus)

Globally, Green-House Gasses (GHGs) that are mainly due to human activities have increased by 70% in the past 30 years. Large growth of (GHGs) emissions is a result of uncontrolled human socio-economic activities mainly from energy supply, transport, and industries. According to the Intergovernmental Panel on Climate Change (IPCC) Global Assessment Report (2005) the forests and woodlands contribute to about 18-25% of the global GHG emissions due to deforestation and forest degradations much of this happening in sub-Saharan African.

Reducing Emissions from Deforestation and Forest Degradation (REDD+) in developing countries ***is a global effort to create a financial value for the carbon stored in forests***. This would offer opportunities for incentives to motivate developing countries to reduce emissions from forested lands thereby investing in low-carbon paths to sustainable development. Furthermore, “REDD Plus” (or REDD+) goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. This means that REDD+ is a mechanism (policy approaches and positive financial incentives) to support the voluntary efforts of developing countries to mitigate climate change by avoiding deforestation and/or forest degradation (i.e. keeping more trees alive than having them dead) would reduce CO_2 emissions from deforestation and forest degradation, promoting conservation, sustainable management of forests, and enhancement of forest carbon stocks.

REDD+ can therefore, provide benefits for climate improvement (through adaptation & mitigation functions), to local communities and improve biodiversity conservation as well as enhance other ecosystem functions through effective resources management and governance mechanisms. It is crucial that REDD+ be embedded into the national forest development programme as well as the country's strategy for economic growth and poverty reduction in order to enhance carbon sinks for results based carbon payment system. Quantifying CO_2 could be easily done through established national Monitoring, Reporting and Verification (MRV) system under the National Carbon Monitoring Centres and Carbon Accounting Systems. Furthermore, deliberate efforts should be undertaken to build capacities of local communities to take on MRVs for forests and woodlands found within their areas. Once they perceive this correctly and with proper understanding of the global intentions to reward good performance in terms of forest and woodland conservation, they will definitely take actions to protect the forests and woodlands from catching fires. Also the need to encourage and promote private sector investments in forestry development activities should be a priority. This is because over the long term such investments would reduce incidences of fire in rural areas as more people will take care of (protect) their investments.

4.0 Sustainable Forest Management and Fire

4.1 Causes and Effects of Fires

In Tanzania, the use of fire to clean farms (slash & burn) is considered to be the principal agents of deforestation and forests & woodlands degradation and more prominent in the Miombo (Stromgaard, 1986). Fire is widely known to influence the structure and composition of some ecosystems including grasslands, closed forests, woodlands and savannahs (Goldammer, 1990; Tyler, 1995). It is also known to influence the development and maintenance of some faunal communities (Whelan and Main, 1979; Madoffe, *et al,* 2000). Thus, the need to use fire carefully to meet particular needs of the human race cannot be overemphasized.

Most bushfires in the Miombo and grassland ecosystems are a result of uncontrolled human activities particularly preparation of cropping fields (URT, 1998), which accounts for about 36% of fires in Tanzania. Other major causes include game hunters who are responsible for about 27% of bush fires, either set fire on biomass deliberately in order to drive wild animals to intended destiny or to attract them later to the re-growing grass on burnt areas for an easy catch. Furthermore, honey hunting & collection responsible for about 5.5% is another causal factor for wild fires on the mainland. Some beekeepers, in the process of harvesting honey, use smoke to drive away bees but often do not extinguish the fires, which lead to accidental or unwanted fires. For livestock keepers setting deliberate fires in grasslands is meant to improve pasture quality and in some areas to eradicate parasites such as ticks or tsetse flies (Fitzgerald, 1971). Charcoal burning in Tanzania is also noted as a serious human activity that leads to forest degradation especially within 200-300 km radius around the major urban areas. Other activities like mining and pit sawing (Poulsen, 1975) as well as controlled burning (prescribed biomass burning) especially in forest plantations including game reserves and national parks, at the beginning of the dry season, is done to reduce amount of biomass and therefore, maintain conditions that could not lead to accidental fires from pedestrian (smokers) and arson induced fires. In the process substantial amounts of CO_2 are emitted into the atmosphere.

In some parts of Africa lightning could be a significant ignition source for wildfire or bushfire for example, in Western Namibia (FAO, 2007), where 60 percent of all fires are a result of lightening (electrical storms). On the other hand, in most incidences of fires are started by some people for reasons known to them as mentioned above but some do cause fires to amuse themselves (cultural believes e.g. *in Tanzania some tribes believe that if one starts the fire and it ends up gutting and spreading to a large extent such a person is bound to live a long life*). Considering the fact that the use of fire by our ancestors played an important role in shaping the environment in Africa for hundreds of thousands of years, one could come to the conclusion that people are also, in a way, a ‘natural’ cause of fire (FAO, 2007).

As mentioned earlier on, fire is widely used in African for various human induced activities however, planned fires (e.g. for cleaning cropping fields) are often left unattended thereby resulting in outbreaks of uncontrolled and destructive fires. Therefore, negligence is the most common cause of fire throughout Africa. Arson fires believed to account for 14% in Tanzania, may be caused by various reasons including but not limited to cultural or religious beliefs, civil unrest and personal anger or fears of wild animals or enemies (forced to burn the bush in order to open up the area and increase visibility). In essence and according to FAO (2007), the basic underlying cause of frequent arson fires is the problem of property (land resources including forests) ‘***ownership***’ or tenure. In most countries of Africa South of the Sahara, the land belongs to the state (in Tanzania land is a public property under the Trusteeship of the President) or to an anonymous company, and most benefits realized from use of land resources never reach the local population. In that context, no sense of responsibility is created for the sustainable use of natural resources and the environment.


Photo 1: Incidences of Fires in Forest Plantations in Tanzania

There are 16 industrial plantations in Tanzania, and fires have been a big challenge in some of the plantations. Uncontrolled fires from neighbouring villages or communities, assisted by strong winds, escape and enter the plantations and thereby cause very significant losses. For instance, in 2009 fire (*as seen in the pictures above*) destroyed more than 1,600ha of compartments of *Pine* spp. aged between 3–20 years worth about TAS 876 million. In 2010 the Green Resources Company (GRC) operating in the Mufindi District lost about 1,900ha of young *Pine* and *Eucalyptus* plantations (1–12 years) with an estimated loss of about 10mil USD or about 10bil shillings. The cause was considered to be arson and the entire area must be re-established.

According to IPCC (2007) Africa is a fire prone continent and most of the forests and woodlands including the savannah grasslands especially in those countries South of the Sahara are prone to unpredictable annual wild fires. It has been a tradition that incidences of bushfires are common and being rampant in every country particularly in the SADC region (see Fig.1). Also fire mapping records at the University of Maryland, USA and fire monitoring records with the Conservation

International (CI) indicate that most of the SADC countries experience incidences of bush fires during the dry season. Climate change is also a contributing factor to increasing drought in the SADC countries. Accordingly, conditions for bush fires eruption are observed to be increasing in Southern Africa due to impacts of climate change (IPCC, 2007 and Dube, 2007). In 2000, the countries in Southern African region, uncontrolled wild fires affected 742,343 km^2 (over 74.2 million ha) of forests and woodlands including Savannah grasslands.

Most of the countries in the SADC region are characterised by wet and dry seasons. During the wet season growth of plants and other vegetation occurs whereas during the dry season, usually between June and November every year, the loss of moisture is substantial such that occurrence of fires becomes a common phenomenon. As the vegetation become drier especially in the C_4 plants, fire can easily erupt due to uncontrolled human activities. A slight increase in temperatures would favour growth of C_4 plants, whose biomass is believed to catch fire more easily than the C_3 plants. In 2009 fires were rampant in the Southern Highlands of Tanzania as seen in the pictures below:

Photo 2: Incidences of Wild Fires in the Southern Highlands of Tanzania (2010)

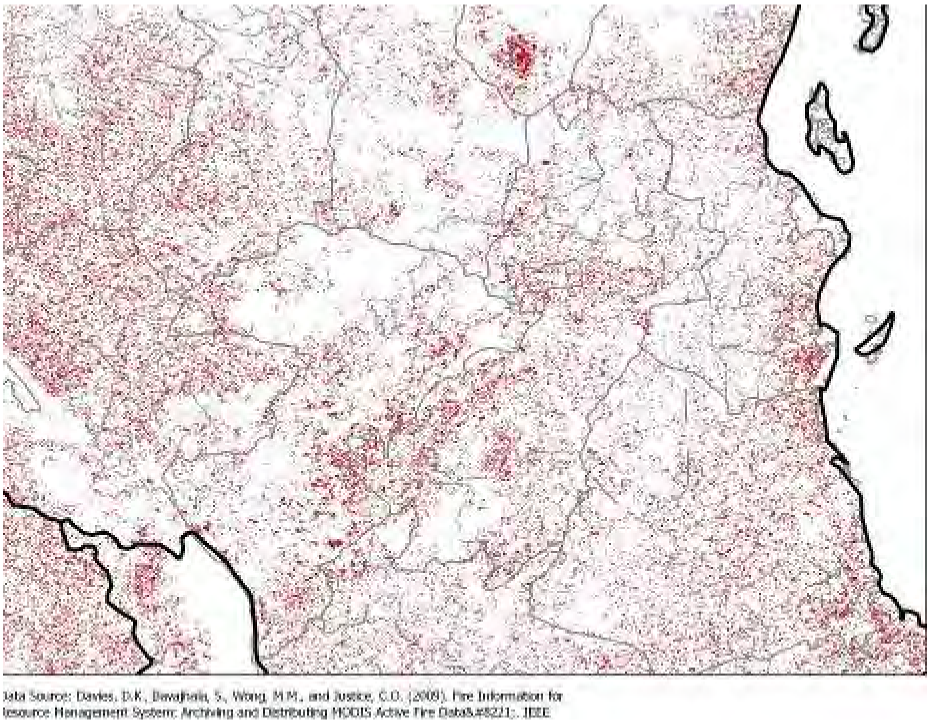

Figure 1: Incidences of Fire in Different Areas of Tanzania (2005)

Past records (through the MODIS technology) show that between year 2000 and 2009, Tanzania lost, on average, 65,000 HA OF FORESTS AND WOODLANDS year^{--1}.

4.2 Fire Management Strategies

National Strategies to deal with effects of wildfires include undertaking a rigorous campaign to educate the villagers and communities so that they could handle fire more carefully. In addition, the villagers adjacent to the industrial plantations are sensitized and assisted to establish fire brigades and educated and enabled to acquire some fire fighting skills. The need to have a strong and fire-sensitive local community cannot be over-emphasized. Most of the bushfires originate from local community settlements. Therefore, in order to reduce incidences of fire within the country and across the borders, we must change the attitude and the way the local communities' use and manage the fires in the areas of jurisdiction. Local people should be sensitized and educated about what REDD+ is all about and what benefits they could get if the implementation of REDD+ activities would be appropriately carried out and attain intended performance levels.

Management of forests and woodlands and other natural resources is guided and influenced by appropriate national policies and legislations. According to the Forest Act (Cap 323 RE: 2002) sections 70–76 issues related to wildfires with clear restrictions on burning of vegetation are predetermined (URT, 2002). The Act requires any person intending to use fire especially during the dry season, for any activity must give notice of his/her intention, in writing on the use the fire i.e. to prepare the farm land or for any other needs, and that notice should be delivered to relevant authorities. Both the Forest Policy and the Act prohibit use of fires in forested lands (be reserved or unreserved). Nevertheless, despite the policy and the Act being clear on aspects of wildfires, enforcement has always been very weak due to inadequate staffs and financial resources.

Fire is a first step to and major driver of forest degradation diminishing forest carbon storage capabilities (change of carbon density). Also, Fire is a threat to various REDD+ building blocks (i.e. Permanence, Additionality & Leakage). The National Forest Policy (URT, 1998a) makes reference to fires as being one of the major threats that leads to degradation of forests and woodlands, which means interfering the permanence & additionality of carbon stocks. The policy clearly underscores that uncontrolled wildfires cause detrimental effects to the environment including killing of various tree seeds hence inhibiting natural regeneration and therefore, resulting in permanent deforestation unless reforestation is carried out. However, the Forest Policy gap as far as fire is concerned is that there are no specific provisions for the Policy Statements to guide wildfire management. On the other hand, the 1998 forest policy is clear on empowering local forest adjacent communities to become the custodians and managers of forests and woodlands through the Participatory Forest Management (PFM) initiatives. Through this policy initiative the local communities in Tanzania have been able to establish more than 4.2mil ha of Village Forest Reserves and enhanced their participation in forest management including taking appropriated strategies to safeguard the forests against fires and encroachment. However, the challenge lies on the policy not being clear on the benefits sharing. Also the way PFM is financed mainly through the development partners' support, which is unsustainable in spite of the fact that the forest sector in Tanzania is not among the key priority sectors for resources allocation. The global initiatives would add value through REDD+ and as important efforts to create financial mechanisms to support developing countries like Tanzania to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. Empowerment requires government commitment and synergy with other policies such as Land, Agriculture, Energy, Water, Livestock, Environment, Land-use & Land-use planning, Regional Administration and Local Government, Wildlife, Beekeeping, Mining and Infrastructure. The policy does not provide scenarios on how common land problems are going to be solved in the context of frameworks of other related policies and legislations.

The Wildlife Policy of 1998 (URT, 1998b) is the basis for the conservation and management of wildlife and other biodiversity resources in Tanzania. The policy clearly states strategies and seeks to minimize the damage to wildlife habitats caused by wildfires. Another strategic approach is lies on the prescribed fires (early burning) for management of Protected Areas (PA) according to the Management Plans (URT, 1998b). The wildlife policy also advocate establishment of Wildlife Management Areas (WMAs) that are managed and controlled by local communities. Such initiatives are another step in reducing fires originating from areas outside PAs including public lands.

Other relevant policies and acts include the Beekeeping Policy (1998c) and Beekeeping Act (2002), which does not address wildfires originating from outside the bee-reserve; the National Environmental Policy (1997) does not treat wildfire as an environmental problem of its own but it seems to be combined with other factors resulting to land degradation (URT, 1997a); The National Agriculture and Livestock Policy (1997b) advocates that agriculture operates in a delicate natural environment that requires proper management and protection. Apart from pastureland, wildfire is not explicitly mentioned in the policy besides land preparation with the use of fire being caught up to be one of the main causal factors of forest and woodland destruction. Again, fire management is not addressed in the National Land Policy (1999) but discourages shifting cultivation and uncontrolled livestock movements, which are amongst the main sources of fires in different ecosystems in Tanzania.

The policies cited above however, do not explicitly say how best wildfire could be contained. This is a gap that needs immediate attention if all we should contain and eliminate the wildfire. Also no evidence in policies and acts on how the synergies and collaboration with other land use sectors could be achieved. In most cases, sectors have operated independently including those under the same ministry such as the forestry and wildlife divisions. This has diminished the chances of attaining successes in managing and reducing the fires during the dry seasons over the years. Instead, lack of effective coordination and cooperation amongst the sectors, dealing with land issues has, therefore led to natural resources management conflicts including failures to address and contain wildfires in situations where natural ecosystem services are severely disturbed by rampant annual bush fires.

The major challenges are centred on the land based policies and acts including their inability to deal with issues related to wildfire management and conservation of PAs. Furthermore, traditional attitudes, socio-economic activities and, to some extent, disincentive factors to the local communities such as lack of clear regimes for property rights and tenure also contribute to failure to attain sustainable natural resources management. For example, in situations whereby the local villagers are not allowed to collect such forest produce like firewood, mushrooms or traditional medicines from the adjacent natural forest and/or forest plantation could aggravate their anger to set the resources on fire as they would tend to detach themselves from the reality hence, do not care too much about the forest regulations but end up setting the resources on fires as an indication of their disappointment.

Despite these and other challenges not mentioned here, the FAO Fire Management Guidelines (2006) though regarded as voluntary, they provide a firm basis for the fire prone counties like Tanzania, to organize themselves and take effective strategies to manage and contain incidences of fire in various localities. The guidelines also provide a framework for countries to improve fire management through education, training, awareness raising, extension and information sharing services. It is therefore a question to how and what extent the guidelines are used and whether they have made any impacts as far as use of fire for various human activities is concerned. There are no evidence in Tanzania to demonstrate that the FAO fire management guidelines have been put to use.

The lack of information on carbon stocks and the impacts of the frequent disturbances from annual bushfires and the manner people are using the Miombo woodland resources becomes an impediment to the development of appropriate management mechanisms (Williams *et al*., 2008). Fire management varies from different localities and public education is inevitable to practise good fire management approaches. Anderson and Smith (1976) and Brown and Davis (1993) proposed that fire could be prevented by education to the public, bonus system, regulation of public uses and law enforcement. Fire can also be reduced by extension services to people in the surrounding villages; frequent patrols, legislation and early burning by forest workers (Lulandala *et al.*, 1995**)**. Although it is reported that integrated fire management has proved to be an effective mechanism in several tropical countries (de Ronde *et al.*, 1990; Goldammer, 1993) the situation of fire during the dry season in African countries is alarming.

4.3 Engagement of Local Communities in Fire Management

Efforts to combat forest fires in Tanzania and possibly elsewhere in Africa are hindered by lack of integrated fire management policies of land-based sectors including ineffective legal instruments to support fire prevention and suppression strategies. Also inadequate institutional capacity in terms of technical and professional staffs as well as financial resources, leads to failure to manage the fires accordingly. In that context: engagement, collaboration and involving local communities in integrated fire management should be encouraged (Bond, *et al*., 2010; Nsoko, 2002) as a matter of priority in managing and suppression of wildfires. The local communities in Tanzania have good own natural resources management systems (e.g. the ***Ngitili*** (meaning enclosure) mechanism (Kilahama, 1994) practiced by the Wasukuma tribe in Shinyanga & Mwanza regions south of Lake Victoria). The ***Ngitilis*** are normally individually owned and based on local beliefs and traditions however, the Village Governments and local institutions like the Community-Based Organizations (CBOs) and their traditional governance systems: could establish communal ***Ngitilis*** on degraded woodland areas to re-establish foregone ecological services but also to enhance forest fire management that complement local ecology and traditions (Nsoko, 2002; MNRT, 2005). The Local Communities could be engaged through:

- Joint Forest Management (JFM) and Community Based Forest Management (CBFM) strategies and through signing of Memorandum of Understanding MoUs through, which heir roles and responsibilities would be defined hereby empowering them to take charge of forest and woodland resources within their areas and guarding them against fires;
- Encourage and where necessary facilitate Village land-use plans to enable the villages take proper control over the resources available within their land boundaries and use them effectively for their socio-economic advancement;
- Undertake effective measures to enhance & strengthen land tenure rights (increasing tenure security to local communities) through policy and legal reforms. This would reduce incidences of fires as the people become aware that they are the owners and beneficiaries of land and other resources thereon;
- Encourage and empower the villagers to undertaking income generating activities such BEEKEEPING or CONSERVATION OF EXISTING NATURAL FORESTS and/or *undertaking tree planting (reforestation/aforestation) activities that could be rewarded through REDD+ payment mechanisms and/or others like CDM* or *non-carbon arrangements such as payment for water or environmental services (PWS/PES)*;
- Build local community capacity to handle and manage fire accordingly. This would entail sensitizing and educating rural dwellers to understand negative effects of uncontrolled fire especially during the dry season. This should be part of promoting stakeholders' engagement in

natural resources conservation and management. The process should also open doors for political interactions thereby supporting Free, Prior and Informed Consent (FPIC) as a way of improving governance and transparency. We should not take it for granted that local communities have no knowledge or education hence cannot comprehend matters. What is needed is dialogue and increase interactions and campaigns to enhance their understanding of REDD+ issues and what the communities could benefit however, doing it cautiously with the understanding that REDD+ is not in itself everything or seen as a panacea. The results from some REDD+ pilot projects in Tanzania (i.e. TFCG, WWF, TaTEDO and Mpingo Conservation Group) will be used to compare the status of fire between areas with and without NGOs interventions: and will form a basis for debates on the influence of fire on forests and climate change. The results will also be useful on the aspects of empowering local communities to manage forests for improved livelihoods through climate change mitigation and adaptation mechanisms;

4.4 Challenges in Incorporating Fire in Management into REDD+

In the event of trying to reduce fire hazards in forests and woodlands as well as encourage local communities' participation in management of bush/woodland fires the following challenges are anticipated:

- Specific details of how REDD+ will be implemented with respect to prevention and management of fires in forests and woodlands are missing. However, different fire management practices in different ecosystems could be practiced to determine emissions and changes in forest carbon stocks hence provide some insights on REDD+ and expected outputs (performance based scenarios);

- Addressing Governance issues and building capacities at the local level are among the most important challenges needing immediate attention not only to Tanzania but Africa as a whole;

- Lack of baseline data about fires that have occurred over the years and emissions resulting from fires makes planning to combat fire difficulty also leading to designing unrealistic strategies. For future mapping and good planning for fire management, there is great need to establish baseline data, which is currently unavailable (i.e. location of fire incidence, day & time of occurrence, what caused the fire, direction & speed of wind and the extent of damage including efforts to suppress the fire);

- Lack of equipments and tools needed to address properly the bushfires for instance, in Tanzania, control of both ground, surface and crown fires is very challenging due to the type of tools deployed to fight or suppress fires. For instant, data on the wind direction and intensity of heat could be useful to plan fire attack but in most cases not available. The commonest tools used are fire beaters, which make it difficulty to approach intense fire. Fire beaters never suppress crown fire. In that context, it would be very difficulty to manage and suppress fire accordingly. Tanzania looks forward through SADC support to install a satellite dish that will provide all-important information in monitoring forest fires as well as suppressing it (which include temperatures, wind direction, humidity and wind speed). The need to measure the extent of damage and hence provide information on the amount of degradation and emissions from specific fires cannot be overemphasized;

- A fire Monitoring and Management Tool for use in the SADC region be developed possibly consisting of satellite and ground based approaches. Furthermore, an Integrated Forest Fire Database Management System (FFDBMS) to help manage data on fires also be developed and used in the SADC region. There is need to have a SADC fire mapping strategy to ensure that cross-border fires are well contained and effectively managed. A SADC integrated fire management whereby the roles & responsibilities of each member state should be defined with the view to reduce incidences of fire across the SADC region.

5.0 Conclusion and Recommendations

5.1 Conclusion

Fire Management must be an integral part of REDD+ activities (i.e. SFM, conservation, community based efforts) to reduce major drivers of deforestation & forest degradation to enhance forest carbon stocks. The prevailing inadequate financial resources, infrastructure and equipment including acute shortage of skilled human resources make fire management efforts in the SADC region unrewarding. The gap between the level of preparedness in fire management and the increasing negative effects of fires is an area requiring an immediate response through capacity building. **Implementation of integrated fire-management approaches face difficulties and obstacles including lack of funding and integrated sustainable fire-management strategies**. Since fire management in Africa is not limited to the forestry sector alone, it is therefore important to involve all the relevant sectors and major stakeholder groups in the management and fight against bushfires.

Each country in the Sub-Saharan African region should analyze its fire situation and develop a strategy for integrated fire management. In some countries, more effective action against arsonists might be an important part of the solution, while in others (e.g. Tanzania with emphasis on local community engagement), awareness of fire prevention and control need to be increased. **An overall strategy would include budgetary allocation; monitoring and reporting; an early warning system; community-based fire management approaches; preparedness; progressive legal, policy and planning frameworks; collaborative agreements with and between countries; capacity-building; fire danger rating; rapid response in fire suppression; and restoration of damaged areas following fire events (response on REDD+**).

5.2 Recommendations

(i) There is need **to establish baseline data** on current fire regimes, in order to have a clear **basis for assessing and monitoring any future changes and trends in fire and emission patterns**. Baseline data is one of challenges facing Tanzania. However, with SADC assistance we will, in the near future, be able to have a database of all fires in Tanzania, which will assist the forestry authorities to monitor and calculate some changes in the levels of emissions from annual fires;

(ii) A **holistic fire Management approach must be an integral strategy of REDD+** in order to address forest degradation, leakages, secure permanence and reduce direct fire emissions across the SADC region;

(iii) **Training of local people and facilitate them as part of local capacity building,** to take on records and report on forest fires accordingly should be a priority in the SADC Region. This approach will supplement the satellite-based data;

(iv) **Develop and adopt the Fire Management Strategy as a tool for Climate change mitigation and adaptation** for the Miombo and other forested areas. The FAO fire management voluntary guidelines of 2006 would be a useful tool to fulfil this requirement;

(v) **Articulate fire monitoring protocols** which could be used by different actors in the SADC region with emphasis on cross border fire management regimes;

(vi) **Increased stakeholders' awareness and understanding of issues**, challenges and opportunity related to Climate change and REDD+ in particular;

(vii) **Capacity building for different actors** on how they could manage forests fires and networking deemed essential undertakings;

(viii) **An Integrated Forest Fire Database Management System (FFDBMS)** for the local forest practitioners be developed and adopted in the SADC region;

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PLENARY PAPER 2

FINDINGS AND IMPLICATIONS FROM A COARSE-SCALE GLOBAL ASSESSMENT OF RECENT SELECTED MEGA-FIRES

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ABSTRACT

In many parts of the world, the number of large wildfires has been increasing at an alarming rate. Among them, so-called "mega-fires" have emerged. These extraordinary conflagrations are unprecedented in the modern era for their deep and long-lasting social, economic, and environmental impacts. This paper examines eight mega-fires from around the globe. It attempts to discern patterns in the causal and contributory factors underlying the mega-fire phenomenon.

The cumulative effects of global warming, the vulnerable condition of fire-prone landscapes, and population shifts into and out of wildland settings are changing the calculus of wildfire protection in many countries. As wildfire risks intensify, this paper suggests the importance of more balanced, more comprehensive wildfire protection approaches that better integrate fire-related considerations into natural resource management strategies at the landscape scale. In this respect, mega-fires have important implications for land managers and policy-makers. This paper's findings provide a basis for more effectively aligning land management policies, plans, and practices across fire-prone landscapes.

PREFACE

This paper was commissioned by the Food and Agriculture Organization of the United Nations under a volunteer arrangement with the authors.

This assessment is not a review or critique of management actions surrounding past wildfires. Nor does it judge the relationship between actions and outcomes. Rather, it is intended to broaden our understanding of the mega-fire phenomenon and identify the factors that underlie these wildfire disasters.

PURPOSE & NEED

Mega-fires are challenging some of the strongest wildland firefighting programs. The growing number of these incidents, along with the ever-higher suppression costs, property losses, and environmental damages, beg a better understanding of the factors that may underlie their occurrence.

In the past, fire operations specialists, managers, and policy-makers in many places have attempted to match increasing wildfire threats with greater suppression force. This approach, however, is not answering the mega-fire problem. Even in developed countries, where, despite enormous investments in larger, more able firefighting capacity, better predictive systems, increased technology, improved cooperation, and larger aviation fleets, mega-fires still occur. The costs, losses, and damages that accompany mega-fires are going far beyond any threshold of "acceptable loss."

Although mega-fires are often perceived as an "accident of nature," or seen as the result of a failed operational response, or blamed on bureaucratic bungling of some sort, the circumstances under which they occur and the factors that fuel them are not well understood. Typically, most after-action reviews or post-fire investigations limit their focus to operational decisions and actions between the time of detection and time of containment. High-profile incidents may examine preparedness issues, but seldom delve much deeper. This paper looks beyond symptoms to explore the causal and contributory factors that seem to underlie these extraordinary high-risk, high-consequence wildfires. A better understanding of these factors may help guide policy-makers to recognize and more effectively address the mega-fire problem. The growing number of large wildfires and the increasing incidence of mega-fires – along with climate change projections for hotter and drier fire seasons - lend urgency to this issue.

INTRODUCTION, BACKGROUND, AND CONTEXT

Although catastrophic wildfires dot history's record, most of them occurred before the inception of organized fire control. In fact, today's large, organized wildfire protection programs were often built on the promise of preventing a repeat of such conflagrations. Many of today's wildland agencies can boast a remarkable success rate in suppressing most wildfires, but the magnitude and intensity of a few extraordinary wildfires that cannot be controlled all but defeat the fundamental objective for protection; to minimize costs, losses, and damages. In the United States, only 1 or 2% of all wildfires become large incidents, but they account for about 85% of total suppression-related expenditures and upwards of 95% of the total acres burned (Williams and Hyde, 2009). Similar relationships exist elsewhere. Among all wildfires, mega-fires are the most costly, the most destructive, and the most damaging. Against the backdrop of global warming, their onset may be signaling that many conventional wildfire protection strategies are "running out of road."

China's 1987 Great Black Dragon Fire perhaps marks the beginning of the mega-fire phenomenon in the modern era. This wildfire claimed the lives of over 200 people and burned approximately 1.2 million hectares (Salisbury, 1989). In Indonesia, a succession of extraordinary wildfires in 1982/83, 1994, and 1997/98 resulted in significant ecological damage. Biodiversity losses and greenhouse gas emissions were nearly incalculable on a global scale. Similar effects in Brazil's Amazon region were witnessed over a period of years, culminating with the Roraima fires, also, in 1998. In the United States, since 1998, at least nine states have suffered their worst wildfires on record. In California, a state fielding perhaps the largest, most technologically advanced firefighting force in the world, multiple large fires claimed dozens of lives and destroyed thousands of homes in 2003. In Australia, a series of disastrous bushfires in early 2003, January 2005, and 2006-2007 were exceeded by the February 2009 Black Saturday conflagration; the deadliest civil disaster in that country's history. This disaster killed 173 people and incinerated whole towns. In Botswana, a severe wildfire in 2008 spread onto the second largest game reserve in the world, disrupting a fragile local economy tied to indigenous grazing and the region's important international tourism base. In 2007, severe wildfires hit Greece, making news around the world. Accounts showed people running for their lives against a backdrop of familiar archeological ruins. 84 people died; some near ancient Olympia. This past year (2010), record-setting wildfires in Russia and Israel were added to the list of internationally known wildfire disasters. Across all of Russia, about 2.3 million hectares burned as a result of over 32,000 fires. Sixty-two people perished and hundreds of homes were lost. In Israel, on the outskirts of Haifa, 42 were killed and much of a treasured forest was lost. Over the past several years, similar catastrophic wildfires have occurred in Canada, South Africa, Portugal, Spain, and Turkey among others.

KEY CHARACTERISTICS OF MEGA-FIRES:

Mega-fires are often extraordinary for their size, but they are more accurately defined by their impacts. Their complexity and their deep, long-lasting social, economic, and environmental consequences make them a serious situation, rather than, simply, a larger incident. Mega-fires are not always a single wildfire, but sometimes a grouping or "complex" of inter-acting multiple fires across a large geographic area. The costs, losses, and damages that come with them seem limited only by the depth of drought, the amount and extent of available fuel, and the extremes of weather.

Mega-fires exceed all efforts at control until firefighters get a favorable change in weather or a break in fuels. Even in countries with modern tools and techniques to combat severe wildfires, firefighters are generally forced onto the defensive; taking action where they can on the fire's terms. Public and political pressures to "do more" are common; no matter how dangerous the situation, nor how slim the chance for control. Managers must be responsive to an anxious public and a demanding media. Someone is to blame and emotions always run high.

Because they burn at landscape scales, mega-fires typically cross ownership boundaries and involve different jurisdictions. Command and coordination functions must accommodate a complex mix of specialists: law enforcement, emergency services, disaster relief, public utilities, and local elected officials...all in addition to rural, volunteer, and urban firefighters.

Mega-fires most severely impact nearby communities, but, they can also have serious “downstream” regional or, even, global consequences. Environmentally, their severity may exceed adaptive limits and interrupt or adversely change energy cycles, water cycles, nutrient cycles, and carbon cycles. In steep, recently burned-over terrain, scorched, denuded hillsides lay vulnerable to mudslides when heavy rains occur before the land can re-vegetate. Adding insult to injury under these circumstances, it is not unusual for post-fire fatalities and infrastructure losses to approach or exceed those from the fire itself.

By virtue of the fire intensities involved, mega-fires tell us something about increased forest flammability. But, by virtue of the growing numbers of recent fire-related fatalities and climbing wildfire suppression costs, private property losses, and natural resource damages, they call into question the efficacy of conventional suppression-centric wildfire protection strategies. Mega-fires are defeating wildfire protection objectives in many places around the world.

METHODS

This assessment used a basic root cause methodology to identify causal and contributory factors that may predispose the mega-fire threat.

Causal factors are defined as those that directly precipitate the outcome. In their absence, the outcome would have been avoided. Causal factors include any behavior, act, omission, or deficiency that starts or sustains an accident, incident, or occurrence. In this case, causal factors answer how the mega-fire started.

Contributory factors are more indirect. They are defined as those factors that contribute to – but do not directly cause – an accident, incident, or occurrence. They are often more subtle; representing any behavior, act, omission, or deficiency that sets the stage for the outcome or increase the severity of the outcome (Whitlock and Wolf, 2005). They may be a considerable distance from the cause, but in a wildfire context, they are implicated in the intensity and spread potential of a mega-fire. The root cause methodology asks “why?” at each node in the process, attempting to reveal the next deepest influence underlying the problem. The deepest contributory factors may be difficult to discern, but they often have a significant influence on the scope and complexity of the problem.
The Food and Agriculture Organization enlisted the participation of wildland fire specialists familiar with recent internationally-known incidents in Australia, Botswana, Brazil, Indonesia, Israel, Greece, Russia, and the United States, to compile background information and frame the assessment’s findings. These eight countries, from both temperate and tropical zones, represent a diverse cross-section of socio-economic conditions, ecologies, and fuel types on several continents.
A standard questionnaire was provided in order to maintain consistency between respondents. The authors acknowledge that different countries have different means of collecting, storing, and evaluating wildfire-related data. Some are still in the process of sorting things out. Therefore, information surrounding these wildfires often varied in detail. Sometimes information was very limited or unavailable.

Finally, the assessment examined two wildfire protection models where mega-fires have ***not*** occurred. The states of Florida and Western Australia, in the United States and Australia, respectively, offer contrasting wildfire protection examples where, despite the presence of drought, mega-fire risks have been much reduced.

KEY COMMON FINDINGS AND OBSERVATIONS

The eight mega-fires covered under this assessment are summarized in terms of cause, area burned, and impacts in Table 1. More detailed information is found in appendices A-H.

Table 1. Summary of Recent Selected Mega-Fires (1997-2010)

<table>
<tr><th rowspan="2">Year</th><th rowspan="2">Country</th><th rowspan="2">Name of Fire or Complex</th><th rowspan="2">Cause</th><th colspan="2">Fatalities</th><th rowspan="2">Area Burned (millions ha)</th><th rowspan="2">Suppression Costs (millions US$)</th><th rowspan="2">Property Losses (millions US$) 2/</th><th rowspan="2">Environmental Damages</th></tr>
<tr><th>Direct</th><th>Indirect</th></tr>
<tr><td>1997/ 1998</td><td>Indonesia</td><td>Kalimantan Complex</td><td>Human (Intentional)</td><td></td><td></td><td>9.7 (region-wide)</td><td></td><td></td><td>700 m tonnes greenhouse gases
Land conversion (loss native forests)</td></tr>
<tr><td>1998</td><td>Brazil</td><td>Roraima Fire</td><td>Human (Intentional)</td><td></td><td></td><td>0.011</td><td></td><td></td><td>Land conversion (loss native forests)</td></tr>
<tr><td>2003</td><td>United States</td><td>Cedar Fire</td><td>Human (negligence)</td><td>15</td><td></td><td>0.11</td><td>32</td><td>2.232 homes</td><td>Watershed
Endangered species habitat
Recreation</td></tr>
<tr><td>2007</td><td>Greece</td><td>Paleochori - Sekoulas Fire</td><td>Human (negligence)</td><td>36</td><td></td><td>0.04</td><td>5</td><td>-71 homes - 6.500 Livestock</td><td>General forest
Agricultural</td></tr>
<tr><td>2008</td><td>Botswana</td><td>Ghanzi Fire</td><td>Believed human-caused</td><td></td><td></td><td>3.6</td><td>0.24</td><td></td><td>Wildlife grazing (tourism)
Thatching grass
Livestock grazing</td></tr>
<tr><td rowspan="2">2009</td><td rowspan="2">Australia</td><td rowspan="2">Black Saturday Fire</td><td rowspan="2">Electrical failure (suspicious)</td><td rowspan="2">173</td><td rowspan="2"></td><td rowspan="2">0.43</td><td colspan="3">4,000</td></tr>
<tr><td></td><td>> 2,000 homes</td><td>8.5 m tonnes CO2</td></tr>
<tr><td>2010</td><td>Russia 1/</td><td>Central Russia Complex</td><td>Unknown, likely human-caused</td><td>35</td><td></td><td>0.0677</td><td></td><td>800 homes</td><td></td></tr>
<tr><td>2010</td><td>Israel 1/</td><td>Mt. Carmel</td><td>Human (negligence)</td><td>41</td><td></td><td>0.003</td><td></td><td></td><td></td></tr>
</table>

1/ Compilation of all data not yet complete

Unknown, unavailable or incomplete at this time

A wide range of determinants may underlie the mega-fire phenomenon, but in this coarse-scale assessment, several common themes emerged among the diverse range of submissions as the process “drilled down” through the analysis:

Causal Factors:

IGNITION SOURCE: Nearly all of the mega-fires studied under this assessment were started by people. At least three (Brazil, Indonesia, and Greece) included examples where fires were deliberately set in order to clear land for agricultural or development purposes. In Australia, the Black Saturday Fires were largely due to electrical supply system failures or occurred under suspicious circumstances.

Contributory Factors:

DROUGHT CONDITIONS: Drought was implicated in all but one of the mega-fires examined in this assessment. The exception was in Botswana where an unusually wet rainy season resulted in an abundant grass crop. During the dry season, this grass crop fueled severe wildfires.

FIRE WEATHER CONDITIONS: Hot, dry, windy conditions accompanied all of the wildfires studied here. In fact, all of these fires ignited on (or burned into) extreme fire weather days; the most difficult to control. In many cases, extreme fire weather (i.e. low relative humidity, high ambient air temperature, high wind speed) conditions exceeded previously observed "worst case." Long-distance spotting and very high rates of spread (fire growth) were commonly observed.

FUEL CONDITIONS and AVAILABLE FUEL: Dense live fuels and/or heavy, continuous dead and down fuels dominated virtually all of the mega-fire sites studied under this assessment. Often owing to drought, a large proportion of total fuels (dead and live) were available to burn.

In the tropical forest examples, mega-fires were principally fueled by dried-out woody debris left behind from logging and land clearing for plantations and/or crop production. Removal of the native canopy likely accelerated drying in the exposed fuelbed, increasing the amount of total available fuels.

In the temperate zones, on warm, dry sites, decomposition rates are slow. In the absence of periodic underburning, which is often known to have occurred under more natural conditions (i.e. before the advent of attempted fire exclusion), vertical and horizontal fuels accumulated well beyond more natural levels. These over-accumulated fuels significantly added to wildfire severity once they caught fire.

Peat fuels, usually too wet to burn, were particularly problematic in the Indonesia and Russia case examples. Resistance-to-control and smoke production characterized the special problems with peat fires.

FOREST/SHRUBLAND/GRASSLAND CONDITIONS: Altered forest conditions were commonly observed across mega-fire landscapes. Alterations resulted from a wide range of acts or omissions. In some cases (Brazil and Indonesia), forest conditions had been altered as a result of intensive logging, land-clearing, and development. Conditions became more flammable when the native canopy was removed and left-over harvest debris dried.

In the Botswana case, the grassland savannah had been altered as a result of a network of fencing, fuelbreaks, and changes in grazing patterns. In this area, continuous grass fuels accumulated across extensive areas.

In the temperate examples evaluated under this assessment, changes in forest structure and composition were commonly observed. Extensively abundant and dense understory biomass, "ladder fuels," and closed crowns often fueled mega-fire potential, under drought conditions.

In Greece, dense forest conditions resulted when resin-tapping, grazing, and other traditional forest uses stopped. Changed land tenures and the loss of traditional practices that once kept fuel accumulations in check were abandoned as people moved away for improved economic opportunities elsewhere.

In Australia, Greece, Israel, possibly Russia, and in the United States, efforts to exclude fire and limit disturbance resulted in the build-up of continuous, homogeneous fuelbeds. These conditions often contributed to uncharacteristically high fire intensities.

Note: In several of these countries, fire specialists have observed that earlier hazard mitigation treatments in or adjacent to mega-fire perimeters have slowed or arrested the spread of running, high-intensity wildfires. In places where understory thinning, selective harvest, and/or prescribed burning reduced fuel loads, forest resilience was much enhanced. In fact, many of these stands survived the passage of high-intensity wildfires.

LANDSCAPE HOMOGENEITY: In the tropical forest types, homogeneous, undisturbed conditions seem to deter the growth of large wildfires. Owing to more wet, humid conditions, undisturbed forests in the tropics are largely fire proof. Mega-fire potential increases only when severe disturbance (e.g. intensive logging or land clearing) coincides with drought, extreme fire weather conditions, and multiple ignitions.

However, in fire-prone more temperate vegetation types, mega-fire potential seems largely predicated on landscape homogeneity; the extent of continuous available fuels. While several factors may influence landscape homogeneity, in this assessment climate and history of disturbance seemed to predominate.

In a cool/wet climate cycle, natural moisture differentials (in naturally regulated temperate forests that burned at frequent intervals) were probably more diverse; in that the landscape was represented by more "patches" of stands with different ages, different structures, different species, and different fuel loads. These differences may have acted to leave some areas relatively safe from burning during the fire season. Spread potential and/or fire intensity from subsequent fires may have been limited by this landscape diversity, even under drought conditions. Certainly, wildfire behavior that is observed today around many of the "patches" prescribed burned beforehand tend to support this reasoning.

In this assessment, most mega-fire landscapes did not demonstrate much diversity, in terms of terms of age-class distributions, vegetative structure or species composition.

Under severe, prolonged drought, moisture differentials all but disappear, as all aspects and all elevations along the moisture/ temperate gradient dry out. Together with drought, the absence of vegetative diversity may be exacerbating the potential for mega-fires by further reducing an important flammability differential.

Dry, densely arranged, homogeneous aerial and surface biomass fueled many of the mega-fires evaluated under this assessment. In Australia, Botswana, Israel, Greece, and the U.S., the absence of landscape "patches" or "mosaics" was judged an important contributing factor to mega-fire potential.

Note: This observation may be most critical in those places where volatile fuel types and people are "sandwiched" between a hot, dry landmass and a much cooler large body of water. These are areas where intense gradient winds typically develop, as were observed in Australia, Greece, Israel, and the U.S..

LAND-USE EMPHASIS and LAND MANAGEMENT POLICIES, PRACTICES: Mega-fire potential seems highest where forest practices result in forest conditions that are furthest outside the natural range of variability. Mega-fires evaluated under this assessment tended to occur at the extremes of forest management. That is; they were most common in places where, either, severely disturbed (exploitation) or altogether un-disturbed (preservation) practices were being emphasized.

In the tropics, conflagration fires were largely confined to exploited logged-off areas, where extensive land-clearing left behind large volumes of available fuel.

In the drier, temperate forest types, mega-fires were observed in places where prolonged fire exclusion practices were coinciding with land management strategies favoring un- disturbed conditions. In the Greece case, the land had been abandoned and left un-attended. With natural disturbance processes excluded and the land being managed for undisturbed conditions, often to preserve values, live and dead fuel build-ups resulted on these mega-fire landscapes. During drought episodes, these increased available fuels added to fire intensity levels and, paradoxically, put at risk the very values the preservation objective was attempting to sustain.

Note: In several temperate countries, most historic conflagrations occurred at the other extreme in land management, where forests were being exploited. For example, the deadliest wildfire in the United States was largely the result of "high-grade" harvest and "slash and burn" practices that were common in early logged-over forests. The Peshtigo Fire (Wisconsin, 1871) burned some 607,000 hectares and killed between 1,200-2,400 people during a severe wind event.

Mega-fire risk seems particularly high where land-use objectives are at odds with the site's disturbance ecologies and fire regime dynamics.

Among the eight mega-fires examined under this assessment, wildfire protection programs ranged from non-existent to suppression-centric. It should come as no surprise that mega-fires would overwhelm those units with little or no wildfire protection capability. However, this assessment found several examples where highly capitalized wildfire protection programs were ineffectual against the mega-fire threat.

Note: In Australia, Greece, and Russia rural (often volunteer) firefighting forces with local knowledge are declining in number. Israel has no dedicated wildland firefighting force. While forest management skills are being de-emphasized, there is a tendency for some governments to increasingly rely on urban-based firefighters and/or rural-based volunteers. These changes may be overlooking the importance of forest management skills in mitigating the fuel hazards that predispose severe wildfires.

GOVERNING LAWS, POLICIES, AND PLANS: Perhaps ironically, in many places, governing wildland laws and policies may be impeding more effective wildfire protection capabilities as fuel hazards grow, drought deepens, and wildfire risks climb.

In Australia, the United States, and elsewhere environmental concerns for air quality, endangered species habitat, water quality, and other values are protected by law. As applied, the law often aims for undisturbed conditions. Preservation aims often rely on suppression-centric protection strategies to maintain current conditions. As droughts intensify and flammability potential compounds, it is proving more costly and less feasible to sustain suppression-centric protection strategies in these places. As mentioned above, preservation strategies may be imperiling the very values they were intended to save in un-disturbed fire regimes under drought conditions.

In Greece, prescribed burning remains banned altogether. Meanwhile, land development laws that protect forested areas are circumvented by arsonists when burned-over lands no longer qualify as “forested.” Furthermore, the use of fire to fight fire is not employed. Firefighters are left to resort to indirect attack methods which, under extreme burning conditions, leave them with little chance of success.

In other developed countries, strict air quality and other regulatory controls effectively limit fuel hazard mitigation efforts, including prescribed burning.

After-action reviews or post-fire investigations seldom recognize or address high-hazard land management or land-use practices, where many destructive wildfires incubate.

CONTRASTING WILDFIRE PROTECTION STRATEGIES

Although drought is often blamed for the onset of mega-fires, Florida and Western Australia offer two examples where, despite the prolonged presence of severe drought, wildfire costs, losses, and damages seem much lower than elsewhere. These programs reflect more balanced prevention, mitigation, and suppression approaches. When compared to more suppression-centric examples, they emerge as places where mega-fires do not occur. In fact, they offer examples where mitigation treatments have stopped mega-fire spread coming off of untreated lands.

Both Florida and the southwest of Western Australia can (and do) experience difficult wildfires, but they tend to occur where prescribed burning is not widely used.

In Florida, the U.S. Forest Service and the State of Florida have a combined ownership of approximately 900,000 hectares. On average each year, both agencies prescribe burn between 10 and 20% of their holdings. Prescribed burns occur on a 2- to 4-year rotation. Prescribed burning costs range from about $US10-30 per hectare in these areas. In forests left untreated, wildfire suppression costs can often exceed many hundreds, even thousands of dollars per hectare, not counting the additional losses and damages that may be involved).

In southwest Western Australia, the Department of Environment and Conservation protects an estate of approximately 2.5 million hectares. It routinely uses prescribed fire to treat approximately 8-9% of their holdings and aim for 70-90% burn coverage. Prescribed burn projects are strategically placed and treated at planned intervals. Wildfire costs, losses, and damages have been much reduced since the prescribed burning program began, following the Dwellingup Bushfire disaster in 1961.

In some areas, community-based fire management initiatives are underway. These models, made up of participants from among private and public landowners, often provide the means to strengthen cooperative efforts, reconcile competing interests, and provide for safer and more resilient fire-prone forests at landscape scales.

KEY CONCLUSIONS

The reasons behind mega-fires may be as diverse as the cultures, economies, histories, and ecosystems as the countries within which they occur. Certainly, these factors vary widely across temperate and tropical forest types and between developed and un-developed countries. Understanding these factors in the context of fire disturbance regimes is fundamental to understanding the mega-fire threat. The science in all of these places may not yet be fully settled. However, it seems likely that mega-fire risks increase as droughts deepen, fuels accumulate, and landscapes become more homogeneous.

- With the onset of more pervasive, world-wide drought, there is no longer the assurance that some places, only because they have not had severe wildfires in the past, will be safe from conflagrations in the future.

- The majority of mega-fires were caused by people. At least two were set intentionally for an expected localized benefit. Both of these incidents, because they had severe "downstream" adverse effects, were categorized as mega-fires in this assessment.

- In the tropical forest case studies, mega-fires resulted when the forest cover was removed. Severe fire behavior was fueled by dried-out woody debris, left behind after "high-grade" logging, land-clearing, and other exploitive practices.

- In the arid woodland-savannah case (Botswana), a mega-fire burned through a network of fences (and some fuelbreaks) intended to control grazing and wildfires. The absence of these disturbance influences over a long period resulted in the development of an abundant and extensive fuelbed.

- In the dry temperate forest and brush-land examples, mega-fires occurred in dense fuel beds across largely undisturbed, homogeneous landscapes, where preservation strategies emphasized "hands-off" land management.

- In virtually all of the tropical and temperate case examples, land management and/or land-use actions or omissions (intentional or not) carried significant wildfire-related risks that were not anticipated at the scope and scales that resulted.

- The direct impacts resulting from mega-fires were often enormous. However, their indirect effects may be far greater. These second-order effects to human health, infrastructure, and local economies are barely accounted and rarely documented. Environmentally, water quality, soil quality, and endangered species habitat are, also, often overlooked when assessing post-fire impacts on a long-term, cumulative basis. Declines in biodiversity, "black carbon" emissions, and invasive weeds may be of special concern.

- Massive amounts of carbon release were documented on some of the mega-fires examined here. In several countries, wildfire emissions are exempt from regulatory controls. Because CO_2 emissions contribute to global warming and mega-fires are the result of drought, mega-fires (and carbon releases) may represent a dangerous feed-back loop that becomes self-perpetuating in the absence of stronger wildfire emissions monitoring and control. Little is known of this possible iterative relationship and its long-term ramifications.

- In several cases, governments are attempting to confront increasing wildfire threats with greater suppression force. There seems a tendency for some governments to rely more and more on urban-based firefighters and/or air-attack assets, but, despite the escalating costs involved, the approach is proving largely ineffectual. A coincident decline in forest management skills appears to be exacerbating the problem.

- In many cases, the data required to better understand causal and contributory factors is incomplete or unavailable. As a result, many places cannot integrate even a basic understanding of fire disturbance dynamics into wildfire protection programs, land management plans, land-use policies, nor the environmental laws that they all rest upon.

- Mega-fires are not occurring where land management practices are consistent with the fire ecologies and disturbance dynamics that define the ecosystem. Mega-fire risk is likewise much reduced in those areas where wildfire protection programs are more balanced between prevention, mitigation, and suppression elements.

"Everything is simple in war, but the simplest thing is difficult."
-Carl von Clausewitz

SUMMARY

Mega-fires need to be understood, instead of dismissed as anomalies, accepted as unavoidable accidents of nature, or faulted as a failure of response. If we look deeply enough, they tell us something about our own complicity in their onset.

Certainly, drought sets the stage and human negligence may provide the spark, but vulnerable vegetative conditions are fueling the mega-fire threat. In exploited tropical forests, "high-grade" logging, land clearing, and wholesale site conversions have left high volumes of slash and debris behind. In many fire-prone temperate forests, where undisturbed conditions are favored as the means to preserve values, continuous fuels and biomass have accumulated over extensive landscapes. Both scenarios, waiting on drought, incubate the next wildfire disaster.

At its root, the mega-fire phenomenon reflects a significant land management issue. Specifically, mega-fires are indicating that land management strategies in fire-prone ecosystems are often in contradiction to the disturbance regimes and ecologies that define these landscapes. These contradictions leave fire-prone forests less resilient and predispose mega-fire risks in the presence of drought.

Often, mega-fires further trace to forest management laws, regulations, and policies that may no longer be achieving their intended aim. The regulatory controls that "worked" in a cool, wet climate cycle may now be imperiling the values that they were intended to save as drought takes hold.

It is not clear that governments have recognized or responded to the mega-fire problem, its root causes, and its contributory factors. Most attention remains directed at the symptoms.

In some places, efforts are underway to "harden" houses and invest in bigger, faster, stronger fire suppression capacity. In other places, some argue to "let nature takes its course" and let wildfires go. Until the root causes and contributory factors underlying the mega-fire phenomenon are more broadly acknowledged and acted upon, it is uncertain that either approach will work. Recent experience indicates that wildfire suppression costs, private property losses, and environmental damages will continue to climb in the absence of more balanced, more comprehensive landscape management strategies. Without an ecological context, unintended consequences may metastasize in ways that we cannot anticipate. In the absence of change, those at risk may almost certainly need to recalibrate their measure of "acceptable loss." In this, the United Nations' "Year of the Forest," the onset of mega-fires should challenge governments around the world to adapt wildfire protection programs to confront causes and contributory factors; not chase symptoms.

ACKNOWLEDGMENTS

The authors wish to thank Jim Carle, Graciela Andrade, Luisa Basile, Roberto Cenciarelli, and the Staff of the Food and Agriculture Organization (Rome, Italy) for their leadership and assistance in compiling this report.

The authors also wish to acknowledge the support and contributions of the following individuals in developing this paper:

- Australian Support: Gary Morgan (Chief Executive Officer, Bushfire Cooperative Research Centre) and Rick Sneeuwjagt (Western Australia Fire Management Officer)
- Brazil Support: Dr. Lara Steil
- Greece Support: Miltiadis Athanasiou
- Indonesia Support: The many dedicated Indonesian and Indonesian-interested fire specialists.
- Israel Support: Cristiano Giovando
- United States Support: Carlton Joseph (Forest Fire Management Officer, Cleveland N.F.), Rich Hawkins (Forest Fire Management Officer, Cleveland N.F., retired), and Neil Sugihara, Fire Ecologist, U.S. Forest Service, Pacific Southwest Region. Also, Dale Dague (U.S. Forest Service Branch Chief for Disaster & Emergency Operations, International Fire) and Tom Harbour (National Director of Fire & Aviation Management, U.S. Forest Service, Washington). Also, Jim Karels (Florida State Forester) and John Saddler (Florida State Forester's Staff) and Clint Cross (U.S. Forest Service Fuels and Fire Use Specialist, Southern Region)

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APPENDICES:

Appendix A. ***Australia*** (compiled by Mike Leonard)***:*** The 2009 Black Saturday Fires (Victoria, SE Australia) were a grouping of several large fires. Some burned together. They followed a 13-year period of drought. Over the period when these fires occurred, the area was experiencing the most severe and prolonged fire weather on record, with extreme ambient air temperatures (> 43 degrees C) and very strong winds. The most deadly of the fires is believed to have been caused by faulty power lines; others occurred due to power supply faults or under suspicious circumstances. Many originated in more remote areas of the public estate. They burned approximately 430,000 hectares in a 14-day period, running onto private lands. The fires killed 173 people, most on one day, following a severe wind event. The fires damaged or destroyed over 2,000 homes. The suppression costs, private property losses, and natural resource damages exceeded $US 4 billion. It was estimated that over 8.5 million tonnes of carbon dioxide was released into the atmosphere as a result of the 2009 Black Saturday Fires. One can only imagine cumulative emissions, considering that, in the State of Victoria alone, close to half of all native forests and woodlands have burned between 2002 and 2010. Australia's history is marked with numerous high-cost, high-consequence wildfires; many involving multiple fatalities.

In the recent past, the Victorian Alpine Fires (2003), the Capital Territory Fires that burned into Canberra (2003), the Wangary Fire on South Australia's Lower Eyre Peninsula (early 2005), and the Victorian Great Divide Fires (2006-2007) are among the worst. However, they pale when compared to the Black Saturday Fires; these became the nation's deadliest civil disaster on record. Eucalypt fuels dominated the general fire area. On private lands, crops, pasture, wineries, and other agricultural values were burnt or threatened. Town sites and small communities were lost. Tourism, wine-growing, and other local economies were devastated, as a result of the catastrophe.

Appendix B. *Botswana* (compiled by Anja A. Hoffmann)***:*** A total of nearly 12 million hectares burned in Botswana during the 2008 fire season. In the central Kalahari, single large-scale fires have occurred as recently as 2002 and go back to the 1970's. However, the 2008 Ghanzi Fire was the most consequential on record. It was believed to have been person-caused, originating in a wildlife management area, close to an established settlement. Grassland savannah fuels dominated the fire area. Unusually abundant rainfall leading up to the fire season resulted in very high grassland fuel loads across the general area. The fire season was very dry, as is typical. The fire burned over 3.6 million hectares during a 50-day period, across a mix of land ownerships. Much of the land was managed for grazing (both domestic livestock and wildlife) across tribal lands, commercial ranches, and game reserves in National Parks and Wildlife Management areas. Among local communities, thatching grass collection was the main income-producing activity. A large network of fences influenced grazing patterns throughout the area. A long-in-place fencing effort has effectively limited the range of large wildlife herds, resulting in a larger contiguous buildup of grass fuels with less landscape "patchiness." On the Ghanzi fire, greater grass fuel loads contributed to higher-intensity, less controllable wildfires with greater spread potential. Homogeneity of the fuelbed was also due to the lack of numerous smaller fires that, under more natural conditions, might have burned themselves out against recent grazed-over areas or other recent burns. In modern times, fuelbreaks have been the principal means of controlling fire. In 2008, however, fuel break construction was delayed well into the fire season. As a result of these wildfires, about 75% of the wildlife reserve was burned over. Most of the damages involved at least one season's loss of grazing and adverse impacts to the local and regional economy, including those to tourism. Costs, losses, and damages were estimated at $US 239,000, a considerable sum relative to the economy in this area. This area's fragile economy made this wildfire particularly devastating to local communities depending on seasonal income.

Appendix C. *Brazil* (compiled by Dr. Jose Carlos Mendes de Morais)***:*** Roraima State, in the north-central Amazon region, has been affected by extraordinary drought-induced wildfires as recently as 2001 and 2003, but the 1998 fires remain the worst on record. These fires were person-caused and intentionally ignited for land-clearing purposes. Agribusiness is the dominate land-use activity in the area. These wildfires burned out of control for over 30-days, covering some 11,000 hectares. A severe drought, accompanied by high ambient air temperatures (>40 degrees C) and strong winds fanned much of the burning. Because wildfires are often self-limiting in humid tropical forest types, organized firefighting assets have not typically been locally available in this area. They were brought in from neighboring states under Brazil's national system for forest fire protection. These assets reinforced local volunteers, associations, and public officials. Smoke impacts, affecting nearby population centers, were among the most significant adverse effects. Other damages were related to

forest mortality; mostly among trees smaller than 5 cm diameter. Much of the overstory survived. No fatalities were reported. Improvements in an organized firefighting response were credited with preventing a repeat of the 1998 disaster, when the severe years of 2001 and 2003 again hit the area.
Appendix D. *Greece* (compiled by Dr. Gavriil Xanthopoulos)***:*** In 2007, Greece experienced its worst wildfire season ever, following a deep drought and at least two heatwaves. A total of 270,000 hectares burned and 84 lives were lost over a period of about 7 days in the end of August, when severe fire weather conditions (low humidity, high ambient air temperature, and high winds) contributed to rapid fire growth. Two of the wildfires (Paleochori and Sekoulas) burned together, claiming 36 victims. This wildfire, 200 km west of Athens, burned approximately 40,000 hectares. Although the majority of acres burned occurred on public lands, 67 villages were affected, destroying over 71 homes in Makistos and Artemida, alone. Dozens of additional homes, along with hundreds of stables, warehouses, and outbuildings in other villages were also destroyed. More than 6,500 goats and sheep were killed as well. At least $US 5.5 million were expended to suppress this fire. Grass, evergreen shrubs, and pine forests were the dominant fuels in the area. Fuel build-up, owing to several years of changing land tenures, decline in grazing practices, and the loss of an "agricultural mosaic" predisposed the area to very large-scale wildfire potential. Prescribed burning is excluded in Greek law, as a means of managing forest lands.

Economic and organizational changes also appear to have affected the 2007 fire outcome. Some forest-based rural economies collapsed following Greece's admittance into the European Union. Resin tapping in the region's pine forests, for instance ended, taking with it a workforce that moved on for opportunities elsewhere. The forests were generally left unattended and a younger local workforce having a stake in its protection disappeared. Also, in 1998, rural firefighting responsibilities transferred from the more rural-oriented Forest Service to the more urban-oriented Fire Service. This move strengthened mechanization capabilities (including aerial assets) and established a suppression-centric wildfire protection program emphasizing direct attack methods. The move diminished the role and capacity of forestry and forest workers. Although the Fire Services, up to this point, demonstrated firefighting success on lesser wildfires, the fire behavior associated with these catastrophic wildfires exceeded all efforts at direct control. Line production rates (including those of aerial attack assets) were altogether inadequate against these fires' rates of spread. There were isolated examples where backfiring and other agile "guerilla" tactics were used to save property, but most were credited to the remnants of the rural Forest Service.

Appendix E. *Indonesia* (compiled by Dr. Peter F. Moore)***:*** The 1997/98 Indonesian fires were person-caused. They were ignited for large-scale land-clearing for pulp and oil palm plantations. There were no reported fatalities. Altogether, they burned over 9.7 million hectares in a diverse mix of tropical forest types, timber plantations, and estate crops. Previous similar-scale fires occurred in 1982/83 and in 1994. Hundreds of intentionally lit fires moved onto secondary or degraded forest lands unintentionally, under the influence of drought. The ignition of peat was particularly problematic. Little to no suppression actions were taken. Because the consequences of these wildfires impacted regional neighbors and the global community, most of the wildfire-related concerns were expressed by non-government organizations and groups external to Indonesia. Approximately 700 million tonnes of greenhouse gases were released into the atmosphere as a result of these wildfires, making them one of the largest pollution sources in the world. It is recognized that the use of fire to clear land and prepare sites for timber and agricultural production are significant to the Indonesian economy. The benefit:cost balance was asymmetrical, in that segments of the country actually benefited from the activity, while the costs were born by other segments of the population or were widely dispersed outside of the country.

Appendix F. *Israel* (compiled by Dr. Jesus San Miguel-Ayanz)***:*** Few details are known about this fire, at this time. In December 2010, 41 people were killed as a result of fast-moving wildfire on Mount Carmel, near Haifa. The fire was the result of negligence. Although the fire's size was limited to 3,000 hectares, in this arid region, the loss of forest cover was devastating, both environmentally and culturally.

Appendix G. *Russia* (compiled by Andrey Eritsov)***:*** The 2010 wildfire season in Russia was the most extreme since 1972. Nationwide, about 2.3 million hectares burned as a result of 32,300 fires. Across 19 regions of the country, more than 2,000 homes burned in over 100 villages. Sixty-two lives were lost, including those of three firefighters. In European Russia, the 2010 fire season was the worst on record. A severe drought combined with record-high temperatures and strong winds between 21 June and 19 August. It is believed that most of these wildfires were caused by carelessness. The general area was represented by conifer and mixed forests, with some areas of peat bogs. The smoke impacts to Moscow, Nizni Novgorod, Cheboksary, and other areas lingered for weeks and, along with the heat, caused pulmonary problems among the population. Russia responded to the wildfire emergency with over 200,000 firefighters, 30,000 trucks and engines, and about 200 aircraft. Fourteen other countries provided assistance. All villages were re-constructed under a government program by 1 December 2010.

Note: Table 1 in this report reflects the impacts from several complexes in Central Russia during the 2010 fire season. Impacts are summarized from the Republic of Mordovia, the Riazan oblast, the Nizni Novgorod region, and the Moscow region.

Appendix H. *United States* (compiled by Dorothy Albright)***:*** The 2003 Cedar Fire, outside of San Diego was person-caused. It ignited on public lands during a large fire emergency occurring throughout Southern California during a Santa Ana wind event. Some 110,578 hectares burned over a ten-day period on the Cedar Fire. The fire killed 15 people (including one firefighter), destroyed 2,232 homes and 588 structures, and cost over $US 32.7 million to suppress. The fire followed several years of drought and was influenced by a high dead-to-live ratio in the live fuels and severe fire weather conditions (single digit relative humidity, high ambient air temperature, and strong winds). Although California has a long history of devastating wildfires, including some since 2003, the Cedar Fire remains the worst on record. The fire area included a mix of public and private lands. On public lands, watershed values, recreation values, and critical wildlife habitat were represented. Large, well-coordinated wildfire suppression capacity is the basis for a land management strategy intended to preserve these values. Fuel reduction burning was routinely used to control the buildup of fuel in a small conifer-dominated recreation area, with positive post-fire results. However, in the more extensive chaparral and coastal sage fuels, prescribed burning was limited. In these fuel types, ecological concerns, endangered species concerns, air quality concerns, risk of escape, and, more lately, questions about its effectiveness as a suppression aid, have limited its use at meaningful scales. Hazard mitigation strategies have recently shifted from age-class diversity burning in brush fuels (at relatively small scales) to intensive fuel reduction practices on the wildland-urban interface perimeter where homes and private property abut public lands. In some places, fuel reduction burning has been complemented with FIREWISE building practices for new home construction, as the principal means to protect private values. Wildfire protection strategies continue to rely on a rapid and aggressive suppression response. Although the strategy aims at protecting private and critical natural resource values, it is unclear the long-term ramifications to these values when suppression efforts fail and very large wildfires occur. Very large-scale vegetative type conversions (e.g. chaparral to non-native grasses and invasive weeds) are being observed where person-caused high-intensity fires have recurred at short intervals. Summertime wildfires have given way to more late-season wildfires that coincide with drier, windier, and more severe fire weather conditions. While the immediate urgency to protect homes and private property dominates the Southern California wildfire problem, the science to support ecologically appropriate, longer-term solutions remains unsettled.

PARALLEL SESSION 3

Fire and Poverty Alleviation in developing countries

FOUR YEARS SINCE SEVILLA!

Progress and challenges of integrated and community based fire management.

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Abstract

At the last International Wildland Fire Conference in Sevilla 2007, FAO launched the Fire Management Voluntary Guidelines which are based on overarching approaches; participation and integrated fire management. The Fire Management Actions Alliance (FMAA) was also launched to support implementation of the Guidelines. The paper synthesizes progress made since then by FAO, the FMAA and others, as well as the challenges at present regarding the implementation of these approaches.

The paper will analyse existing opportunities, including the REDD plus[1] Partnership, the need to discuss fire in the context of climate change and to include fire management in the broader landscape policy and management framework. Regarding the community based approach the paper will highlight the need for more attention to traditional indigenous fire practices and knowledge. Finally the paper will present research needs regarding both approaches.

Keywords: Fire Management Voluntary Guidelines, Integrated Fire Management, Principles, International strategy.

Introduction: an international strategy and guidelines

The Ministerial Meeting on Forests and the 17th Session of the United Nation's Food and Agriculture Organisation's Committee on Forestry, March 2005 (Rome, Italy 2005) called upon FAO, in collaboration with countries and other international partners, including the UNISDR, to develop a strategy to enhance international cooperation in fire management, that advanced knowledge, increased access to information and resources and explored new approaches for cooperation at all levels. They also requested preparation of voluntary guidelines on the prevention, suppression and recovery from forest fire. The need for such tools to assist in international cooperation had also been highlighted at the 3rd International Wildland Fire Conference and the International Wildland Fire Summit (Sydney, Australia 2003) because of the increasing incidence and severity of impacts of major fires globally.

An international expert consultation in wildland fires (Madrid, May 2006) agreed that the non-legally binding Strategy to Enhance International Cooperation in Fire Management include the overarching framework for component parts: i) Fire Management Voluntary Guidelines; ii) Implementation Partnership; iii) Global Assessment of Fire Management; and iv) Review of International Cooperation in Fire Management.

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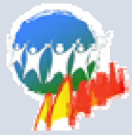
[1] Reduced emissions from deforestation and forest degradation in developing countries, including conservation, sustainable management of forests and enhancement of forest carbon stocks.

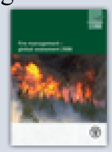
Strategy to Enhance International Cooperation in Fire Management
The overarching framework in response to the Ministerial Meeting and COFO requests

Fire Management Voluntary Guidelines
Including the Principles and Strategic Actions developed with multiple stakeholders

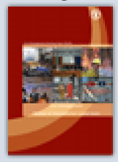
FireManagement Actions Alliance
for implementing the Voluntary Guidelines



Global Assessment 2006
Review and analysis of fire management, incidence and impact in all regions, with global analysis



Review of International Cooperation 2006
Review of priority themes, key actors activities and scope for future international cooperation in fire management



These tools have been tailored primarily for land-use policy makers, planners and managers in fire management, including the Governments, the private sector and non-governmental organizations to assist in the formulation of policy, legal, regulatory and other enabling conditions and strategic actions for more holistic approaches to fire management. Their scope includes the positive and negative social, cultural, environmental and economic impacts of natural and planned fires in forests, woodlands, rangelands, grasslands, agricultural and rural/-urban landscapes. The fire management scope includes early warning, prevention, preparedness (international, national, sub-national and community), safe and effective initial attack on incidences of fire and landscape restoration following fire.

The strategy, guidelines and actions alliance were presented and launched at the last international Wildland Fire Conference in Sevilla (2007),

Development process of the Strategy and the Guidelines

The Strategy to Enhance International Cooperation in Fire Management and the component documents were formulated and reviewed through a multi-stakeholder process. Technical core group meetings (Rome, March, July and September 2006) and an expert consultation (Madrid, May 2006) held working sessions for participation of fire specialists from Governments, private sector associations, non-governmental organizations and inter-governmental organizations to prepare and revise the draft documents. The fire management strategy and voluntary guidelines were presented to, and discussed at, the Regional Forestry Commissions and at various United Nations International Strategy for Disaster Reduction (UNISDR) fire management meetings during 2006. The voluntary guidelines for fire management were available on the internet and feedback invited from Governments and other organizations involved in the various aspects of fire management. Stakeholder submissions were considered in reviews of the documents until December, 2006.

FAO’s collaborating partners that provided inputs on an "in kind" basis included members of the USDA Forest Service; Global Fire Monitoring Center (GFMC); UNISDR Global Wildland Fire Network; The Nature Conservancy, the Government of Spain and the International Liaison Committee of the 4th International Wildland Fire Conference. A broad stakeholder group of experts representing Governments, the private sector, IGOs and NGOs also gave of their valuable time.

Objectives of the Fire Management Voluntary Guidelines

The voluntary guidelines are intended to serve the following objectives:

1. establish principles in accordance with the relevant rules of international law for responsible fire management activities, taking into account all relevant biological, technological, economic, social, cultural and environmental aspects;

2. contribute to the establishment and implementation of national and subnational policies and planning mechanisms for establishing or improving the legal, regulatory and institutional framework required for responsible fire management activities;

3. provide guidance that may be used, where appropriate, in the formulation and implementation of international instruments, both binding and voluntary;

4. facilitate and promote mutual assistance and technical, financial or other forms of cooperation in fire management between agencies and donor organizations;

5. encourage and publicize the contribution of effective community-based fire management in providing food security and meeting people's livelihood needs; and

6. advocate sustainable land and resource management programmes that consider the ecologically appropriate use and management of fire, where permitted, and the suppression of unwanted, damaging fire.

Special consideration is given to social and community values and to engaging the community in fire management planning and implementation.

Any effective fire management programme must consider the ecology and fire history of the area. In many cases, maintenance of appropriate fire regimes or the reintroduction of fire is as important as preventing unwanted, damaging fires. The use and benefits of planned fire are not simply for protection and suppression.

Principles of the Fire Management Voluntary Guidelines

The principles address various dimensions of fire management. This section summarizes specific aspects that should be considered for each. Although the principles are grouped as social and cultural, economic, environmental, institutional and enhanced fire management capacity, they are closely interlinked. Some aspects are listed under more than one principle to reinforce these linkages.

Social and cultural principles

Principle 1: The appropriate use and management of fire will promote sustainable livelihoods. Aspects of the principle include:

Principle 2: Human health and security will be improved by minimizing the adverse effects of fire.

Principle 3: The traditional uses of fire on the lands of indigenous peoples and traditional rural communities should remain as a practice for those communities and be adapted to the current environment.

Economical principles

Principle 4: Protecting lives and assets. The destructive impacts of unplanned fires on lives, property and resources should be minimized, if not totally prevented.

Principle 5: An effective and efficient fire management programme requires a balance between the benefits society receives from the use of fire and the costs, damages or undesirable impacts caused by unwanted fire.

Environmental principles

Principle 6: The interactions of climate change with vegetation cover and fire regimes should be understood and appropriately considered in the planning and implementation of fire use.

Principle 7: Fire should be managed in an environmentally responsible manner to ensure properly functioning and sustainable ecosystems into the future.

Institutional principles

Principle 8: All fire management activities should be based on a legal framework and supported by clear policy and procedures.

Principle 9: Successful fire management requires participatory approaches to leadership and management that are appropriately shared by public and private landholders, the fire services and communities of interest.

Enhanced fire management capacity

Principle 10: Few nations and no single agencies or communities have the ability to manage every situation. As fires routinely affect multiple jurisdictions, agencies should develop cooperative arrangements to mitigate transboundary impacts.

Principle 11: Access to and appropriate application of knowledge are essential in all fire management activities.

Strategic actions in the guidelines

The strategic actions are intended to assist planners and managers, landholders, local groups and communities of interest in the holistic management of fire. They can also be used as a checklist to assess organizational capacity.

The guidelines distinguish strategic actions in the following fields:

- Fire and resource management planning
- Fire management in natural or protected areas and reserves
- Fire awareness and education
- Fire prevention
- Fire danger rating and early warning systems
- Fire preparedness, including technical training
- Pre-fire-season activities
- Fire detection, communications and dispatching
- Initial attack/action
- Large-fire suppression and management
- Managing multiple incidents
- Fuel management
- Planned fire
- Burned area restoration and rehabilitation
- Monitoring and assessment

Use of the guidelines

More than 12 000 copies of the guidelines were distributed in the 6 FAO languages (Arabic, Chinese, English, French, Russian and Spanish) as well as in Korean and Bahasa Indonesia. Three quarter of this amount were sent upon request by countries, organizations and individuals.

Some documents that existed already like the format for international agreements (Fernandez Arriaga, 2004) can help to implement the principles and or strategic actions.

Other new documents were developed, like:

- A methodology to revise existing or develop new fire management policies or strategic action plans, based on the principles and strategic actions of the guidelines (Rosengren, Vuorinen, 2008). The methodology was tested in subregional meetings in the Caribbean region.
- Forest fires and the law. A guide for national drafters based on the Fire Management Voluntary Guidelines (Morgera and Cirelli, 2009).

The Wildland Fire Management Handbook for trainers (Heikkilä, T. et all, 2010) was updated with chapters on Community Based Fire Management and reprinted.

And finally a publication on Community Based Fire Management (CBFiM) is foreseen for the end of the year. The document will give an overview of the status of CBFiM and what next steps are needed to respond to present demands.

The Fire Management Actions Alliance

When the Fire Management Voluntary Guidelines were launched in Sevilla, 2007, the Fire Management Actions Alliance was also launched with 32 founding members. Since then the membership has grown to 45 members, among government agencies, NGO'and private enterprises.

The objectives of the Alliance are to:

- review and update the Fire Management Voluntary Guidelines;
- encourage stakeholders at all levels to adopt and use the Guidelines;
- review experiences from applying the Guidelines;
- strengthen international cooperation in fire management.

Alliance are informed 3-4 times per year through E-mail messages on the latest developments and activities on integrated fire management and the use of the guidelines.

Through the Alliance the Forest Fire Working group of the North American Forestry Commission developed a short Incident Command System glossary in 4 languages, accessible at: http://termportal.fao.org/faoic/main/start.do .

The Alliance was also active in presenting the advances of the guidelines at international events like the World Forestry Congress in Buenos Aires, 2009, and several meetings of the FAO Forestry Commission.

Challenges and conclusions

Applying the principles and strategic actions is still a big challenge in many countries. But while new approaches and techniques are starting to be accepted and implemented like prescribed burning, integrated and participative approaches new challenges have appeared.

Discussions on climate change and fire point to the seemingly obvious relations between fire and climate; fire as a consequence of and as a contributing factor to climate change. However trustful statics about the contribution of vegetation fires to total emissions are lacking. Savannah burnings might have limited impacts by being neutral in a sense that they produce emissions one year and absorb them in a next growing season. The REDD plus[2] Partnerships might help to produce more coherent data on this but until now fire has not been a strong element in their Measurement, Reporting and Verification activities.

New challenges exist also in the field of the integrated approach. Now that the integration of all fire related activities in coherent policies become common thinking, the issue of integrating these policies in the broader forest or even landscape management has appeared.

[2] Reduced emissions from deforestation and forest degradation in developing countries, including conservation, sustainable management of forests and enhancement of forest carbon stocks.

Regarding the participatory and community based approach the paper many experiences are being developed around the world but what are the lessons learned? And how can they be translated in guidance for new activities?

Much of research in fire management is directed towards fire modeling and behavior or very focused on specific infrastructure or silviculture treatments. Stronger links have to be developed between research and practice in order to search for solutions that have to be addressed. Research on broader issues which might help to take decisions in the development and implementation of fire management policies needs more attention. If we want to convince general public and politics to invest more in fire management we should better understand the broader economics in relation to prevention versus suppression, Green House Gases emissions by vegetation fires in relation to the total emissions, efficiency of participatory methodologies in reducing fire impacts, use of indigenous knowledge and practices etc.

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COMMUNITY BASED FIRE MANAGEMENT; EXPERIENCES FROM THE FAO FUNDED PROJECT IN THE PROVINCES OF MANICALAND AND MATABELELAND NORTH, ZIMBABWE

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ABSTRACT

Zimbabwe's Fast Track Land Reform Programme (FTLRP) which commenced in 2000 resulted in the re-distribution of land to more than 300 000 smallholder farmers.

The presence of a large number of households on previously sparsely populated farms resulted in an upsurge in the forest fire incidents owing mainly to poor land clearing methods.

In an effort to control fire occurrences, the Government launched a National Fire Protection Strategy in June 2006, which gave various responsibilities to its departments and structures.

In 2008, the Forestry Commission sought partnership with the FAO to implement a pilot 15-month long community-based fire management project aimed at **reducing forest fire emergencies through the use of fire as a resource.** A total of 200 facilitators were capacitated with skills and fire fighting tools and equipment. Fire emergencies were reduced by ±80% in the project areas.

This paper discusses the above project which was implemented in selected communities of two provinces. Community-based fire management facilitators were trained and then led the process of fire management in their respective communities through early fire season controlled burning, awareness raising and actual fighting of fires. The paper also suggests the way to go on community fire management in Zimbabwe.

KEY WORDS.

- Community Based Fire Management.
- Controlled burning.

1.0 BACKGROUND.

1.1 General description of Zimbabwe.

Zimbabwe is a landlocked country in Southern Africa with a total surface area of 391,000 square km. It is bordered by Botswana and Namibia in the West, Zambia in the North, Mozambique in the East and South Africa in the South. Some 45 percent of the land area is covered by forest or woodland, characterized by a developed forest plantation sector and gazetted reserves of indigenous forest and woodlands.

Fig 1: Location of Zimbabwe on the African continent.

Zimbabwe's economy is anchored on agricultural production with significant mining activities also taking place.

The estimated human population is about 12 million with 70% of this population living in the rural areas. See figure 1 for details on the location of Zimbabwe.

1.2 Location of the project areas

This project was implemented in 2 selected communities in each of the 10 districts (5 districts per Province) of Matabeleland north and Manicaland Provinces of Zimbabwe.

Matabeleland north Province is located in the western part of Zimbabwe under agro-ecological zones IV and V, which are characterized by low rainfall averaging 500 mm per annum and generally dry weather conditions and deep Kalahari sandy soils. The project was implemented in Binga, Bubi, Hwange, Lupane and Umguza.

Manicaland is located in the eastern highlands of Zimbabwe. The Province is characterized by a dramatic contrast between the cooler, moister and cloudier uplands, and warmer, drier and sunnier lowlands, with annual rainfall averaging 800 mm. Soils vary from sandy loams in the low lying areas to the heavy clays in the higher altitudes where plantations are located. The districts of Chimanimani, Chipinge, Mutare, Mutasa and Nyanga were selected for the project.

See figure 2 below for details on the location of the 2 Provinces.

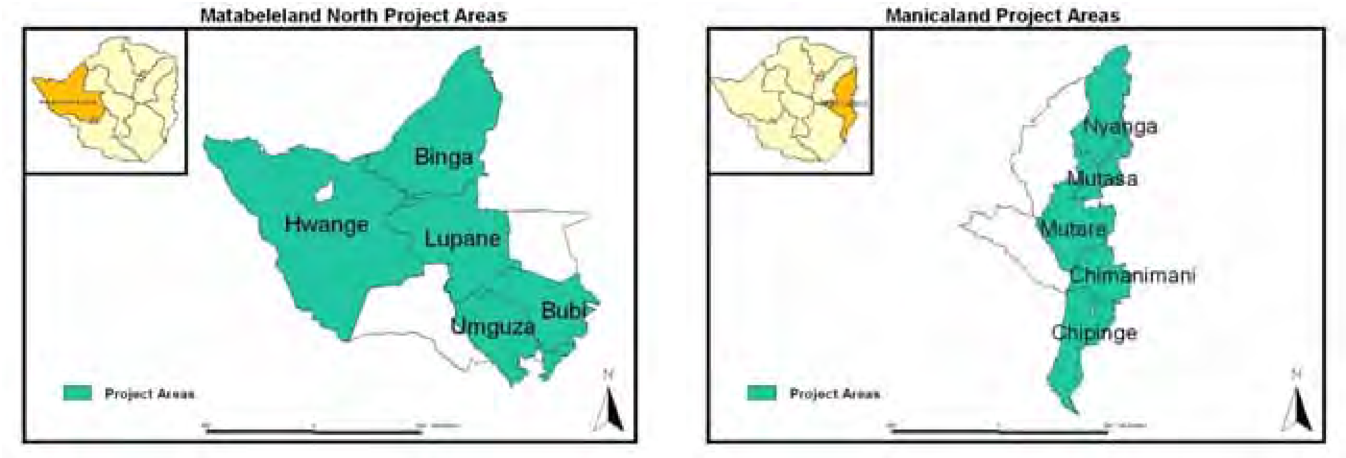

Fig 2: Location of Matabeleland North and Manicaland in Zimbabwe.

2.0 INTRODUCTION

In the year 2000, Zimbabwe embarked on a Land Reform Programme, whose main objective was to redistribute land. Significant land use change associated with the Land Reform Programme and the resettlement of people has modified land management to numerous smallholder land owners practicing small scale subsistence farming and traditional ways of exploiting natural resources. The spread of human settlements in areas that were not previously settled has led to increased anthropogenic activities which have led to a rise in fire incidents. The increase in fire incidents led to widespread losses of lives, property and resources. One of the notable incidents occurred in Matabeleland South where six school children were caught up in a forest fire whilst walking from school and were burnt beyond recognition. In Manicaland, approximately 190km^2 of pine plantations were burnt by fire in 2008. The projected impact of this disaster is erratic log supply in the next 20-25 years. According to the Ministry of Environment and Natural Resources Management (MENRM) (2006), property worth Z$1.245 trillion was lost to fires in 2005 and Z$328 billion in 2004 which is a three-fold increase in property lost, and the fires claimed seven lives in 2005.

Zimbabwe has over the past decades used the prevention and suppression approach to fire management, particularly in the commercial Forestry plantations, protected areas and private land. This approach was effective but costly and excluded communities living adjacent these areas; communities were perceived as part of the problem and not part of the solution to the problems of fire. The current dispensation whereby human settlements are spread on a wider space than before calls for a paradigm shift in the way fire is managed. Involvement of local communities has proved to be effective in countries such as Namibia and the Gambia (Ganz, 2000 and Jurvelis, 2003). Zimbabwe made a deliberate decision to develop a National Fire Protection Strategy in view of the challenges of widespread uncontrolled forest fires resulting from activities such as land clearing by small holder farmers, poaching and other human activities.

It is with this background that the Forestry Commission (FC) of Zimbabwe and the Environmental Management Agency (EMA) with technical and financial (US$285 000.00) support from the Food and Agriculture Organisation of the United Nations (FAO) developed this TCP/ZIM/3102 (D) project, which sought to influence community involvement in fire management, as well as promote the use of fire as a resource.

3.0 THE FIRES IN MATABELELAND NORTH AND MANICALAND.

Most of the gazzetted indigenous forests of Zimbabwe are located in Matabeleland North Province. There are human settlements in some of the gazzetted forests and in adjacent communal and resettlement areas. These forests (a combination of savanna and woodland savanna) carry a lot of highly flammable fuel in the form of dry long grass and dry fallen trees, which lead to high intensity fires on an annual basis. In this area, the dry winter to early hot summer period coincides with episodes of high wind velocity especially in July, August and September. The main fire regimes are winter-spring and early summer with the peak period between August and October. The clean burns often experienced have a negative effect on forest composition and structure including health, vitality and reproductive capacity of these forests. According to Beaty, (2009), 60% of Zimbabwe's forest fires occur in this Province.

Major timber plantations (dominated by the resinous and highly flammable pines) are located in Manicaland where temperatures vary between 16°C in June and July and 30°C in September and October, whilst the turbulent wind period is during two months (September-October), and this is the fire peak period in the province. During this period there is high level of fuel/biomass accumulation in timber plantations and whenever fires start they cause serious destruction as a result of ineffective control methods.

Anthropogenic activities such as land clearing, hunting, poaching and others in areas in and around the plantation and indigenous forests are often times the major sources of fires.

Fig 3: Part of a timber plantation up in flames in Manicaland. This is a potential threat to future availability of timber in Zimbabwe.

4.0 NATIONAL FIRE PROTECTION STRATEGY (NFPS)

The National Fire Protection Strategy was developed with the aim of providing guidance on how fire was to be managed throughout the country. It is coordinated by EMA and focuses mainly on fire prevention and suppression and has components of awareness raising and training. The national strategy alludes to the need to strengthen environmental education in all areas in order to engender people's values skills, behavior and attitudes consistent with sustainable environmental management.

5.0 COMMUNITY BASED FIRE MANAGEMENT (CBFiM) APPROACH IN MATABELELAND NORTH AND MANICALAND.

The CBFiM approach is drawn from the realization that grass roots fire management is not adequately catered for in the objectives of the NFPS document though mentioned in the preamble. The purpose of this pilot project was therefore to pilot decentralization of fire management to the local community level.

The specific project objective was ***to reduce the threat to rural lives and livelihoods and to the natural environment caused by wildfires in gazetted forests and forest plantations during the winter fire season of 2008 and beyond by increasing awareness of stakeholders and by providing training in forest fire prevention and control, thus leading to a reduction of 80 percent in 2008 in fire incidences and damage as compared to earlier years.*** The project was implemented over a one and half year period between 2008 and 2009.

5.1 Project institutional structure and method of implementation

This project was implemented by the Ministry of Environment and Natural Resources through the FC and the EMA. There was a national steering committee comprised of stakeholders from public and private organizations, which was led by the National Project Coordinator (NPC) from the FC. This set up was duplicated at Provincial and district levels, with the Provincial and District (Fire Management Facilitators- FMF) heads of Forestry being Coordinators at the 2 levels respectively.

Community Based Fire Management Facilitators (CBFMF)) were set up to coordinate all fire management issues at ward level. Stakeholders at Provincial, District and local level were trained in fire management as a way of capacitating/preparing them for implementation of the project and to coordinate all issues to do with fire in their respective areas. Meetings were held at all levels to monitor progress.

The project received technical assistance from a Forest Fire Specialist (International Consultant) and National Fire Consultants. The FAO Forestry Officer and the FAO country representative provided technical and administrative support respectively.

5.2 Awareness creation on forest fires

Awareness campaigns started at National level during the national launch of the project at which the Minister of Environment and Natural Resources Management was Guest of Honor. This was then followed by two launching ceremonies held in the targeted Provinces, which were led by the Provincial Governors. The launching ceremonies cascaded down to the districts where 10 ceremonies (one in each district) were held. The project was also launched in 20 (2 per district) targeted communities. These ceremonies were meant to create awareness about the project amongst stakeholders at all the mentioned levels. It was also the intention of the launching ceremonies to invite local leadership; political, traditional, administrative at all levels to buy into the project for the sake of its success.

The print and electronic media were other approaches used to create community awareness of the project. This involved radio and TV recordings, mass media advertisements, fliers and posters.

5.3 Training in Forest Fire Management

One of the major objectives of this CBFiM project was community capacity enhancement in fire management. A Training manual was produced and used in the training of CBFMF members. 2 FMFs (FC and EMA) per district were nominated to coordinate the implementation of the project at the grass roots level. The FMFs were trained under a Training of Trainers programme and they were then able to train CBFMFs and communities in their respective districts with the National Fire Consultants.

An important training objective was to extend the use of controlled burning beyond wildfire hazard reduction to land use and environmental management objectives. Emphasis was put on techniques that use fire behavior and existing structures such as tracks and pathways to plan and implement controlled burning with the least effort. Training was done in a participatory way, such that it accommodated ideas, views and opinions from all participants.

A total of 200 CBFMF members were trained in the two Provinces. Main topics covered in the training were Fire behavior, Fire management planning and implementation amongst others. Emphasis was put on the use of controlled early burning as a tool for effective forest fire management due to its effect of depriving the late dry season of fuel, thus reducing fire heat intensity. It was also noted that the early burning (done during the cool/cold dry period) regimes had minimal effect on both flora and fauna due to low heat intensity fires.

Training also covered use of equipment in fire protection. The soil type dictated some of the equipment; Matabeleland north for instance was issued with shovels because of the appropriateness of this tool in sandy soils; Manicaland was given fire beaters instead.

The Training manuals were distributed to each CBFMF member as reference material; some of the stakeholders also received these manuals. The high demand for additional copies of the manual indicated its usefulness. These manuals and tools are now being used by FC, EMA and the Zimbabwe Civil Protection Unit in their fire protection campaigns and training.

Collaborative management between neighbors, stakeholders and the Fire Management Facilitators demonstrated the support for the project and for the ward brigades to implement their duties with confidence.

Fig 4: Communities developing a Fire Management Plan during a training session in Manicaland Province.

5.4 Environmental education

Training of communities was done in an integrated manner which took forests as an integral part of the broader environment, made up of the human system (man and his physical assets) and the ecosystem (natural assets). Communities were therefore taught to manage their environment in a holistic manner, knowing that fire prevention and control were not just meant to protect forests but also the other community valuables such as property, life and pastures.

5.5 Fire fighting tools and equipment at community level

Communities were issued with tools and equipment in the form of shovels, fire beaters, knapsack sprays, racks and a wide range of related tools and equipment. CBFMFs were issued with overalls, boots, gloves and helmets as protective gear. Communities were however taught that the lack of any of the tools/equipment should not constitute a constraint in fire fighting activities. They were advised to improvise with locally available alternatives such as buckets, branches and other appropriate locally available tools/material.

A Traditional leader or a Local Authority member was nominated to be responsible for storing the equipment in a secure yet readily accessible place.

The Matabeleland FC was issued with 10 VHF radios to re-establish the communication network at Forest stations and in FC vehicles to enhance communication during the fire season. There was an improvement in fire reporting and reaction by both FC and communities as a result. Communities had their own means of communicating fire messages amongst themselves and with adjacent forest stations, such as drum beating and cell phones.

Fig 5: Practical controlled burning using fire beaters by members of the CBFMF in Manicaland.

5.6 Decentralisation of fire management (Integrated Fire Management Strategy)

The concept of CBFiM was taken to communities with the intention of ensuring that they understood and accepted the need for them to be actively involved in forest fire management. Communities were encouraged to choose CBFMF, who then led all fire issues within their wards; they were also instrumental in the dissemination of fire related information.

Focus was on the use of fire as a resource. Controlled burning was used as an effective tool in managing wildfires, land use and the environment. The key elements of the strategy was decentralization of fire management to the grass roots level; property specific fire management programmes; and a coordinated approach linking programmes through neighbor collaboration. Communities in the project areas and the immediate environs benefited through pasture availability throughout the dry summer period and safety of their lives and property. Results of adoption of this approach by communities in the project areas were that:

- Fire management plans were developed and implemented.
- CBFMF (Brigades) were established and became functional.
- Project areas in Manicaland witnessed a drop in area burnt from 15000 ha in 2008 to only 100 ha in 2009. This represents a reduction of about 99.0%.
- In Matabeleland North Province, area burnt in the project areas dropped from around 17400 ha in 2008, to 4600 ha in 2009, representing about 75.6%. This was however preceded by a

2333.6% rise in area burnt between 2007 and 2008 (715 ha to 17400 ha respectively), maybe communities had not yet internalized the CBFiM concept.

The above statistics are based on the records captured CBFMF in their respective areas.

5.7 Study tour

Its objective was to enable key members (Project Coordinators at the National and Provincial level) of the project implementation team to experience the progress and achievements of the 3 year Caprivi Region Integrated Fire Management Programme in Namibia.

Visiting a community Fire Management Committee (Brigade) gave the Zimbabwean team members an insight into grassroots decision making on fire issues. The team also participated in a practical collaborative fire management activity. It was joint burning within Mudumu National Park with Park Rangers, Community Fire Management Committees and NGO staff. This was firsthand experience that was shared with project communities back home.

Fig 6: From left to right- Manicaland Project Coordinator (Ms. M Mapanda), National Project Coordinator (Mr. S Zingwena) and Matabeleland North Project Coordinator (Mr. MM Sebele) pose for a photo during their study tour in Namibia.

6.0 LESSONS LEARNT

- The project ran for one and half years, which was too short a period to adequately evaluate and be conclusive on its impact. The Namibian Community Based Fire Management project was observed over a relatively longer period; impact could therefore be validated with a high degree of confidence. A fire project would require 2-3 seasons for impact to be adequately felt. Notwithstanding the above, communities in the two Provinces witnessed a marked reduction in area burnt between 2008 and 2009 (average of 87.0%).
- Political commitment is important in influencing community ownership and participation in projects. This was evident following the launching ceremonies held at the three levels of Province, District and Community. Communities were encouraged and motivated by their leadership commitment to the project.
- Use of fire as a resource was already being practiced in the project areas; it took the form of burning along contours to improve grazing, as well as burning to clear farm residue in the fields. These practices were however not organized as they did not take into account the temporal, fuel and other dynamics of fire. With knowledge acquired under this project, communities were able to improve their practices and use fire as a resource by effectively conducting early controlled burning, which had the effect of reducing fuel load during the dangerous late dry period.
- Community Based Fire Management needs to be incentivized if communities are to collaborate with other stakeholders. Issuance of protective gear and equipment motivated CBFMF to perform their duties diligently and as required by their communities. Communities are committed to work on a project without remuneration if the project has clear benefits to

their livelihoods and this should be encouraged under CBFiM, some form of incentive would however be required to sustain the voluntary spirit.
- Communities at times do certain actions out of ignorance. The awareness campaigns and training given under this project clarified some issues (for instance fire legislation), which were not known to some community members. There is however a gap in the area of decision making by fire crews; there is over reliance on Foresters before taking action on fire. This needs address if full CBFiM is to be realized.
- Perceptions on fire differ between people settled inside and those outside gazzetted forests and treatment of these perceptions requires different approaches.
- The recognition of traditional leaders in Community Based Natural Resources Management (CBNRM) projects implemented in their areas works as an incentive for them to render optimum support and protect implementers from potential rowdy elements of the community,
- Linkages must be established between community based institutions with common interests to enhance grassroots collaboration as was observed in Caprivi. In the case of Zimbabwe project linkages could be established between the community based fire management with such structures as CAMPFIRE committees, Council Environment and Natural Resources Management Committees and the Environmental Management Agency facilitated Fire Management Committees, among others.

7.0 WAY FORWARD/FOLLOW UP ISSUES

- The TCP ***Reducing Forest Fire Emergencies…*** managed to achieve a significant measure of its objectives registering a reduction of over 80% in area burnt during the second fire season, such that it would be prudent to upscale the project by developing a National Integrated Fire Management Strategy (NIFMS)which recognizes the role of communities in fire management. Emphasis should be put on the use of fire as an effective resource in controlled burning.

- Strengthen institutional capacity and resources within the Ministry of Environment and Natural Resources Management- FC and EMA to effectively coordinate and implement the proposed NIFMS at National, Provincial and District levels.
- Resources are currently limited so it might be difficult for CBFiM to easily get adequate funding from any sources. There is need to develop local level capacity to generate and manage funds, which could be used in sustainable natural resources management including fire management. Fines charged by traditional leaders for natural resources related offences could be considered for this purpose; other options could be explored.
- There is need to investigate existing legal and policy framework to support Reduced Emissions from Deforestation and forest Degradation (REDD) as a potential sustainable funding source in future. Current investigations on Climate Change under the “national forestry programme” could inform this process and provide the necessary guidance for the REDD initiative in Zimbabwe.

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FROM FIRE MANAGEMENT TO RURAL DEVELOPMENT. A COMMUNITY BASED FIRE MANAGEMENT CASE STUDY FROM SYRIA.

by

Said Helal

Abstract

The majority of wildfires in Syria (95%) are human caused and are often associated with changes in land use patterns and practices. Further, lack of appropriate land development policies in Syria have led to extensive deforestation and ecologically inappropriate fire use. This situation could change positively if the access to natural resources by the local population would be better considered in the legal and regulatory systems. The recognition of local people's rights would reduce land tenure conflicts, whereby stakeholders will take their role to protect forests from fire and cutting.

The ultimate outcome of the on-going FAO Project is the establishment of "an integrated community-based fire management system". This system includes community development plans, application of silvicultural practices and fuel reduction techniques with the involvement of local community-based organizations within pilot forest areas. Training of community representatives and local staff on sustainable forest and natural resources management, and on the development of incomes generating activities are also part of this project.

To make Integrated Forest and Community Based Fire Management a viable option in Syrian forestry, the Project continues to promote an ecosystem approach to achieve greater integration and participation of communities. By strengthening livelihoods, working on food security and poverty alleviation of forest and mountain inhabitants within a framework of integrated watershed management the negative impacts of fires are thought to be reduced.

Introduction

FAO's vision is of a world free of hunger and malnutrition where food and agriculture contribute to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner. To foster the achievement of this vision and the Millennium Development Goals, FAO will promote the continuing contribution of food and sustainable agriculture to the attainment of three global goals, among them the "sustainable management and utilization of natural resources, including land, water, forest, climate and genetic resources, for the benefit of present and future generations".

Forest resources contribute directly to livelihoods and can complement other key components of poverty reduction and food security. Unfortunately, the world's natural forests are shrinking, and global climate changes are expected to have serious impacts on forests and agricultural systems. Fire has been a major influence on the development and management of many of the world's forests.

The forest areas of Syria are considered relatively densely populated and consequently are supporting the livelihood of many local communities. The high population growth led to an increasing pressure over the natural resources in general and on forest resources in particular. The forested areas have gradually degenerated mainly because of deforestation, overgrazing, fire, overcutting for fuel and charcoal production, clearing for cultivation and general lack of management. This process of forest degradation has led to severe water and wind erosion, loss of biodiversity, deterioration of land and water resources and lowering of agricultural productivity; and therefore risked therefore the local people livelihood and food security.

Background

The territory area of the Syrian Arab Republic is 185,180 km^2 of which 32.2 percent is cultivable land, 20 percent uncultivable, 2.7 percent forests and 45 percent steppe and pastureland. The forest lands in Syria cover approximately 501,650 ha, of which 234,500 ha are natural and 267,150 ha are man-made plantations, which is equivalent to 2.71 percent of the territory (CBS, 2007).

The total population of the country was estimated in 2007 to 19.4 million inhabitants of whom 51.2 percent male and 48.8 percent female. The rural population represents about 50 percent, mostly living around the forest areas. Population growth in rural areas is causing a significant increase in land reclamation for agricultural purposes, accelerating forest land conversion into cultivated lands for crops and trees. Moreover, urban expansion is contributing in shrinking forest areas. The population of Syria is growing at a rate of 1, 95%, which is equivalent to an annual population increase of 350 000 persons. This means that the Syrian population has grown by three (3) million people since the FAO Integrated Forest Fire Management (IFFM) project started in 2004, and by four (4) million for the period 2000-2010. This implies, that 350 000 new students are entering school every year, and that all of them need to be educated in fire awareness programs. The Forestry Directorate (FD) fire statistics show, that the more people there are, the more fires will occur (see chart below).

Fire ecology and statistics

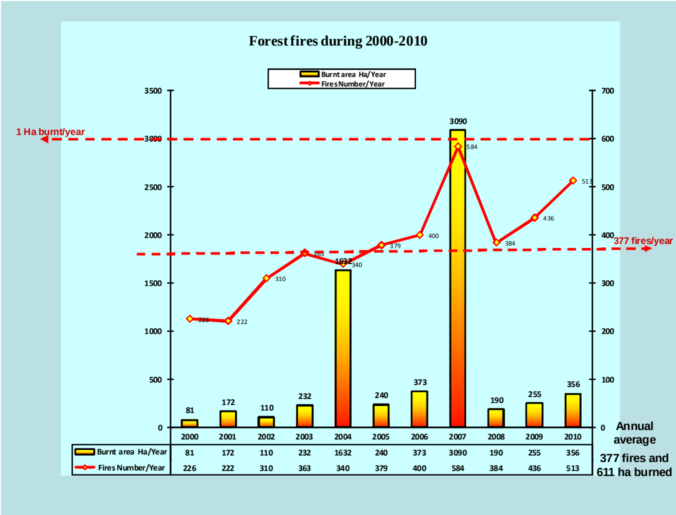
The fire ecology in Syria has evolved along the same lines as in the other countries of the Mediterranean basin. Over the past thirty years, the frequency and intensity of forest fires in Syria has increased. Human use of fire (anthropogenic fire) has changed the natural fire regimes and composition of flora and fauna particularly in Syria, during its 8 000 year long history on civilization. The uncontrolled use of fire, especially during the last 2 000 years, has drastically changed the species composition of present forests and wood lands in Syria, which have become **fire-dependent** instead of **fire-sensitive** as during historical times. These “original” **fire-sensitive** Syrian forest species: Abies, Alnus, Castanea, and Plantanus can still be seen along water courses and in some protected areas.

The decline in silvicultural managed areas in Syria (the size of area treated annually has remained the same for many years) has resulted in too high fuel loads that will result in more intense fires during unusually dry years, coupled with the loss of species that had thrived in more open forests landscapes that previously burned more frequently and less intensely. With present fire ecology prevailing in Syria, it is essential to involve local forest communities in assisting the Government in silvicultural forestry activities, especially to reduce the present high fuel loads observed in most forests.

The lack of procedures in Syria for the use and application of prescribed (i.e. controlled) fire, will in the future result in fires that severely damage forests, soils, and watersheds, and an increasing economic cost both in lost property, reduced water for irrigation and cost in fighting these fires. Landscapes like in Syria depend on fire to maintain native species, habitats and landscapes, which have evolved into so called ***fire-dependent ecosystems.*** Conversely, there are other areas, where fire can lead to the destruction or loss of native species and habitats. These areas are called ***fire-sensitive ecosystems***.

Services provided by ecosystems such as clean air, clean water and healthy and productive soils can be affected negatively or positively by fire depending on the adaptations of the species and other characteristics of the environment, and on how often and how intensely an area burns. Still, the role of fire in many ecosystems around the world is poorly understood by scientists, and generally not recognized at all by society. Where the benefits of fire are recognized, the ecologically appropriate fire regime may be unknown like in Syria.

At the national level, both the number of fires as well as total area burned are continuously increasing since year 2000. Presently the average annual fire figure is **377** with a burned area of **611** ha. The improved fire preparedness and fire suppression has resulted in that the average size of forest fires has remained manageable. However, it is to note, that both the fire weather in 2004 as well as in year 2007 was extreme all over the Mediterranean area (see chart here-cons).



The FAO Project "GCP/SYR/012/ITA" Objective and Implementation Strategy

The majority of wildfires in Syria (95%) are human caused and are often associated with changes in land use patterns and practices. Further, lack of appropriate land development policies in Syria have led to extensive deforestation and ecologically inappropriate fire use. This situation could be reduced when local peoples' uses and needs are considered in the development of legal and regulatory systems. The recognition of local people's rights would reduce land tenure conflicts, where stakeholders will play their role to protect the forest from fire and cutting.

It is therefore necessary to address the reasons for these fires, rather than only trying to increase the suppression capacity or by tightening fire legislation. Fire and forestry professionals need to be looking for solutions to these problems beyond conventional fire management approaches. National and community-based solutions need to be sought; solutions that engage local communities, NGOs and other stakeholders who are critical to success. There is a need to apply an ecosystem approach wherein all fires regardless of the reason behind them, are managed in an integrated manner that takes into consideration the needs of nature and people, especially communities living within or around forest land/areas.

Taking into account its multi-disciplinary nature, the Italian funded FAO Project "Integrated and Community-Based Forest Fire Management - GCP/SYR/012/ITA" has been implemented in a holistic way on the basis of sustainable forest management principles. The challenge is to reconcile the role of the forests in meeting national and local socio-economic objectives as well as environmental objectives. The integrated forest fire management strategy developed under the previous phase and reinforced by the on-going project stressed the need for a *fundamental change in the mentality, the attitudes and approach of the forest service,* and in the *behaviour of the local communities in regard to the forests, in general, and to forest fire management, in particular.* It also allowed to think about forest wild land fires in more ecological terms and to change the traditional mission of the forest managers from forest fire control to genuine forest fire management.

In this regard and in addition to backing up and reinforcing IFFM strategy initiated by the first phase, the on-going FAO project attempts to *ensure sustainable forest resources management for the best of the Syrian population livelihood through enhancement of the capacity of wild fire management of the Forest Directorate of Ministry of Agriculture and Agrarian Reforms*. The ultimate outcome of the project is the establishment of "an integrated community-based fire management system". Community Based Fire Management (CBFiM, FAO 2006) is a management approach based on the strategy to include local communities in the proper application of land-use fires (managed beneficial fires for controlling weeds, reducing the impacts of pests, and diseases, generating income from non-timber forest products, creating forage and hunting, etc.), wildfire prevention, and in preparedness and suppression of wildfires, in addition to restoration and rehabilitation of burned areas.

Planning for local community development

To make IFFM/CBFiM a viable option in Syrian forestry, the Project initiated in 2009 the involvement of local communities in four selected pilot villages of Bassaleya; Aleppo, Beksareya; Idleb, El Bassel; Lattakia and Blusseen-Beit Jach; Tartus, in the formulation of local forest fire management plans and in their implementation. Several community meetings and interviews with user groups have been organized allowing to assess the community situation and problems encountered and to identify needs and priorities of community members. The preparatory work, some of which already was started in 2005 under the previous phase, had already raised the expectations of community member's vis-à-vis initiation of a number of activities by the Project.

Following the diagnosis phase, several planning meetings and interviews with user groups and local staff have been organized to help up in building up and develop community plans for each pilot village. Fishbein/Maslow charts were used to assess the present socio-cultural levels and state of community members. The identified needs and problems were prioritized and validated with the help of four communities. About half of the identified problems (47%) have been reported by all the four villages or at least by three villages. These needs and problems can be classified into three categories as follows:

- Needs and problems that could be met and solved by the project, e.g. "*lack of fuel wood"*, "legal access to NWFPs", "*the production of organic fertilizers*", *etc*.
- Needs and problems for which the project can play a role of mediator in order to raise these needs to be met/solved by other competent institutions, e.g. "*olive trees do not produce fruits*", "*lack of water for irrigation*", "*lack of transport*", "*make credit available*", *etc*.
- Needs and problems for which the project can play a role as reporter to the related authorities, e.g. *"low price of agricultural products", "high cost of chemical fertilizers", etc.*

After prioritizing and validating the identified needs and problems of the four pilot communities, a community development plan for each of the four communities was drafted. Specific interventions (mini-projects) as well as field training of local people were identified such as fuel breaks maintenance, production of organic fertilizer, collection, storage and marketing of NWFPs, including food security issues related to mushrooms, apiculture and aromatic plants, water harvesting techniques, as well as raising the literacy of women, and integration of gender. The four major identified and recorded interventions are:

- The development of farming, including management of water resources;
- Raise the standard living of local community through different income generation activities;
- Developing the management of forestry resources including the community based forestry fire management,
- Improving infrastructures.

Each local development plan included a detailed timetable of main activities and sub-activities to be implemented within the framework of the major interventions, including method, place and period of execution, responsibility and target group, and regrouped as follows:

i. Raising awareness of the pilot communities,

ii. Interventions for meeting community needs and solving their problems,

iii. Formation of IFFM voluntary groups,

iv. Income generation activities.

Each of the four drafted community development plans was discussed with the concerned technical group of the Project after it has been completed. Each plan was also discussed thoroughly with its concerned local community. All the received comments upon the drafted plans from all parties have been taken into consideration for the improvement/finalization of said plans. Many legal and institutional arrangements are required including the forming of Voluntary Groups/Community-Based Organisations, design of a standard “Community Contract” to cover pilot activities, and the development of procedures and appropriate working methods for implementing community-based fuel reduction programme/activities in selected communities.

During these interviews, which were attended by more than 200 villagers, it became obvious, that from **Beliefs** on fire management and forest activities, people’s **Attitudes** had already changed. The majority of participants had reached the level of intentions. The on-going field implementations will strengthen their determination to change their **behaviour**.

Public awareness rising

To achieve planned changes in the behaviour of Pilot communities members as well as of other target beneficiaries in order to manage the use of fires locally and to develop the People preparedness in fighting fires that supports other efforts relating to the development of Syrian forestry sector, the Project assessed the achievements of the national fire campaign launched throughout the first phase (GCP/SYR/010/ITA). This assessment represented an essential step for the adjustment of extension efforts that could actively lead to an accomplishment of a successful awareness raising process. According to the assessment results, public awareness raising programs and implementations are inadequate and need strengthening by giving increased attention to rural people, and particularly women, by using tools such as TV broadcasting and roadsides billboards. Also, the assessment allowed valuable conclusions on the current awareness raising campaign and results which were not sufficient to influencing forest neighbours’ and local communities’ awareness concerning forest fire;

as well as clear recommendations regarding trends/perspectives for building a learning-centred awareness campaign, effective criteria for preparing awareness material, and an outline proposal for updating of the awareness plan.

To help implementing these proposed changes, the Project organized two CBFiM training courses for the profit of local Forestry Engineers and Extensionists in facilitation and development of new Community skills vis-à-vis management of forest and local livelihoods to encourage field implementation of improved approaches (Pedagogy, Neuro-linguistic programming, body language and human behaviour) in fire extension work between the Project staff and local villagers. The training provides for increased skills in persuasion and motivation, thereby the staff are being able to prepare belief-targeted messages and testing their effectiveness in the pilot villages.

Th**e** new tools provided centred on strengthening of participant’s capacities in changing beliefs, attitudes and behavior of the Extensionists through a variety of approaches, enabling them to develop local resources, improve local food security, increase income for community members and increase the capacity of communities to manage fires in an environmentally acceptable way.

The Project supported activities of students and teachers of both schools of pilot villages of Beksareya and El Bassel, of wall journals featuring the importance of the forest resources and how to protect them against fires, and the establishment of a green area in the school yard. Also, roadsides billboards summarizing the Project activities and warnings concerning fires use have been designed and installed along roads leading to the pilot village of Beksareya.

The Project also participated at the celebrations of World Food Day and other national Agriculture Exhibitions, and to the organization of several meetings for forest fires prevention during Youth camps

Capacity building for community members

According to training needs of community members as identified by local community plans of pilot villages in community-based fire management, including income generating activities, to increase their knowledge of legislation, and to provide community education on fire management issues in order to enhance community preparedness and response, a training program 2010 for capacity building of local community representatives was prepared and different sessions were organized in selected topics of organic fertilizer production, apiculture, mushrooms, medicinal and aromatic plants cultivation and fuel reduction techniques.

During the past two years, twenty (20) training sessions in selected topics have been implemented in the profit of a total number of 372 participants as representatives of local communities in pilot villages of Bassaleya, Beksareya, El Bassel and Blousseen-Beit Jach, in addition to 233 technicians from the forestry circles of the designated governorates of Aleppo, Idleb, Lattakia and Tartus.

Each training session has been attended by an average of 20 participants from pilot communities (10 female and 10 male participants) and 10 technical staff from the Forestry Circle to create synergy and collaboration between project staff and local community. The community training courses implemented are summarized in the table below.

Topic	Duration	Trainers	Aleppo	Idleb	Lattakia	Tartus
Medicinal and Aromatic plants; cultivation and processing	3 days	Dr. Jamal Radwan	1, 2, 3, June, 2010	24,25, 26 April, 2010	18, 19, 20 May, 2010	7, 8, 9, June, 2010
Production of organic fertilizer and mushroom cultivation	1 day	Dr. Riyadh Zeedan	27 January 2011	26 January 2001	20 January 2011	1st June, 2010
Apiculture and bee keeping	2 days	Dr. Abdulla Hattoum	4,5 August, 2010	21,22 July, 2010	13, 14 June, 2010	18,19 July, 2010
Fuel reduction techniques (fuel breaks and roadsides clearing)	1 day	Dr. Georges Kadah	6 July, 2010	28 June, 2010	18 July, 2010	20 July, 2010
Silviculture; thinning and pruning techniques	1 day	Dr. Georges Kadah	9 November 2010	8 November 2010	17 October 2010	26 Oct. 2010

All training sessions included both academic courses and field exercises implemented within the surrounding forests of the pilot villages. Also, field visits to pilot farms of medicinal and aromatic plants cultivation and to mushrooms production and apiculture projects have been organized for the profit of the representatives of pilot communities and forestry staff in the designated governorates. In collaboration with "the Women Union", the project trained local women/girls of the pilot village of Bassaleya in handicraft, embroidery and marketing.

Capacity building of forestry staff

On the basis of training needs assessment, the Project provided a variety of training opportunities in Syria and abroad to increase the local capacity of Forestry Directorate staff to develop and implement proactive fire management approaches in upland communities; improve community involvement in fuel reduction management, and to increase livelihood security by improved skills in generating income activities.

As indicated above, the Project organized during the past two years twenty (20) training sessions in selected topics for the benefit of 233 technicians from the forestry circles of the designated governorates of Aleppo, Idleb, Lattakia and Tartus covering the following selected topics: *Medicinal and aromatic plants cultivation and processing; Mushroom cultivation, processing and trade; Organic fertilizer production; Apiculture; Silviculture and fuel breaks and roadsides clearing*. In addition to technical staff, all these training sessions have been by the representatives of the pilot villages to create synergy and collaboration between Project staff and local community.

In addition, the project continued during its second phase providing specialized training on forest fires management to strength capacity of forestry staff at central and local levels. The training need on fire suppression approaches and methodologies has been addressed by a "Training of Trainers" workshop and correct suppression actions were expected to be passed on to the many fire crews around the country. The training included both academic courses and field exercises focusing on the following major issues: Fire planning; Incident Command system; Early warning system and Keetch-Byram Drought Index process; Fire information system; Fire suppression techniques; and watch tower duties. Field exercises on basic fire fighting skills have been arranged separately and in collaboration with civil defence crews. For being repeated for several times during the previous phase of the project and the last years, training of fire crews seems to become automatic and reflects a good mastery of fires fighting.

Also, the Project provided specific training courses on the use of recording weather stations to facilitate the establishment of Early Warning System of fire danger that provides for an effective Fire management system and local emergency plan for threats and potential severe conditions throughout the daily monitoring of meteorological data; as well as on geographic data collection and forest management using GPS, GIS and visual interpretation of satellite

images, conducting field survey in pilot sites, and to produce general map for the Syrian forests in selected governorates of Lattakia, Tartus, Idleb, Aleppo and Hama; as well as design of management plans for pilot subsectors, including fire risks and prevention.
With the purpose of building capacity of FD local staff on IFFM/CBFiM through exchanging information and experiences in sustainable forest management and developing cooperation with regional countries, two study tours were held in Tunisia and Turkey, two countries that have similar fuel, topography, social environment, etc. for the profit of thirteen (13) forest engineers/technicians involved in the implementation of the GCP Project activities at national and local levels.

Ecosystem approach "sustainable mountain development"

Fires on steep slopes cause extensive soil erosion during the rains following the fire occurrence. Many hillside communities have lost most of their fertile top soil due to earlier or recent high intensity fires; and consequently their food security became compromised, in addition to loss of water and biodiversity. Therefore, it would be an advantage for many poor farmers to learn techniques in composting and water harvesting in order to restore soil fertility. This would enhance crop yields as well as increase their present level of food security. In addition to training of the representatives of local community and forest staff in organic fertilizer production, the Project initiated the development of an "integrated participatory watershed management program" which should enable the implementation of an ecosystem approach for enhanced role of natural resources in food security, and to reducing the negative impacts of forest fires on rural livelihoods and the climate change. It allows a smooth transition from "*forest fires prevention to the rural development*". A project document on "Integrated Participatory Watershed Management in the Coastal Area of Syria" and a draft of "Concept Paper towards the Development of an Integrated Watershed Management Strategy in Syria" have been prepared. Also, a proposal for the establishment of a Watershed management Unit detailing the rational, functions, responsibilities and affiliation of national and provincial entities has been drafted. The proposal draft includes valuable inputs regarding the methodological, technical, institutional and legal issues for the establishment of an integrated participatory watershed management capacity.

Financial partnership and synergy with other stakeholders and relevant projects

The development of participatory and community based forestry projects requires efforts for involvement of local communities and stakeholders but also adequate involvement of foresters willing to understand and accept new ideas and approaches. In other words such a project should not only involve Project staff, consultants and local villagers, but foresters should also be among the main decision making and implementation partners. Otherwise sustainability and expansion of the project's results are seriously risked

Another important issue is how to complete implementing the income generation/livelihood improvement activities planned under the project. The project budget does not have, except training, adequate resources for supporting such activities (e.g. bee-keeping, non-wood forest products' cultivation, collection, processing, marketing, small water resources utilization structures, etc.). Implementation and sustainability of such activities requires at least some additional resource allocations from the other related agencies at the central as well as local levels. Adequate involvement of the director of agriculture, provincial or district governors as well as other government agencies in planning and implementation of the project's on the village and/or watershed level development activities requires special attention and efforts. It should be remembered that as long as field implementations are not materialized and visually not seen by the local communities, foresters and other decision makers, unimplemented participatory assessment and planning's results are not adequate alone for the project's successes.

In 2010, the Project managed to establish a partnership with the Agricultural Development Project in the Coastal Region and the Rural Women Empowerment Departments at central and provincial levels (RWE) that resulted in the preparation of comprehensive programs for training women and young girls of the pilot villages on several topics for enhancing their skills and to support them in developing of income generating activities; including through providing of small loans. These annual programs, which are of a great support to the Project field implementations, should be materialized during 2011 in close collaboration between the provincial Project Units and RWE Circles. Other opportunities of mobilization of additional financial resources and the development of partnership with others stakeholders; mainly directors of agriculture and provincial and district governors in the designated governorates should be investigated.

Sustainability of the Project activities

Over the last two years, the project has gone a long way to initiate a community-based forest fire management approach as well as to introduce an institutional development and legal arrangement for the involvement of local communities and other stakeholders, including local foresters in the sustainable management of natural resources and forest fires. The Project also identified an experimental community-based fuel reduction program of 50 ha, including 25 ha of silviculture activities and 25 ha of fire breaks and road-sides maintenance, which has been incorporated into the community development plan of each pilot village. This experiment has been started in 2010 with the involvement of local people under the technical supervision of trained forest management units being allowed thinning and pruning of a total forest area of 47 ha and clearing of 12 km of roadsides in the neighbouring forests of pilot villages. This work should be continued during 2011 and might extended to other densely forest stands.

However, these achievements still need to be consolidated. Indeed, the number of fires is continuously increasing since year 2000 in spite of the fire awareness work carried out by the FD has increasingly been expanded and the quality and efficiency improved. Apart from fire behaviour, the understanding of human behaviour is equally important and need to be fully understood by the FD staff and field extensionists. A real participation of local communities will only be reached if they will receive benefits from their involvement in fire prevention and management. The following strategic important issues have to be considered:

- Institutional issue: special institutional arrangement which should break with the Top-Down approach and can help the local communities to be effective partners in the management of forests and the development process that leads to conserving forest resources and fires management.
- Legal issue: new legislation and bylaws should be issued for an enhanced forest legal framework. This will protect user's rights of local people and enable them to have access to the natural resources and ensure their involvement as real partners of FD in the sustainable forest management. In this respect the proposed legal drafts for i) Creation of community-based organizations "Forest Neighbouring' Associations (FNAs)", ii) Contractual agreement for officially engaging the FNAs by the Forest Circles in the implementation of silviculture and fuel reduction activities in surrounding forests, iii)

review standards of implementation of the user's rights should be urgently endorsed and put into effect.

- Technical issue: providing practical conditions for the involvement of local people in fuel reduction implementations, as well as the development of a protective silviculture, including norms to reduce fires hazard and improving the capacity of forest areas to protect themselves against fires, It is fully recommended identifying and implementing an integrated and community-based forestry planning and management project. The project will contribute to strengthen and mainstream policies, laws, regulations, strategic and management plans operational practices and institutional capacity of Forestry Directorate of the Ministry of Agriculture and Agrarian Reform to achieve greater integration and participation of communities to focus on livelihoods and integrated forestry planning and protective silviculture to reduce fire risks and to facilitate management of forest resources on a sustainable basis.
- Financial issue: the project has very limited budget to finance the implementation of the community development plans of the pilot villages, therefore additional financial support from different sources have to be searched and mobilized for and by the FD. Responsibility and financial support should be shared as well with partners and all stakeholders including local communities.
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Conclusion

To make CBFiM/IFFM approach a viable option in Syrian Forestry and to safeguard the sustainability of the FAO Project activities after its termination, many changes in forest management processes need to be started or reinforced namely:

1. To change the fundamental vision, mission, values, attitudes and approach of Forest Directorate staff *vis-à-vis* forests, in general, and forest fire management, in particular;
2. Integrate forest communities into the economic circuit of the forests, regarding them as partners in forest development, forest fire protection and sustainable use of natural resources. Local communities should receive more training about collection of mushrooms, aromatic plants as well as methods to improve their agricultural yields of e.g. tobacco, and fruit trees by local production of organic fertilizer through composting of all types of bio-degradable fibres and plants;
3. Convince communities that involvement in forest fire management will improve their livelihoods, health, food security and water harvesting; and not only, that they are needed to fight fires in government owned forests. A real participation of local communities will only be reached if they will receive benefits from their involvement in fire prevention and management;
4. Develop norms for Community Based "protective silviculture" to improve the capacity of forest areas to protect themselves against high intensity fires, by reducing fuel loads, providing "defensible" space for fire fighters and possibly waste materials like small branches and twigs for production of organic fertilizer;
5. Enhance the forest legal framework to allow/safeguard the official involvement of local community in forest fire management, livelihood development and food security.

EMERGENCIES CAUSING HIGHER FIRE RISKS; HURRICANE FELIX IN NICARAGUA.

by

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Abstract

Fire risk can be increased or complicated when other emergencies occur. In Nicaragua different emergencies influence wildland fire risks. Severe outbreaks of the southern pine beetle developed in native forests of *Pinus caribaea* and *P. oocarpa* in Nicaragua between 1999 and 2002 in northern Nicaragua. This caused in Nueva Segiovia, an increase of fuel and of fire risk. The situation was complicated by an earlier emergency which had left personal mines in the same forests. While the place of these mines originally was known they where later removed to other places by landslides as a consequence of a hurricane.

This paper will analyse the consequences of the Hurricane Felix (2007) in another part of the country; the Región Autónoma del Atlántico. The hurricane felled many forest trees, which caused a mayor fire risk during the following summers. Government agencies with the local community and with support from FAO worked on the reduction of this risk and strengthen the livelihoods of affected population.

The paper highlights the importance of the used community based and integrated fire management approach in order to reduce fire risks during the following fire seasons.

BACKGROUND

The weather conditions in the last ten years have become a very recurrent issue in Nicaragua. Natural phenomena's have been affecting the most vulnerable areas in our country affecting livelihoods of an already poor and vulnerable rural population. They also caused serious damage to natural resources and fragile ecosystems.

In a quick retrospective of these, Nicaragua has been visited by hurricane Allen (1980), hurricane FiFi (1982), hurricane Jeanne (1988), Gilbert (1988), Mitch (1998); tropical storms Bret and Gert (1993); and the two last ones were the hurricane Felix (2007) and hurricane IDA (2009). The hurricane Jeanne and Felix require a special mention because they produced heavy damage to the forest ecosystems of the Caribbean Coast in Nicaragua.

On September 4 hurricane Felix, classified as category 5 in the Shaffir-Simpson scale, entered in Nicaraguan territory and went through different areas of the

Caribbean Cost, particularly in the Autonomous Region of the North Atlantic (RAAN), causing at least three hundred people to die and many missing. A huge proportion of this rural population (92%) was already living in extreme poverty and depending heavily on natural resources.

There are two etnic groups in the RAAN: Creole (Afro-Caribbean) and mestizo and three indigenous groups: Rama, Sumo-Mayangna (sometimes divided by their languages into Panamasca and Tuashka) and Miskito. About one third of the population in the RAAN is urban in two-thirds are rural. The autonomous region has seven municipalities: Puerto Cabezas, Siuna, Waspam, Rosita, Bonanza, Prinzapolka and Mulukukú.

NATURAL RESOURCES AND WILD FIRES IN THE AUTONOMOUS REGION OF THE NORTH ATLANTIC (RAAN).

According to the National Forest Inventory (2008) the national forest area can be estimated at 3,254,145 ha, which means 25% of the national territory. Of this area 3,180,466 has (98%) correspond to natural forests.

The Autonomous Region of the North Atlantic (RAAN) has two different forest types: the pine forests (Pinus caribaea) and the biggest rain forest in Centroamerica. The region is one of the poorest of the country even though it is very reach in natural resources. Most of the communities live in remote areas that are extremely vulnerable to natural disasters.

According the National Forest Inventory the RAAN has 1,412,093 ha or 43 % of the total national forest area. The largest area or 49% of the total forest area is owned by indigenous communities. Private ownership accounts for 35% of forest area, the state and municipalities own 11% and 5% was not determined.

One of the biggest problems in RAAN has been the forest and agriculture fires because of their environmental, economic and social impacts. Wild fires destroy important ecosystems and big extensions of forest areas almost annually. In addition, they put in risk human lives, infrastructure and affect the biodiversity and natural regeneration.

In 2008 the affected area by forest fires was 26,138 ha, but in 2009 it was only 11,103 ha. As a result of organizing the communities, establishing and capacity building of voluntary community fire brigades, the forest fires in the RAAN have decreased.

A NATIONAL SYSTEM FOR PREVENTION, MITIGATION AND RESPONSE TO DISASTERS

Nicaragua has a National System for Prevention, Mitigation and Response to Disasters (Sistema Nacional para la Prevención, Mitigación and Atención de Desastres - SINAPRED) According to the Law #337, SINAPRED is responsible for:

- making the National System operational, ensuring appropriate staffing of the Secretariat and of member agencies;
- preparing and activating a National Emergency Plan, clarifying policies, procedures and standards to be applied;

- training System members in the planning and roles in disaster response, prevention and mitigation;
- establishing a Disaster Management Fund to assure sustained financing for emergency response and relief;
- establishing and maintaining a data base, supported by geographical information systems (GIS), relevant to disaster management, including information on hazard and vulnerability assessments, as well as on programs.

In case of an emergency, the Centro de Operaciones de Desastres (CODE) which is led by the Civil Defense, coordinates the response. SINAPRED is assisted by nine sector commissions (Education and Information, Natural Phenomena, Security, Health, Environment, Coordination of Humanitarian Aid, Infrastructure and Transport, and Special Operations).

The departmental/regional, municipal, and local committees – known as CODEPRED/ COREPRED, COMUPRED and COLOPRED respectively – are SINAPRED's decentralized structures and are headed by the governors, mayors, community leaders, ministries' staff and, often, civil society representatives.

STRENGTHENING THE PREVENTION AND WILDFIRES CONTROL SYSTEM IN RAAN

a. Objective

As a result of the hurricane Felix (2007), FAO Nicaragua started several projects in order to prevent forest fires, considering the increased fire risk by the forest mass that was felt by the hurricane.

The projects were mainly focused on the prevention and control of forest fires. This initiative, allowed developing different actions to prevent forest fires. The general objective of the project was to support the restoration and protection of the forest ecosystems.

b. The Institutional Coordination and Commitment with the Communities.

The Forest National Institute (INAFOR) and the Regional Government (GRAAN) were the counterparts for the implementation of all activities. One of the most important issues during the implementation of the project was to build local capacities and strengthening the technical skills. This policy brought us very good result during the implementation of all activities.

Regional government and INAFOR prioritized activities related to strengthening the prevention and control of forest fires because the enormous affected area (1,166,579 ha) with fallen trees represented an immense fuel load and thus a high fire risk. The risk was increased by the upcoming summer season when the communities traditionally use the fire as a tool for agriculture practices. There was a high risk for huge forest fires and a serious catastrophe.

Before the projects started any activity it was crucial to get in contact with the communities, to introduce staff and to negotiating activities to develop with the communities. This was a key step because the communities are the owners of the land and without their participation very little could be done. Building good relations with them and their participation from the beginning were key for all the activities later on. This process was led by project staff and institutional partnerships.

c. Operational Activities

The activities started with the definition of the affected areas with the highest fire risk. The big challenge was to strengthen the prevention and forest fires regional control system which was very weak before the hurricane.

Firstly, a training program on the prevention and control of forest fires was developed. This program was conducted with the participation of technical staff of INAFOR and in close coordination with the communities of the most vulnerable areas, like Rosita, Bonanza and Siuna. The training program contributed to the technical preparation of all stakeholders. Each workshop took place in the communities with the participation of all community members. The training program originally was set up for 40 communities to be trained but finally 85 communities were reached. As a result of the training program 2,352 stakeholders were trained in prevention and techniques of forest fire control. They are now part of the voluntary community fire brigades. Now there are 346 voluntary community brigades. Each one has 10 members. Note that the members of the brigades have not received any payment or salary for those activities. The voluntary community brigades in the most affected areas and where the fires have been most common in the past, received wildfire equipment

Part of the training program was also dedicated to 101 technicians of the agriculture and forestry institutions in order to develop capacities of other public institutions at regional level. The aim was to develop a local network for prevention and control of the forest fires.

During the dry season (March- April) an awareness campaign to prevent forest fires was launched through the local media, mostly radio which is a very effective communication tool in the communities. But most effective were the sermons of the preachers during the Sunday mass, attended by most community members, in which the population was asked not to use fire that year. The communities responded very positively to this.

Besides the training program the project build also eight forest observation towers to strengthen the prevention and forest fire control system. Those towers are located at strategic places in the most affected area by the hurricane. All towers were equipped with radios in order to communicate with the central base. During the summer season INAFOR used the towers and hired personnel from the communities as observers. It´s very important to mention that the labor for the construction of eight forest observation towers were hired within the local communities. This led to commitment in the communities to care for and protect the towers.

In order to strengthen the system of prevention and control of forest fires four UHF antennas for communication were installed which cover the whole area. The UHF radio communication system was initiated with different projects and also with technical support from the National Army. This system is now also used by INAFOR for the control of wood extraction in the region, especially the transport of sawn wood.

Another project focused on the rehabilitation and maintenance of 832 km of secondary roads, forest trails and fire breaks in the most affected area. This project started with a diagnosis and georeference of the locations of all the trails, secondary roads and fire breaks. Besides their rehabilitation, 7 bridges were rebuilt on forest roads which articulated different areas. This was very important because these areas are affected by fires each year, making the transport of fire brigades, water and materials a priority.

A strong community based component dealt with timber extraction of the trees felled by the hurricane to reduce fuel load and to rebuild destroyed houses in communities of the North Llano sector, Puerto Cabezas, through a Community Forestry Approach. At technical level, community members were trained in the use of chainsaws and small sawmills. The communities also received organisational support to organize the whole process from side selection, preparing the trunks, transporting the logs to the sawmill, up to the actual sawing of the logs. The community members together build house by house. In this way 240 houses were rebuild in 8 communities.

CONCLUSIONS

- The Regional Government and communities recognized that the projects met the expectations and responded to the local needs and demands.
- The projects contributed to the training of technicians and community brigades to prevent wild fires and the responsible use of the fallen trees.
- One element of great impact for the field teams of technicians and for the communities was the construction of watch towers with communication equipment for the early mobilization of the trained community brigades.
- The projects permitted the development of a long term vision and strategy for the protection and rational management of the forest resources with considerable participation of the communities at all levels (political, technical and community).
- FAO supported the national and regional government agencies to organize the projects in one coherent integrated fire management strategy. The training and awareness raising activities which are part of this should continue.
- The technical staff of the INAFOR working together with the communities has experienced that the communities can and should be more involved in the protection and management of forests and that community forestry may contribute to this. This requires a definition of roles and task for both sides.
- From institutional perspective, the projects have played a major role in strengthening coordination between central government and regional authorities and agencies, responsible for the prevention and control of wild fires.

FUTURE CHALLENGES

Among the many challenges for the future are:

- To continue the consolidating training, coordination and synergy with public institutions, focusing on the technical staff of the NGOs working in the region.
- To continue the yearly training activities for the community brigades and strengthen the fire management capacities of the communities for their forests in and outside the fire season.
- To integrate the trained and experienced regional technical team in the future regional fire management activities.
- To evaluate the technical possibilities to incorporate the communities in the UHF communications network installed in the region.
- To continue strengthening the regional prevention and firecontrol system by the Regional Government and INAFOR in the RAAN, including prevention and awareness raising activities.
- To integrate the fire management activities in the broader forest and landscape management, considering an Integrated and Community Based Fire Management.

PARRALEL SESSION 4

Use of Remote Sensing and GIS technology in Fire Management

THE GLOBAL FIRE INFORMATION MANAGEMENT SYSTEM: TRANSITIONING TO AN OPERATIONAL SYSTEM AT UN FAO

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Abstract

The synergy of remote sensing, GIS, internet and mobile technologies has revolutionized the way in which near-real-time satellite-derived fire information is delivered to users around the world. The Global Fire Information Management System (GFIMS) delivers MODIS active fire data in a range of easily accessible formats (including an interactive web mapping service, email alerts and downloadable kml, shape and text files). GFIMS has recently been enhanced by the addition of MODIS burned-area maps which can be viewed as part of the web-based mapping service.

GFIMS, and its precursor, the Fire Information for Resource Management System (FIRMS), were developed by the University of Maryland with funding from NASA's Applied Sciences Program. While GFIMS is established at FAO, FIRMS will become part of NASA's Land Atmosphere Near-real-time Capability for EOS (LANCE), continuing to meet NASA data-user needs. This paper describes how GFIMS evolved, outlines the open-source software solutions currently used and describes future plans for GFIMS and FIRMS.

Keywords: MODIS, fire, WebGIS, satellite-derived fire information, email alerts,

1. Introduction

The use of satellite remote sensing for monitoring the Earth's surface and generating information on fire has been well documented (Kaufman, Tucker et al. 1989; Barbosa 1997; Eva and Lambin 1998; Roy 1999). Information on vegetation fires is important for many different applications; policy formulation, strategic land management, detection and early warning, deploying assets for fire suppression, follow up restoration planning, strategy development for preparedness and prevention, ecological monitoring, modelling fire emissions and validating fire risk maps, all from the global to local scale. One source of fire information useful for these purposes, is data from the MODerate-resolution Imaging Spectroradiometer (MODIS) sensor on board NASA's Earth Observing System satellites, Terra and Aqua.

MODIS data are routinely used to generate a number of land surface products to meet the goals of NASA's Earth Science Enterprise (Kaufman, Justice et al. 1998). By design, the MODIS fire products meet the general needs of global-to-regional monitoring and modelling (Justice 2002). MODIS fire products include a daily (day/night) active fire product (MOD14/MYD14 thermal anomalies & fire) and a monthly burned area product (MCD45). These products are described on the "MODIS Active Fire and Burned Area Products" website (http://modis-fire.umd.edu/index.html) and by (Giglio, Descloitres et al. 2003; Roy, Jin et al. 2005).

For timely information on fires, the MODIS active fire product is most useful as it can be produced in near-real time. The standard MODIS burned area product is also of value but the monthly product is only available with a 2-3 month lag. This is because a time series of 90 daily observations are used to process the product (data for the month prior to and the month after the calendar month being processed). MODIS burned-area maps can be viewed as part of the web mapping application (section 3.1). As GFIMS was initially designed to provide quicker and easier access to the active product the following discussion focuses primarily on active fire data.

2. Origins of GFIMS

The original request for the delivery of near real-time active fire data came from the US Forest Service (USFS) in response to the 2000 wildfires in Idaho and Montana (Sohlberg, Descloitres et al. 2001). At the time, MODIS active fire products could only be obtained in hierarchical data format (HDF) format a few days after satellite acquisition from NASA's Land Processes Distributed Active Archive Center (LP-DAAC) through the EOS Data Gateway web interface (http://edcdaac.usgs.gov/main.asp). Obtaining data in HDF format involves downloading large volumes of data (typically 50 MB) and requires some expertise to order data and use the data. The large volumes of data combined with the time-lag between satellite acquisition and product availability, made the MODIS standard products of limited value for operational fire management.

A partnership between NASA Goddard Space Flight Center (GSFC), University of Maryland (UMD) and the USFS Remote Sensing Applications Center (RSAC) was established to process and deliver MODIS data. The data was initially produced by MODIS Rapid Response (Justice et al. 2002) and subsequently by MODIS receiving stations, delivered within an hour of satellite overpass. In the beginning, data was available for only the Western United States but later expanded to the United States and Canada (Quayle, Sohlberg et al. 2004). The Fire Information for Resource Management System (FIRMS), the precursor to GFIMS, was then established to expand the distribution of MODIS fire data to a broader range of fire and forest monitoring organizations around the world as a contributory project to the Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) program (http://www.fao.org/gtos/gofc-gold/index.html) (Davies, Ilavajhala et al. 2009).

In 2006, the University of Maryland was funded by NASA's Applied Science Program, to refine the fire information and monitoring system and establish it as an operational global fire monitoring system at the United Nations Food and Agriculture Organization (UN FAO). Refinements were user-led, driven by correspondence with key partners, and the results of focus group discussions and one-on-one interviews with users in Africa, Asia, Central America, Europe and the USA. In addition to the goal of providing faster, easier access to fire data, the system was designed to enable users to integrate fire information with local geospatial information in order to obtain a timely overview of fire activity in their area of interest. The most recent refinements to GFIMS take advantage of enabling technologies in the fields of open source GIS, virtual globes, and faster query and visualization of large spatial datasets.

3. Overview of GFIMS

GFIMS was officially launched at the UN FAO in August 2010 amidst some of the worst wildfires ever seen in Russia (Davies, 2010). As such the system immediately proved valuable for those seeking information on the wildfires in Central Russia. With GFIMS, users anywhere in the world can access fire information in near real-time. Multiple distribution modes are a key feature of GFIMS. Figure 1 and the following section provides an overview of GFIMS and describes the main components by which users can the fire data.

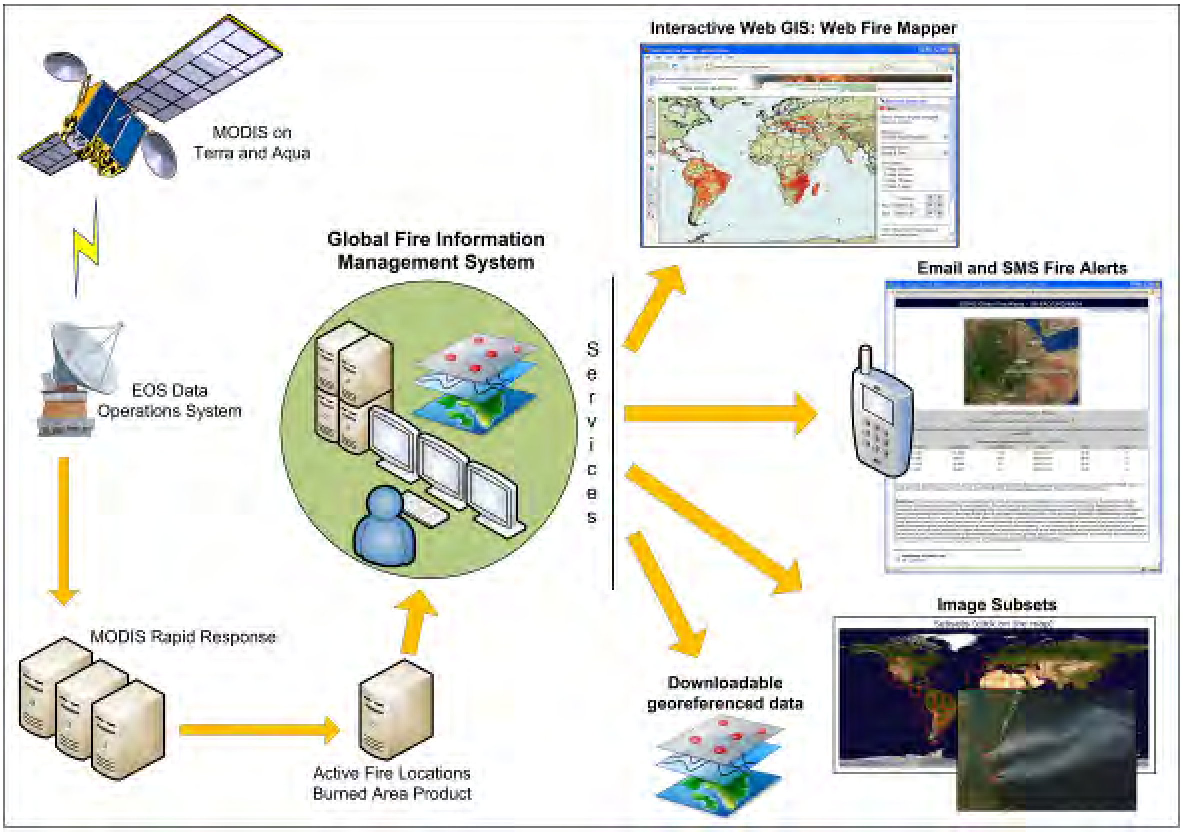

Figure 1—Overview of the Global Fire Information Management System

The data feed for GFIMS comes from NASA's Land-Atmosphere Near real-time Capability for EOS (LANCE) at Goddard Space Flight Center (GSFC) in Maryland, USA.

The fire detection code is identical to that used to process the science quality data; however, as predicted satellite ephemeris data, rather than the definitive ephemeris, is used to process Aqua data, there may be small differences in location. These differences are generally under 400m and often under 100m. Graphs of the differences for each day are available from the MODIS Rapid Response website (http://rapidfire.sci.gsfc.nasa.gov/ephdiff/).

MODIS scans the Earth from the North to South Pole every 1-2 days and relays fire data to LANCE - GSFC. MODIS distinguishes characteristics of fire based on brightness temperature viewed as thermal radiation (Giglio, Loboda et al. 2009). It flags these image pixels to identify an active fire. The MODIS Rapid Response component of LANCE processes this data into photo-quality images for distribution; the FIRMS component processes the data into vector files, and both turn around information within two-and-a-half hours of orbital overpass and feed this information to GFIMS.

3.1 The Web Fire Mapper

The Web-based GIS application of GFIMS, provides a browser-based interface to display, query, and download MODIS fire locations dating back to November 2000. The Web Fire Mapper (WFM) user interface (Fig. 2) was designed using the Google Web Toolkit (GWT) (http://code.google.com/webtoolkit), a Java-based software development framework used to develop advanced web applications. The core WebGIS functionality for the WFM is provided through MapServer's (http://mapserver.gis.umn.edu) open source spatial data publishing platform, via a common gateway interface (CGI). The GWT framework was utilized to develop a custom WebGIS application, by harnessing the MapServer CGI. All the standard GIS functionality such zoom, pan and identify tools are realized using GWT classes accessing the MapServer CGI. For the spatial database, the PostgreSQL (http://www.postgresql.org) relational database was used in combination with the PostGIS spatial database extension (http://postgis.refractions.net). Together, these two components store the MODIS fire archive, along with multiple indexes and data summary information.

Figure 2—Screenshot of Web Fire Mapper

In addition to the core data tables that hold the fire location information, aggregate summaries of the fire data are also stored in the tables with different spatial and temporal ranges. If there are too many fires to reasonably display on the map for a selected date range, the spatial and temporal aggregate tables are queried to display fire summary information in the form of a fire density grid.

This greatly speeds up the query response times by avoiding the need to query the entire database and display individual fire points. The suitable spatial and temporal resolutions for the aggregate tables were determined after thorough testing of the database, which lead to the optimization data retrieval times and enabled the users to readily visualize the fire data through the summarized aggregate density grids.

The MODIS burned area images and other raster data are displayed using a tile-caching mechanism, which caches, pre-fetches, and displays the tiles as background layers. This facilitates a "Google-maps" like look-and–feel, which has become the industry standard. To achieve this under WFM, raster data (background images and burned area data) are stored as tiles for each of the ten pre-set zoom levels. The Ajax mechanism of GWT fetches the raster tiles from the disk cache for a specific zoom level and lays them out sequentially. It also pre-fetches the surrounding raster tiles to facilitate smooth panning. Efforts are currently underway to provide download functionality for the burned area images in the GeoTIFF format.

3.2 MODIS active fire data sets

GFIMS provides active fire data sets as comma-separated values (CSV) text files and as ESRI shape files. These files are produced for a pre-defined set of regions and are updated regularly to provide the most up-to-date fire location information. In addition to this, the newly released download tool allows users to download customized data sets from the FIRMS archive. Using the download tool, users can define their area of interest on a map or by choosing from a list of countries or protected areas. The user requests are processed twice daily; an email is sent to users with instructions on how to download their requested data.

For those users who prefer to be able to ingest the active fire data layer into their own web or desktop GIS, a Web Map Service (WMS) of fires detected during the last 24 and 48 hours are provided. As users have the option of saving a WMS layer in a desktop or web GIS application, the latest fire data layer will be pulled from the GFIMS server whenever the service is refreshed.

The WMS service meets the needs of users who are accustomed to handling geospatial data, but there are increasing numbers of the general public, who access and view geospatial data through web mapping interfaces – even though they may have no expertise in handling these datasets. As part of this trend, GFIMS provides data in formats suitable for viewing within NASA World Wind (http://worldwind.arc.nasa.gov) and Google Earth (http://earth.google.com). With Google Earth, users have a choice of downloading the Keyhole Markup Language (KML) files with most recent fire detections, or a KML file that will automatically update the fire detections every two hours.

Providing active fire information in vector format has advantages of small file sizes and the option of querying attribute information. However, viewing the raster source data, from which the active fire locations are derived, can be beneficial for two reasons. First, it enables users to better understand the extent which fires may have been obscured by thick smoke, cloud or haze. Secondly, viewing the raster source data can provide visual cues to the extent of the burn and direction of prevailing smoke. This ancillary information can be useful for tactical fire fighting, restoration management and for estimating fire affected area. In collaboration with the MODIS Rapid Response System (http://rapidfire.sci.gsfc.nasa.gov/), GFIMS provides customized geo-referenced MODIS imagery subsets. This not only saves the user time but it provides links to data they may not otherwise access.

3.3 MODIS image-subsets

The MODIS imagery subsets provided to users are customized geo-referenced MODIS images (GeoTIFFs or JPEG images with world files) for a user specified area of interest. The subsets are produced in near real-time by MODIS Rapid Response using MODIS Level 1B data (Justice, Townshend et al. 2002). The subsets are available in 3 formats, i) true color, bands 1-4-3, ii) false color, bands 7-2-1 and iii) Normalized Difference Vegetation Index (NDVI), and at three spatial resolutions (1km, 500m and 250m). In providing these readily accessible images, the system removes the burden of users having to download and process HDF files.

Accessing MODIS image-subsets or a web-based mapping service demands the user log on to the Internet periodically to check for updates. To avoid this, a fire alert service was created to deliver the locations of MODIS active fires as e-mail messages.

3.4 Fire E-mail Alerts

The fire e-mail alerts were initially developed to deliver fire data directly to users, with slow Internet connections. The first version of the system was text-only, containing the coordinates and attributes of detected fires, and was developed in cooperation with Conservation International for a pilot study in Madagascar. The current version of the e-mail alert system supports the option to include a map and a CSV file of fire coordinates. The map image enables users to readily visualize the exact location of the fire and the CSV file can be ingested in to a GIS for further analyses or can be used to build up a local database of fires.

Fire alerts are sent in near-real time or as daily or weekly summaries. Users can select any area of the world for notification by drawing on an interactive map, or selecting a country or protected area via drop down boxes. Users that select a protected area also have the option of including a 5, 10 or 15km buffer around the protected area.

3.5 Country Based Analyses

In the context of FAO support to national fire programmes, data from GFIMS have been processed to generate maps, aggregated statistics, and correlate the incidence of fires with land cover. Currently, statistics for more than 30 countries, mostly in the African continent, are available. Using spatial overlay techniques, active fires are aggregated by administrative unit and land cover type. Tables, charts and maps are generated as output products, regularly updated and published through Power Point slide shows and Excel worksheets. GIS data are also made available for download. Alternative solutions to standardize outputs, increase information content and format are under investigation at FAO, aiming to produce regular country bulletins on satellite derived hotspot/fire locations and burned areas.

4. The future of GFIMS and FIRMS

FAO is tailoring GFIMS to meet the needs of the broader United Nations' user community by providing GFIMS-derived information in English, French and Spanish; wildfire monitoring and detection are also in line with the UN Framework Convention on Climate Change (UNFCCC) and the Convention to Combat Desertification (UNCCD) objectives. In the future, FAO also plans to implement a Short Message Service (SMS), which will enable users from developing countries to receive fire alerts directly on their mobile phones. FAO also plans to provide more analytical products such as burned area assessment, biomass loss and carbon release estimation. There is an effort in FAO to promote an integrated fire approach, which crosses various departments, especially Forestry and Natural Resources. This approach focuses on relating monitoring, assessment, management, policy and national capacity development activities concerning fires. In this context, GFIMS will become a core product in the broader natural resources monitoring strategy, which FAO is implementing at the corporate level.

While GFIMS is established at FAO, FIRMS will become part of NASA LANCE (Land Atmosphere Near-real-time Capability for EOS), in an effort to continue to meet the needs of NASA data users. LANCE provides access to near-real-time data from the AIRS (Atmospheric Infrared Sounder), AMSR-E (Advanced Microwave Scanning Radiometer for EOS), MLS (Microwave Limb Sounder), OMI (Ozone Monitoring Instrument) and MODIS instruments. NASA data users, operational agencies and researchers utilize these products for a wide range of purposes (from weather forecasting to monitoring natural hazards). These users often need data much sooner than routine science processing allows and in some cases are willing to trade science quality for timely access.

5. Conclusion

Even today, major obstacles prevent the uptake of remotely sensed information by a wider population of users. These obstacles include the cost, the timeliness of delivery, knowing which data are available and the potential utility of the available information for particular management activities. The challenge to improve uptake of this information for fire management includes increasing user awareness of available products and making timely and easy-to-access products. GFIMS was developed as a response to this challenge; developing systems and services that make satellite-derived fire data readily accessible to natural resource managers worldwide. The increasing use of MODIS active fire data from GFIMS on blogs and other web mapping applications is a clear sign that the data are being more widely distributed. For the future, the UN FAO will provide a broader platform to further expand the user community through forestry and fire management programs.

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PARALLEL SESSION 12

International Exchange and Assistance

USING THE FIRE MANAGEMENT VOLUNTARY GUIDELINES TO DEVELOP FIRE MANAGEMENT PLANS

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Abstract

The Fire Management Voluntary Guidelines (FAO Working Paper FM17) provide agency personnel a systematic framework for developing fire management plans and other policy and program documents. The Guidelines move beyond fire suppression planning, and provide a holistic approach to wildland fire management, from establishing the initial legal and policy framework to monitoring program effectiveness and restoring burned areas. The Guidelines can be used in different ways; including as a survey document to assess current plans or as a template to guide plan development.

This paper will demonstrate how the Guidelines can be used to assess national and regional wildland fire situations and prepare policy, program, and operational documents. For example, during an FAO funded technical cooperation project to the Former Yugoslavian Republic of Macedonia (FYRM), the list of strategic actions were used as a template to assess the current plan, and provided managers options for a revised national fire management plan.

1. Overview

In 2006, the Food and Agriculture Organization of the United Nations (FAO) published Fire Management Working Paper 17 – Fire Management: Voluntary Guidelines, Principles and Strategic Actions. The Guidelines "set out a framework of ... principles and internationally accepted strategic actions" for developing new wildland fire management programs or assessing established programs worldwide.

FAO began the multi-stakeholder process to prepare the Guidelines based on recommendations from several international and global events. The 3rd International Wildland Fire Conference and 1st Wildland Fire Summit in 2003 provided a foundation for this work. In 2007 the report of the 18th session of the FAO Committee on Forestry supported the process and recommended that member countries and others make use of the Guidelines.

FAO followed an established process to assure there was broad stakeholder participation in the development of the Guidelines. A core group of authors prepared an initial draft for review by an expert consultation. The expert group was set up with a diversity of expertise, backgrounds and regional fire management knowledge. From the beginning, it was recognized that input from a broad spectrum of fire experts, and other related groups was critical to developing a meaningful product useful to a wide range of programs and governments in ecosystems around the world.

The first objective in the Guidelines is to: "establish principles in accordance with the relevant rules of international law for responsible fire management activities, taking into account all relevant biological, technological, economic, social, cultural, and environmental aspects". The key is "all relevant ... aspects". The Guidelines were developed to include the full range of fire management activities, not limiting them to areas such as fire suppression or fire training. Many times these are the most visible and socially important actions, but a fire management program should be holistic in nature and align with national laws and policies, before establishing plans for training and fire fighting actions.

It is clear that some areas and organizations will not be able to utilize the entire list of strategic actions set out in the guidelines. For example, in many countries it is illegal to use planned fires to reduce the threat of ignitions or transform areas into a safer fire environment. In those countries, the section on planned fire would not apply; however, fire managers could use that strategic action to review the ecological and social aspects of planned fires and make recommendations for changes in the law, if a change would be beneficial to the environment and protect lives and property.

2. Using the Guidelines

Results of several assessments are documented in the FAO working papers noted in the References section of this paper. The assessments are at both the country level and the regional level. A simplified diagram of the methodology is in Figure 1. A form developed by the FAO staff for the problem analysis step is available in FAO Working Paper 19 (ftp://ftp.fao.org/docrep/fao/010/aj116e/aj116e00.pdf) and FAO Working Paper 22 (ftp://ftp.fao.org/docrep/fao/011/aj118e/aj118e.pdf). Results from a workshop held in Trinidad and Tobago are presented in FAO Working Paper 20 (ftp://ftp.fao.org/docrep/fao/010/aj119e/aj119e00.pdf).

Figure 1—Simplified diagram from the FAO methodology

The FAO methodology lays out a step by step process to introduce the Guidelines, analyze the situation, and propose actions. There are advantages to taking a systematic approach and working with a fire management expert who is not from the country or region. Many times someone not familiar with the specific program will ask questions and engage the group in discussions that highlight unrecognized weakness and needs, or organizational strengths. Using the assessment process among neighboring countries or within a regional context can also be beneficial. This is particularly true for organizations or countries that have common problems or are developing cross boundary agreements. Assessing programs in light of the need to cooperate can provide cost effective outcomes.

Since the publication of the Guidelines, several groups used them to assess and develop national and regional programs. In 2009 FAO funded a technical cooperation project (TCP) in the Former Yugoslav Republic of FYRM (FYRM). One of the activities of the TCP was to prepare a national fire management plan. The Guidelines were used to provide an overall assessment of the current program and plans in FYRM and then became a template or outline for a potential future fire management plan.

The process used in FYRM was a basic version of the FAO methodology. The Guidelines were used as a checklist for gathering information and served as a tool for the international consultants to systematically gather information and to review current laws, policies, and programs. Using the list of the strategic actions, the team first looked for existing documents or processes. While many parts of the plan had fully functioning components and policies in place, there were sections that lacked a plan or needed to strengthen a component. The team was able to document missing information and make recommendations for improvements.

3. A Look to the Future – Building Better Plans

The strategic actions in the Guidelines provide an outline, or a table of contents, for a fire management plan. What the fire community needs is a source or reference center for each of the individual components – a Global Fire Management Plan Database. The Database would include the various laws, policies and plans as well as data systems and other components of the plans from across the globe. With the advances in electronic communications, one option would be to set up an online database with copy and paste features for creating or updating plan components. As more countries and groups develop plans that follow the outline in the Guidelines, more information will become available. Sharing existing knowledge is an important step for the development of new plans and programs.

Starting with the Fire Management Guidelines Strategic Actions as the table of content, each strategic action could be sub-divided using the Regional Networks in the Global Wildland Fire Network. Under each regional network, the database could be arranged by country, language, or fire ecological area. This level of grouping should be designed to meet the demands of the regional network members and the fire management systems in place.

The strategic actions on prevention have components that could be arranged in different ways. The section on prevention plans might easily be arranged by country and language. Strategic action 4.4.4 Use and Management of Fire might be better structured by fire ecological groups or divided into one section where fire use is common and another where fire use is strictly banned by law. The entire database may not fit into a single system but should be arrange to best meet the needs of the regional users.

4. Example of a Data Base

If we use the strategic action for section 4.4 Prevention as an example, a system might look like this. In this example only the North American Regional Network is expanded by county and language. There are only three countries and primary languages in the network and was used to keep this example short.

4.4.1 Prevention Plan

- Sub-Saharan Africa Wildland Fire Network (Afrifirenet)
- Eurasian Wildland Fire Network

- Southeast Europe / Caucasus Wildland Fire Network
- Euro-Alpine Wildland Fire Network
- Central Asia Wildland Fire Network
- Northeast Asia Wildland Fire Network
- South Asia Wildland Fire Network
- South East Asia Wildland Fire Network (ASEAN)
- Australasia Wildland Fire Network (AFAC)
- North America Wildland Fire Network
    - Prevention Plans from Canada – English and French
    - Prevention Plans from Mexico – Spanish
    - Prevention Plans from the United States - English
- South America Wildland Fire Network
- Mesoamerica Wildland Fire Network
- Caribbean Wildland Fire Network
- Mediterranean Wildland Fire Network

4.4.2 Traditional Fire Use, Laws and Regulations, and Community Involvement

4.4.3 Fire Cause Database and Analysis

4.4.4 Use and Management of Fire

Strategic Actions 4.4.2 through 4.4.4 would be structured to best meet the needs of the regional members and in a manner that logically displays the information.

The structure of the database should be flexible. Some of the Strategic Actions may not need to be organized by Regional Network. Strategic Action 4.5.6 covers establishing a fire danger and early warning system. Since there are only a few systems world-wide, this section could be arranged first by the danger rating system followed with a listing of the countries or agencies using that system. The paper by de Groot, et al, presents a proposal for a global system and also references the systems currently in use. The link in the database could simply direct users to this paper on the Global Fire Monitoring Centre website.

5. Summary

With the publication of the Fire Management Voluntary Guidelines the fire community has an outline for complete and comprehensive fire management planning. The next step should be to set up and maintain a database for users throughout the world who are assessing their current plans or need to develop a new plan. A Global Fire Management Plan Database would be a user friendly process for fire managers and provide them access to current plans, policies, and processes. The end result will be safer communities, protected resources, and healthier ecosystems.

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PARALLEL SESION 13

Indigenous Fire Management

INTEGRATION AND APPLICATION OF TRADITIONAL ECOLOGICAL KNOWLEDGE AND MODERN SCIENCE FOR CONTEMPORARY WILDLAND FIRE MANAGEMENT IN TRIBAL LANDS OF NORTH AMERICA

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Abstract

When early European settlers arrived in the Americas, the landscapes they encountered were not virgin wilderness, but were rather shaped by management actions taken by Native Americans over many generations. Fire was used as a principal tool for management of wildlife, and to produce the foods, medicines, and materials to meet community needs for subsistence and commerce. As indigenous management practices were replaced by policies of fire exclusion and strategies based on economic extraction of monetary value from natural resources, fire regimes and ecosystem processes have been drastically altered, resulting in vegetation shifts, unprecedented fuels build-up, and increased incidence, intensity, and cost of wildfires. Investigations are underway to facilitate information exchange and establish enduring partnerships between tribal communities, academic institutions, and agencies involved in wildland fire science and management. Integration of traditional ecological knowledge with contemporary western science will open new paths to improving understanding of the role of fire in resource management and effects on ecosystems and communities.

Traditional ecological knowledge (TEK) is the trans generational accumulation of information and observational experience that integrates spiritual and cultural values. Modern western science disaggregates earth systems into constituent parts for detailed study and management. Both TEK and western science can usefully inform policy decisions affecting contemporary wildland fire management. TEK can contribute place-based knowledge of ecosystem relationships while western science can provide complementary information about ecosystem components. Combined, these different ways of thinking can improve our collective understanding and capacity to meet today's challenges for sustainable natural resource and wildland fire management.

Integration of traditional knowledge and Western science for contemporary wildland fire management will require commitment to abandon preconceptions, correct legacies of misunderstanding, and embrace collaborative visions that extend beyond accustomed boundaries of professional training and cultural orientation. Historical factors are converging that offer new opportunity: Wildfire hazard is increasingly viewed as an ecosystem crisis; Attitudes about the appropriateness of fire on the landscape are evolving; Native American cultures and ecosystem values can no longer be regarded as subordinate to those of Euro-Americans; and Tribal forest fuels programs are now looked to by agencies in the United States as models for public land management.

Introduction

The need for a new paradigm to deal effectively with environmental issues of increasing magnitude and complexity is becoming ever more apparent. The ability of land managers to care for the land and its resources has too often been stymied by the inability to overcome differences arising from diverse, sometimes conflicting, goals and objectives. Our collective capacity to meet the challenges of managing natural resources for sustainability in the face of complex interrelationships involving uniqueness of place, interdependence of resources, cultural values, economic implications, legal and administrative constraints, and social aspirations would be greatly enhanced if we can find a path to weave the benefits from diverse world views into our management approaches while preserving the

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integrity of each.

Long before Columbus "discovered" America, native peoples had established self-governing societies and cared for the resources that sustained their life ways for thousands of years. The traditional knowledge () still held by tribal communities across the Americas was accumulated over countless generations of living on the land and caring for resources. Thus TK couples place-based, long-term observational experience within a social context that integrates spiritual and cultural values. At its core, TK reflects a holistic worldview involving people and resources with the primary moral imperative for long-term stewardship. It is based on indigenous understanding that humans and environment are interrelated and that balance is vital to sustainability. The status of tribes as co-managers has been recognized by judicial decree and policy at both the United States federal and state levels for a number of natural resources such as fish and wildlife and water. Tribal involvement in processes involving management policy and direction for public natural resources has proven instrumental in overcoming decision gridlock that has stymied the capacity to take management action to address condition that threaten important resource values.

There is an urgent need to improve information exchange between tribal, agency, and scientific communities regarding wildland fire management. Indian tribes, agencies, research organizations, and institutions of higher learning share a common need for effective and efficient means of sharing and applying wildland fire science. In general, Indian tribes lack ready access to forest research information generally and particularly to developments in wildland fire science. Tribal fire managers and practitioners have not fully benefitted from emerging applied wildland fire science (Palmquist 2008) and decision support tools. Fire science and non-Indian resource management agencies have been largely uninformed of traditional insights into ecosystem health and the use of fire as a management tool gained by intergenerational experiential learning from the anchored stewardship commitment of Indian tribes (Trosper 2007).

Aggressive management interventions on tribal and non-tribal ownerships are needed to address ecosystem declines and unprecedented wildfire hazards created by vegetative fuel accumulations (Healthy Forests Restoration Act 2003). Warming trends and drought stresses associated with global climate change heighten the need for adaptive management (QFR 2009). Hazardous fuels removals have been identified as a source of needed raw material for renewable energy development (Perlack et al. 2005). However, integrated management to combine objectives of wildfire hazard, climate change, renewable energy, and ecosystem sustainability is difficult, time-consuming, and costly. Catastrophic wildfires are increasing; three times as many acres are burned by wildfires as receive fuels treatments (QFR 2009). Costs are enormous and escalating (QFR 2009). Collaborations are needed to turn the tide of ecosystem declines (WGA 2006).

Inadvertent or unnecessary damage to cultural resource values important to tribal communities have resulted from a lack of awareness by agencies and fire scientists when conducting field activities relating to wildland fire management. Because wildland fire threatens environmental, social and economic stability, tribes are seeking a more proactive role in confronting declines in forest health on US reservations and adjacent ownerships, including the treatment of hazardous fuel loads under Stewardship contracting. In many areas, especially in the rural western US, tribal natural resource departments represent the only surviving and functional resource management infrastructure. Fire science findings and decision support systems have potential to provide powerful support to tribes if customized for improved delivery and application. As resource management strategies evolve to meet complex contemporary challenges, fundamental tribal ethics of stewardship and sustainability provide a steadfast anchor from which to integrate the needs of place-bound people with the health of the environment. Gathering and synthesizing traditional fire knowledge held by tribal communities presents an opportunity for modern fire science to expand understanding of fire regimes, gain insight into early indicators of change in ecological processes and cultural life ways, and adjust research priorities to better reflect cultural and environmental priorities. National forest fire challenges can also contribute to economic development in tribal communities by creating opportunities for tribal enterprise development and employment of Indian fire fighting crews. Natives have been a major part of the nation's wildland fire fighting capabilities for decades (Dejong 2004). Tribes have long managed timber to maintain desirable forest conditions and as a means to generate wealth. Tribal enterprises are important to the well being of communities and forests.

The potential benefits of multi-disciplinary and cross-cultural collaborations involving tribal and non-tribal communities to integrate hazardous fuels reductions and bioenergy development with efforts to respond to uncertainties of climate change have not been realized. The commitment and expertise of Tribes to national and regional forest health is a unique human resource worthy of investment to improve forest stewardship.

Underapreciation and underutilization of TEK in modern science

Legacies of misunderstanding and prejudice, compounded by fragmented historical records, have hindered appreciation of aboriginal influences on North American ecosystems (Vale 2002, Bonnicksen 2000, Suzuki and Knudtson 1992, Clements 1931, Greeley 1920, Marsh 1864). The scientific community has displayed little appreciation of the whys, whens, and hows of tribal resource management practices (Wuenther 2006, Trosper 2007). Ecosystems found by early European settlers in the Americas were not virgin wilderness, but were instead landscapes altered through time by many generations of Natives who intensively burned, pruned, sowed, weeded, tilled, and harvested to meet their requirements for fuel, fish and wildlife, vegetal foods and medicines, craft supplies, and materials for shelter and transportation (Aikens and Jenkins 1994, Anderson and Moratto 1996). A fundamental land ethic, founded upon the survival imperative and implemented through adaptive management involving multiple, diverse values, has endured through millennia of interaction between man and nature, in ways that conserve resources while providing for the needs of people (Stewart and others 2002). Fire was, and will always be, an important management tool for Indian peoples. Periodic under-burning not only produced desirable ecological conditions, but reduced fuel accumulations that might otherwise sustain intense fires and cause the catastrophic loss of property, resources, and lives (Pyne 1982, Williams 2003). Tribal elders who have inherited understanding of the reasons and responsibilities associated with its use keep knowledge of fire, accumulated by generations of native practitioners.

Since European settlement in the western United States, ecosystem conditions across landscapes have changed dramatically. With the imposition of European concepts of property and management, the ability of tribes to manage the land and preserve their culture diminished. Fire exclusion and cessation of indigenous management practices have resulted in altered fire regimes, unprecedented forest fuels build-up, and increased incidence and intensities of wildfires. Indian reservations, often located in rural areas prone to wildfire, suffer from limited wildland and structural fire-protection capability, scarce funding for programs and services, minimal capacity to influence land-management practices adjacent to trust lands in the western US (especially on reservations with checkerboard land-ownership patterns), inadequate fire and building code standards, and lack of access to relevant developments in wildfire science and best practices. Thousands of acres of tribal timberlands have been destroyed by catastrophic wildfires. For example, fires in Southern California in 2003 devastated several Indian reservations (NYT 2003) as did fires in the Ponderosa pine forests of the Inland West (NWCN 2008) and the Southwest, where the White Mountain Apache Tribe lost nearly 300,000 acres of productive tribal forest during the 2002 Rodeo-Chediski fire (Keller 2005).

Examples of tribal efforts at outreach to capture and make available valuable perspectives on fire from tribal elders to help inform the general public, resource managers, and the scientific community include the “Fire on the Land” project produced by the Confederated Salish and Kootenai Tribes of the Flathead Reservation, Montana, in cooperation with the Bureau of Indian Affairs and the National Interagency Fire Centre (CSKT 2005), and “Beaver Steals Fire”, a Salish traditional tale of fire (Arlee and Sandoval 2005). These and other projects are creative beginnings, but further efforts are needed to integrate tribal perspectives into wildland fire management

Geographical designations are often employed for organizing ecosystems and social communities. The Joint Fire Sciences Program in the United States is funding the creation of Regional Science Delivery Consortia. However, we see important value in improved communication between the fire science community and tribal communities and suggest that, in this circumstance, cultural issues are paramount. Powerful differences in language, social arrangements, and conceptual construct must be thoughtfully considered. Scientists tend to be secular and specialized while tribal peoples are more generalist with holistic worldviews. Native languages vocalize identities, values, and symbols that are shared timeless attributes between humans and nature while English words have formal properties, definitions, and meanings that can be fixed in a single generation and serve to separate humans from nature. Scientists rely upon experimental design while Natives depend upon keen multi-generational observations. North American tribes share many practical values and are uniquely united by historical circumstance, but they have many different cultural backgrounds and resource issues. This paper recognizes that science and culture are complementary and interconnected. In our view, within Indian Country, a cultural, rather than geographical, approach would be most fruitful for achieving an integration of TEK and modern wildland fire science objectives.

Historical factors are converging now that offer new opportunity: 1) Wildfire hazard is increasingly viewed as an ecosystem crisis (QFR 2009); 2) Attitudes about the appropriateness of fire on the landscape are evolving (Trosper 2007); 3) Native American cultures and ecosystem values can no longer be regarded as subordinate to those of Euro-Americans (Kimmerer and Lake 2001); and 4) Tribal forest fuels programs are now looked to by agencies as models for public land management (WA DNR 2004).

Two ways of thinking and knowing

Across the Americas, tribal peoples have actively influenced ecosystem functions for thousands of years to sustain their ways of life. The survival of their communities depended on life ways rich in tradition and intimate place-based information, cumulatively referred to as indigenous or traditional knowledge (TK). Berkes (1999) defined TK as a body of knowledge and beliefs handed down through generations by cultural transmission about the relationships of living beings (including humans) with one another and with their environment. McGregor (2004), drawing from multiple authors, elaborated further describing TK as including a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. Cajete (1994) describes TK as known within all four aspects of being: mind, body, emotion, and spirit. TK is built upon practical experiences, guided by spiritual beliefs, and implemented through traditions and cultural stories, interpersonal teaching, and practice. Keepers of TK have responsibility to transfer knowledge to future generations. The stories of interactions between people and the environment form the basis of societal identity.

In contrast to TK, Western or scientific ecological knowledge (SEK) is based upon a conceptual separation of humans from the environmental world (Kimmerer 2000), has focus on control of nature (Pierotti and Wildcat, 2000), and is primarily concerned with theories of general interest and applicability (Berkes 1993). SEK disaggregates systems into constituent parts for detailed study (Freeman 1992) and relies upon logical, linear, and replicable methodologies to verify results. SEK has its origins in Europe whereas TK has evolved from the place of its use.

Historically these two epistemologies have existed worlds apart. SEK relies upon peer review and publication to disseminate results, leaving others with the responsibility to apply results to specific circumstances. Sharing of TK is done primarily through stories, traditions, customs, language, interpersonal teaching, and learning by doing on the land. SEK has been known as “science” while TK has been regarded as “folklore” (Deloria 1995). However, as Trosper (2007) correctly cautions, broad generalizations of indigenous knowledge and Western science tend to overlook shared similarities such as systematic observation of nature and objectives of reliable predictability.

Modern challenges in wildland fire

Oral and written histories coalesce over time into conceptual mythologies that provide solidarity of purpose and guide societal development (Wheelock 2006). However, when born of misconceptions, cultural mythologies evolve correspondent patterns of living that depart from practical realities and initiate amplifying sequences of unintended consequences (Botkin 1990, Deloria 1995). Consider for example just one of the many mischaracterizations of Indians in North American history. Since the arrival of Europeans in North America, the significance and sophistication of Native American influence on “pre-settlement” environments have been either misunderstood or discounted (Stewart 2002, Vale 2002). With fire and other means, indigenous peoples manipulated the landscape for thousands of years creating the prairies and forest conditions, free of under growth, which greeted the first European settlers (Pyne 1982, Bonnicksen 2000).

Early suppositions that Indians were few in number and had little impact on the environment set the stage for a series of inaccurate myths about people, fire, and natural resources (Kay and Simmons 2002, Mann 2005). Upon arrival of European to the Americas, and imposing European concepts of property and management, the ability of Indian tribes to manage the land diminished (Anderson 2005). Fire exclusion and cessation of indigenous management practices along with grazing, harvest activities, introduction of invasive species, development, pollution, recreation, and other factors have resulted in altered fire regimes, unprecedented forest fuels build-ups, and increased incidence and severity of wildfires (Arno and Allison-Bunnell 2002). Time-tested reduction of fuel loads through periodic burning, as had been Native tradition, was labeled Paiute forestry and denigrated by early foresters as incompatible with Euro-American objectives of resource management (Boerker 1912, Leopold 1920). Instead, a highly simplified belief in forest protection through fire suppression gained popular adoption and regulatory support (Pyne 1982, Carle 2002).

By the 1990’s, elevated risk of wildland fire to communities declines in ecosystem health across landscapes, and escalating costs of wildfires combined to become a source of national alarm, which led to the development, and adoption of a 10-year Comprehensive Strategy in the 90’s. The National Fire Plan followed in 2000 and the Wildland Fire Leadership Council was established in 2002. The Healthy Forests Restoration Act was passed through Congress in 2003. State and federal agencies have been mobilized and billions of dollars have been spent but the costs and environmental impacts of forest fires continue to increase.

Integration of TEK and modern science for wildland fire management

Our collective capacity to meet the challenges of managing natural resources for sustainability in the face of complex interrelationships involving uniqueness of place, interdependence of resources, cultural values, economic viability, legal and administrative constraints, and social aspirations would be greatly enhanced if we can find the means to draw upon the knowledge of both TK and SEK while preserving the integrity of each. The need for a new paradigm to deal holistically with environmental issues of increasing magnitude and complexity is becoming ever more apparent (Chapin et al. 2010).

Historic use of fire on the landscape by Native Americans is a compelling example of TK in adaptive practice (Kimmerer and Lake 2001). The persistence of cultural practices in the face of centuries of subjugation provides testament to the enduring adaptive capacity of indigenous peoples (Berkes 1999). Historical evidence indicates that the pre-settlement conditions of many forests as well as other ecotypes throughout North America resulted from anthropogenic fires (Boyd 1999, Stewart 2002, Cronin 2003). Lewis (1973) identified 70 different objectives for Indian firing of vegetation. Williams (2003), after review of some 300 different studies, summarized twelve major reasons for Native American ecosystem burning: hunting, crop management, growth and yield improvement, fire proofing, insect collection, pest management, warfare, signalling, control of resource access, clearing for travel, felling trees, and riparian habitat management. Better recognition of past cultural influences on the landscape sets the stage for reconsideration of indigenous ways of knowing.

It’s time to listen and learn. A broad view that elements of both TK and SEK might be complimentary may be gaining acceptance (Michel and Gayton 2001, Tsuli and Ho 2002, Kimmerer 2002). TK can contribute place-based knowledge of ecosystem relationships while SEK can provide complementary information about ecosystem components (Power and Chapin 2010). The feasibility of applying TK to contemporary resource management problems has been recognized in the international arena, as reflected in the following quotation from Our Common Future, the report of the World Commission on Environment and Development (WCED 1987):

“Tribal and indigenous peoples’…lifestyles can offer modern societies many lessons in the management of resources in complex forest, mountain, and dryland ecosystems.”

As the need grows great and time becomes short, respectful partnerships can move beyond legacies of prejudice, ignorance, and misunderstanding. Now is the time to discover new opportunities for cross-cultural knowledge sharing. First we must learn to listen to one another (Bengston 2004, White and McDowell 2009).

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LESSONS LEARNED ON FIRE MANAGEMENT IN INDIGENOUS COMMUNITIES OF BOLIVIA

by

Carlos Pinto[1] Ernesto Alvarado[2]

Abstract

The subsistence agriculture practiced by indigenous communities on tropical lowlands in Bolivia is commonly associated to slash-and-burn agriculture, or "chaqueos". This traditional practice is being replaced by non-mechanized commercial agriculture. This paper will describe Indigenous land use practices in the department of Santa Cruz, Bolivia. Fire research in Bolivia is generating information on the role of fire in the country's forests ecosystems and the relationship with the need of using fire by Indigenous communities. This information is needed to open the communication among communities, researchers, environmentalists, and government. It is intended to provide cohesive information for the development of a national policy on integrated fire management in Bolivia.

1.- Introduction

South America is currently experiencing a large increase on population and a growing need for land for agriculture and livestock for food production. Adding to this situation, the poverty, lack of resources and technical capacity create a fire situation where wildfires are almost entirely intentional (Haltenhoff, 2005). Every year, fires in Bolivia are mostly of human origin, either by the conversion of new forest land to farming or ranching or the burning of large areas of natural grasslands or cultivated pastures. Fire is the cheapest tool to reduce vegetation cover, and in the case of small and poor farmers, is the only one available in their present circumstances (Pinto, 2007)

BOLFOR (1994) estimated that every year in Bolivia burns more than 100 thousand hectares per year. However, the magnitude of the fires in some years reaches catastrophic proportions such as in 2010 when a national emergency was declared by the government (Figure 1). As noted in the same figure, the frequency of occurrence of large-scale forest fires in the country is increasing. Nevertheless, the lack of information in Bolivia on damages caused by the fires every year makes difficult to conduct real assessment of the magnitude of the problem.

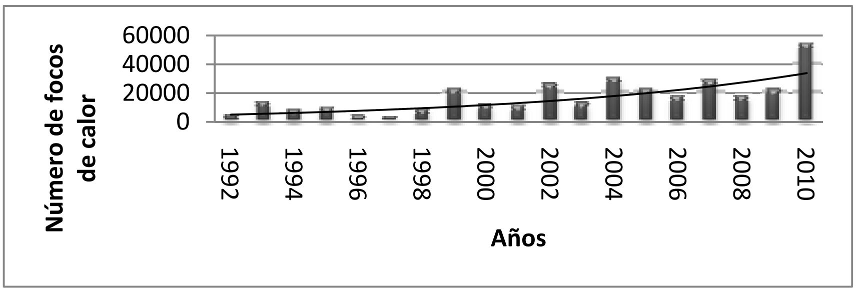

Figure 1— Number of hot spots (NOAA 12-MMODIS) in Bolivia from 1992-2010

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The current social and economic needs of the rural population have changed the nature of traditional farming practiced by the indigenous peoples of Bolivia in small areas (<5ha), for non-mechanized commercial farming which requires larger areas (5-15 ha) (Pinto, 2007). As a result of this change, the increase in forest fires originated in agricultural areas. Burn control and prevention of escaped fires is more effective when the slash and burn areas are smaller than when they are over 5 ha.

This paper describes the experiences in the past five years on strengthening local capacities for the use of fire as a tool used for agriculture use in rural communities in Bolivia's lowland, mainly encouraging community participation in the "slash-and burn" as a fundamental pillar for the establishment of fire management plans at community level. Those activities have been developed by local organizations such as Friends of Nature Foundation (FAN) and the Bolivian Institute of Forestry Research (IBIF) with the support and assistance of the University of Washington (UW).

2.- Methodology

As a requirement to adopt measures of adaptation to climate change, FAN developed a diagnosis of burning practices, production systems and social organization in rural communities and ranches located in the dry forest protected areas of Chiquitano, methodology to carry out this diagnosis was based on the development of field surveys aimed at people from communities and managers and/or owners of cattle ranches in and around the study area and where there has been increased incidence temporal in hot spots forest fires (FAN, 2010)

Formulation of the field survey was designed primarily to understand the following:

- Local perceptions about forest fires
- Land ownership and use
- Terms of use of fire
- Production systems and markets

The survey was conducted in 30 communities and 28 cattle ranches in the area of study, making a total of 158 surveys conducted throughout the area. The sampling intensity in communities was 20%. However, in some cases, such as the Mennonite colonies, the survey was applied only to the leaders of the colony, because according to their organization, they are responsible for providing the requested information. In other communities, due to logistics and accessibility, the survey applied only to community leaders.

In order to strengthen a small agricultural system, which provides a greater awareness, attention, organization and management control over the fire, IBIF implemented the "fire management program at the community level in the province Guarayos ". The goal of this initiative is to achieve cohesion at the community level, the adoption of responsible fire management through the coordination of activities by a slash and burn by "fire inspector " the fire inspector, a member appointed by their community, who brings information on planning for community members to make clearings and performs monitoring on the application of fire in them (Pinto, 2007).

3.- Study Area

Figure 2— Study Area

Communities and ranches that are based in and around four protected areas in the block Chiquitano the Department of Santa Cruz: Laguna Concepción Municipal Protected Area, National Historic Park Santa Cruz la Vieja Valley Reserve Tucavaca Departmental and Natural Area of Integrated Management San Matías. Indigenous and peasant communities in the province Guarayos in the department of Santa Cruz, located 310 km. north of Santa Cruz de la Sierra and 265 km south east of the city of Trinidad. (Figure 2).

4.- Results

This section describes the results of the survey for making a diagnosis of burning practices, conducted in established communities and ranches in and around the four protected areas of Chiquitano block, which carried out this study, also it describes the results of the experience of community participation in the use of fire for land clearance for agriculture in the province Guarayos.

4.1.- Local perceptions of forest fires

A wide area of study, 59% of the respondents felt in recent years there is no increasein the presence of uncontrolled fires. In the analysis of information from the survey results for farms and communities, we can see that there is a significant difference in opinion between the two groups, given that 64% of respondents in communities consider that forest fires are not considered a problem, while 61% of respondent’s in ranches consider these phenomena themselves are a problem.

4.1.1- Temporal regimes of forest fires

According to the analysis of survey data, the frequency in the presence of forest fires in protected areas covered by this diagnostic data from 2 to 5 years, information that matches the satellite reports of fire hot spots that show this time trend of occurrence of forest fires in the area.

4.1.2.- Origin of forest fires

According to the perceptions of those surveys, the main reasons causing forest fires are the hunters (32%), followed by the burning of grasslands (27%), the slash (15%), vandalism (5%) and cigarettes left in the forest (4%). According to the perception of both people in communities as owners and/ or managers of cattle ranches in the areas of influence of protected areas which took place on this diagnosis, hunters are identified as the main causes of forest fires followed by the burning of pastures, slash, vandalism of people and cigarette butts.

4.1.3.- Effect of forest fires

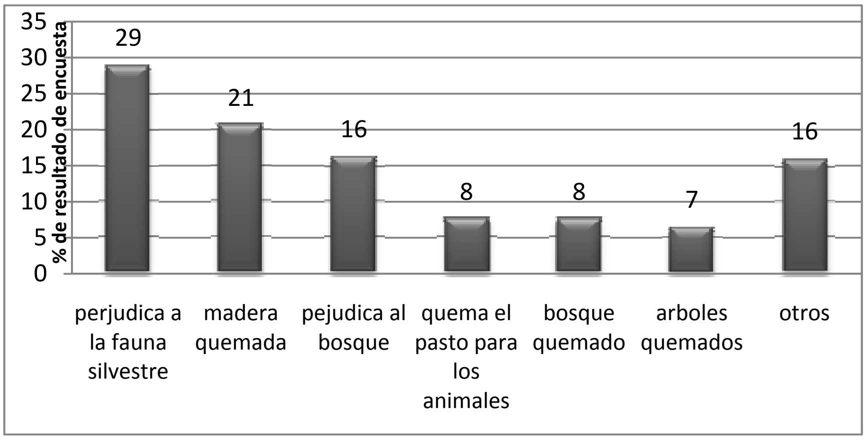

Figure 3— Fire effects, general perception

The damage caused by forest fires to wildlife (29%), mainly because the fire scares or due to death by scorching thereof, the main consequence of these phenomena indicated, wood burning (21%), injury to forest in general (16%), burning of pastures for animal feed (8%), burned forest (8%) and burned trees (7%) (see figure 3) are the main consequences identified by the impact of forest fires in the area study (see Figure 2). For the inhabitants of the communities in and around protected areas where this diagnosis was developed, the main consequence of forest fires is the harm to wildlife (32%), while for the owners and/or ranches in charge of burning wood is the main consequence to the health of the forest.

4.2.- Land tenure and use

In the study area 40% of respondents said agriculture as their main activity, so 18% of respondents mentioned that they are dedicated to agriculture and livestock at the same time. The livestock alone is identified as another major activity in the study area (14%), while housework (9%), employee of cattle ranches (4%), housework and livestock (3 %) are some of the six main activities conducted by the population surveyed in the study area (see figure 3).

Evidently, the livestock alone is the main activity that takes place in the cattle ranches (61%), whereas in communities where the diagnosis has been developed, 48% of respondents consider agriculture as the main activity in place. Having pointed to agriculture as the main activity in the study area, it is in this context that 72% of respondents considered that the character of this activity is purely subsistence, as shown in figure 23. 13% of those surveyed said they do not have a property where they can either have land for agriculture and/or livestock (see figure 4), so they do not engage in any activity related the field either agriculture and/or livestock.

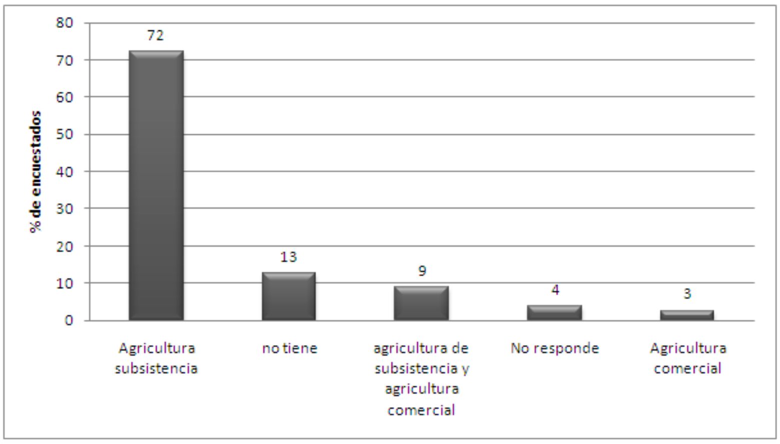

Figure 4— productive nature of agriculture in the study area

4.2.2.- Area used in agricultural activities and distance to these areas from homes

The land areas used for agriculture are quite small, 59% of respondents mentioned that they work in plots of 1 to 3 ha of land, thus demonstrating that agriculture is practiced predominantly for subsistence, as was mentioned earlier. As for the areas intended for livestock in the area, it is not considered as primary, so 76% of respondents do not have the authorization for this activity, however, 46% of respondents mentioned that they use less than 20 ha land for this activity, 13% use areas between 20 and 60 ha. The spatial distribution of areas of slash and the range in housing of residents in the study area, as reported by the respondents, is mainly around the same area; these areas are designed primarily to provide land for agriculture. Also, while many paddocks are also set around the home, most of them are between 1 and 10km from the house, although other cattle ranches are located between 15 and 35 km from the property owner's home.

4.2.3.- Preparación de tierras para la agricultura y ganadería

The land for agriculture or livestock involves planning that is subject to certain times of year. Thus, the burning of stubble is generally expected for the month of August, the cutting or demolish of existing trees in the area of swidden agriculture is scheduled mainly for the month of June and July, while slashing the understory is scheduled for months of May, June and July. As for the burning of pastures for the renewal of pasture for livestock, we can see that is a practice that develops in a lower intensity compared to stubble burning for land clearance for agriculture, this practice is developed from May to October (see Figure 5). As for the frequency rating used in areas designated for agriculture and/or livestock, 53% of the respondents stated that they use slush, mostly every 2 years. That is, a property is usually used by that time as agricultural area, once the land has been used for this purpose and for that period, the property passes to be used for livestock, pasture being planted in the area previously used as agricultural area (see Figure 6).

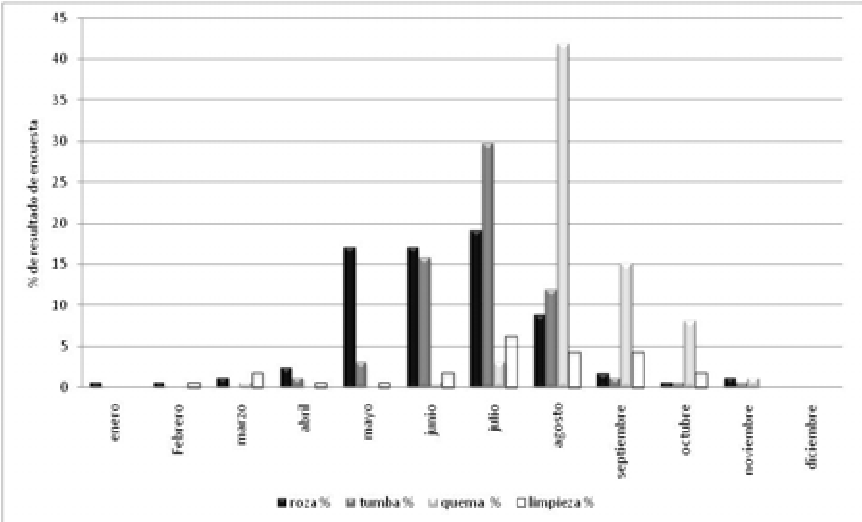

Figure 5— Planning of land use for agricultural purposes and/or livestock in the study area.

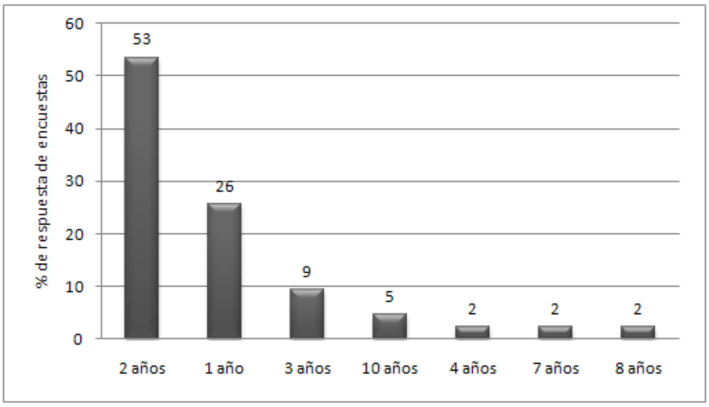

Figure 6— Use of agricultural areas and/or livestock, according to time used.

4.3.- Local conditions of use of fire

Having identified the major work activities that people engage in the study area, it was reviewed the use of fire with everyday work activities performed in the field. The results show that 84% of respondents use fire as a tool in their activities, while 16% think they do not use it. In the analysis of the use of fires in major work activities performed in the study area, 88% of respondents say that communities use fire as a tool and 68% of respondents use fire for livestock. Respondents in the study area mention that the use of fire is intended primarily to clean (sometimes) of stubble in the slush (22%), however, a high percentage of respondents mention that do not use fire as a tool, either pasture burning or agricultural burning (17%). It is noted that the use of fire in the field activities is also used to maintain pastures (14%), for burning pastures (8%) and hunting (5%), among others. 22% of respondents mentioned using fire in slash-and-burn, while 15% feel that they don't perform agricultural activity and/or have livestock –therefore; they do not burn, and finally 15% of respondents said they used fire to burn pastures.

4.3.1.- Local considerations for burning.

The empirical knowledge of the inhabitants of the study area to enable areas of crops and/or pasture, can be confirmed as indicated by 26% of respondents who reported that high drought conditions and the proximity season of the rainy season are factors that favor an effective burning. 16% said that they burn the property after the first rains, while 14% of them burn before the rainy season and a similar percentage of respondents also noted that they burn grassland during high drought. The high drought conditions and the proximity of the rainy season are main variables used for burning clearings and/or pastures, according to what it was reported by 26 and 27% of respondents in both communities and in livestock farming. It is important to note that 27% of respondents in ranches mentioned that the burning of grasslands is performed after the first rains.

According to the planning of agricultural activities in the study area, forested areas are mainly the most compromised (27%), since they are replaced by areas designated for agriculture and/or livestock. 18% of respondents consider fallow land in order to perform these activities, as well as another 18% who consider cutting forest (primary forest) for agriculture and reuse it later as pasture for livestock.

4.3.2.- Community participation in the slash and burn of grasslands.

One of thethe main mechanisms to reduce the risk of forest fires , especially thoseoriginating from areas of slash and / or burning of grasslands is associated with the participation and coordination neighborhood or community for mutual support in theuse of fire in these areas. However, according to the statement by 94% of respondentsin the study area, these mechanisms for community participation in the burning ofclearings and / or pasture not exist in the study area

.4.3.3.- Season and time of use of fire in the burning of land clearings and pastures.

According to the statements made by respondents in the study area, burning clearings and grassland are scheduled for August mainly (46% and 40% respectively). Others say they planned to burn clearings and pastures for the month of September (17% and 20% respectively). 51% of respondents in the study area, indicates that the appropriate time for burning both clearings and grassland is between 12:00 and 14:00, 27% of them indicated that they burn between 10:00 and 12:00, while 15% will between 14:00 and 16:00. In the burning of pastures, 63% of respondents agree that the best time to actually burn the pastures is between 12:00 and 14: 00, a similar view for respondents in communities 49%, which show that slush has the same schedule. The hours between 10:00 and 12:00 is used by 31% of respondents in cattle ranches to the burn pastures, and 26% for slush, 17% of respondents in communities say that between 14:00 and 16:00 is the appropriate time for chaqueos.

4.3.4.- Local practices for the implementation of prescribed fire and fire prevention measures

Burning techniques used in livestock farming areas, in the study area, are based on empirical knowledge about the application of fire and the needs of its use by the inhabitants of the area where this diagnosis was developed. The technique of back burning is the main technique used in the study area (27%), while 21% of respondents say they use a combination of burning and back burning progress. 15% of respondents did not describe a specific technique to burn their land, while 12% of respondents mention using the technique of broadcast in favor of the wind and on rings. Taking into account climatic conditions as the primary consideration used when applying heat (69%); the type of vegetation that is to be burned is another consideration prior to the application of fire in these areas (21%). 74% of those surveyed said they use preventive measures for the use of fire in agricultural and/or livestock areas, so that it is contained exclusively in the prescribed burn site, and does not affect either areas of forest, pasture, fallow or another causing a forest fire. According to the statement made by respondents in both cattle ranches and communities, they ensure that they coincide in establishing preventive measures necessary for the use of fire in their land, so that it does not cause forest fires 29% of respondents in the study area indicated that the lanes, from 2 to 3 m. wide to the contour of the land, are the main measure to prevent the fire from spreading outside the prescribed burn area. 21% establish lanes of 3 to 5 m. wide, and 28% use the same technique, but did not specify the width.

4.4.- Production systems and markets.

There were identified 19 main products produced throughout the study area. In Figure 7, 12 were identified and grouped under "other" the rest of them are grown in smaller proportion. According to 28% of respondents, corn is the main product cultivated, with 23% cassava, beans with 14% and 11% rice; these are the major crops (see Figure 7). 31% of the corn crop that exists in the study area is planted in cattle ranches, while 27% of this product is planted in communities. 23% of cassava planting is done in communities and 18% in cattle ranches. The growing of beans is mainly in the communities (15%) compared to 8%, which is produced in cattle ranches. Sugar cane is grown mainly in cattle ranches. It is important to note that the cultivation of sugar cane and corn in ranches is generally used as a forage resource for the dry season, which may explain the higher percentage of agriculture of these two products in the study area.

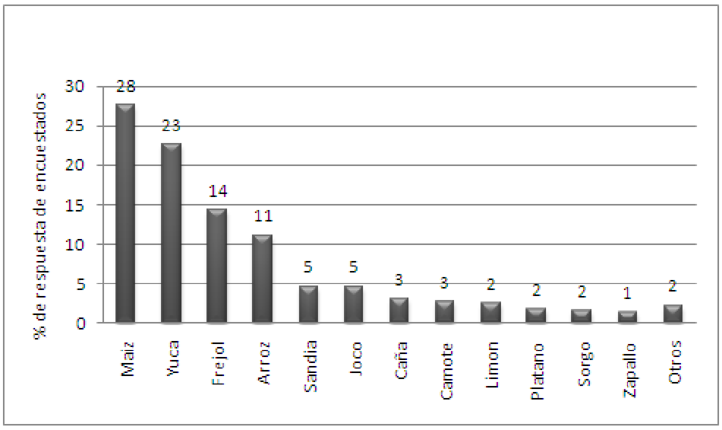

Figure 7— Main crops produced in the study area

4.5.- Fire management at the community level in Guarayos.

The following describes the characteristics of the practices for land clearance for agriculture in the six communities in which they developed the "fire management program at the community level in the province of Guarayos", cases based on data collected by the community of fire inspectors. Farming in Guarayos communities is quite diverse in regard to the intensity of time and effort spent working in the clearings. The attention given to the application of fire is in all cases small, approximately 1 to 2% of all activities in slush. In other words, if the cost for all the chaqueo is 1,248 Bolivianos per hectare, the cost to the application of fire is only 17 Bolivianos per ha (see Figure 8).

Generally the most expensive activity is harvesting, and then the costs depend on how the slush is organized. Chaqueos in some communities is the most intensive, in other communities is cleaning. The application of fire is among the cheaper activities because it gets the job done and it does it very quickly. On the other hand, if you look at the number of people who are involved in this activity is also lower. To control the fire, it is essential having several people duly organized. If there is a larger slush, there is not an increase in the attention given which would be necessary to adequately control the fire. In conclusion there can be improvement in the preventing of forest fires through intensification in the attention and control of fires.

	Tamaño promedio del chaco (ha.)	Costo en Bs. por ha.	Costo en Bs. por chaco	Costo aplicación de fuego en Bs. por ha.
Limoncito	2.22	2.173	4.825	28.61
La Cachuela	4.33	1.164	5.044	19.29
Momené	2.15	1.221	2.626	25.64
San Pablo	2.03	1.843	3.737	14.06
Yotaú	2.42	382	925	5.63
Sta. María	2.72	362	985	6.43
Promedio General		**1.248**	**3.181**	**16,61**

Figure 8— Total cost of chaqueos in relation to the size and cost of fire per ha. Note: $1USD=6.94 Bolivianos

4.5.1.- Experiences Study: Indigenous Community.

The Momené community has about 280 inhabitants; most of them live primarily of agricultural self-subsistence. The community is relatively new, about 25 years old, first formed as an agricultural association and then as a community. The population is mostly Ethnic Indians from Guarayo, but it also has some Chiquitanos and Western ethnic groups (Quechua and Aymara). Due to its indigenous characteristic, customs in the land use are generally traditional with rice and corn as the most important crops.

The Chaqueo in Momené

According to the recorded areas of chaqueos by Edil Sanchez and Pedro Sanchez, Momené's inspectors of communal fires, the investment of work time between different agricultural activities shows that more time is devoted to harvesting and cleaning (Figure 9)

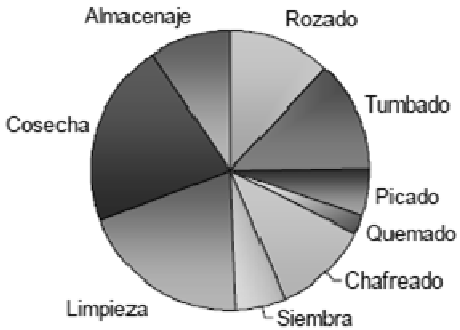

Figure 9— Percentage of time spent on agricultural activities in the community of Momené.

Of the 20 chacos studied, 13 have been exclusively for food production for domestic use. The average size of a slash was 2.15 ha, with a minimum area of 1 ha and a maximum of 5 ha. 25%, with 5 being clearings, with a larger size of 2 ha. In 15 cases, preference was given to chaqueos in the forests; others were partially or fully established in secondary forest (fallow). Converting hours in wages, Bolivianos. 35 currently, we can express each activity in a cost value. The higher cost from agricultural activities is the crop with a value of 259 Bolivianos per ha, the cheaper is the burn. Cost of slush per day is 26 Bolivianos.1.222

4.5.2.- Experiences at the Farming Community of Cachuela.

The community has 167 inhabitants Cachuela, the smallest of the participants in the program. The ethnic composition has a higher number of people, they identify themselves as Quechua or Aymara; however, most people speak Spanish. There is a small minority who identify themselves as Guarayos or Chiquitanos. That's the reason why is called La Cachuela indigenous community and non-farming community. The distinction is made by the implications of traditional practices in land use and the vision of the role occupied by the slush in the family economy.

Chaqueo

According to the records of slash areas by Juan Batallanos, Cachuela communal fire inspector, the following shows labor among different activities in the preparation and maintenance of the slush in the case of The Cachuela, having chaqueos and harvest at the highest percentages. In all studied chaqueos in Cachuela (13), the primary purpose of agriculture is the marketing of the product (rice and corn), but also obvious is the production for self-consumption. The average size of the clearings in Cachuela was 4,3 ha, he smallest 2 ha and the largest 8 ha. 78% of the clearings showed a larger than 2 ha. The nine chaqueos were established clearing primary forest (Figure 10).

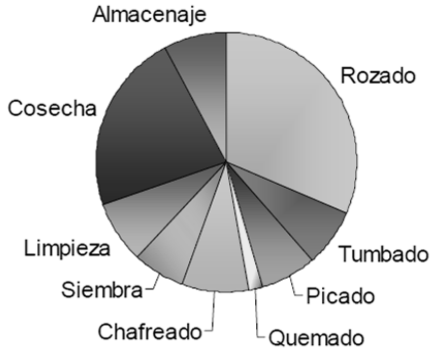

Figure 10— Proportion of time spent on agricultural activities in the community of La Cachuela

5.- Conclusions and Recommendations

Local inhabitants of settled communities and ranches in and around protected areas consider that the presence of forest fires are a phenomena that doesn't occur often and in an intervals of two to four years; nevertheless, each time with greater intensity. Hunting activities are usually associated as the main cause of the origin of forest fires. However; hunting is a secondary activity or entertainment used by the villagers themselves in the study area; therefore, people consider this industry as a leading cause of home fires and everyone must assume the responsibility of this problem. Perception is widespread of the damage caused by fires on flora and fauna and the adverse consequences caused by the presence of the same.

The main activity, in the study area, is agriculture -- the farm size (1 to 3 ha) and it's almost exclusively for subsistence and where land ownership is basically communal. Similarly, livestock is basically a subsistence activity, where land ownership is mostly less than 20 ha and is mostly private. This situation, related to the problem of forest fires, promotes the development of a strategy for the development and implementation of fire management tools in place, from a suitable organization, the empowerment and burning of agricultural land and/or livestock land help mitigate the impact of forest fires originating from these areas and it helps generate action in coordination with competent authorities for local control of burning practices in the area. Considering that the presence of forest fires in the study area is a recurrent phenomenon, it has generated the development of prevention and control of these fires that are not constant. These measures are mainly activated in case of emergencies or disasters caused by the presence of forest fires.

Communication channels and local organization are favorable and are suitable for development and implementation of coordination mechanisms to prevent and control of forest fires, mechanisms that would be based on the development of integrated information systems, organization and technical assistance that allows the construction of a system of early warning of forest fires that is adaptable and convenient to the needs of the people [using fire] and conditions. The state's role in this regard is critical, placing a comprehensive program to support and strengthen fire national policies designed to establish competence and the intervention of national government departments, regional, municipal and local levels, as well as NGOs and international cooperation

It’s essential that the agricultural sector urgently adopt responsible management practices for fire prevention. We can’t expect much from spontaneous changes by individual farmers. If we want a farmer to invest time and money on prevention, others must as well. This is fair and necessary to prevent unfair competition between farmers.

Rather, it requires a total commitment of different users. Groups must reach an agreement because at the end, the damage caused by the mishandling of fire affects everyone, even if one person caused the fire, the responsibility belongs to everyone. As a group we can understand farmers, sugar cane growers, agricultural unions, peasant and indigenous communities and can also be among agricultural communities of a province.

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RESERVE PAPER FOR PARALLEL SESSION 6:
Africa Fire Management

EVALUATING THE EFFECTIVENESS OF FIREBREAKS IN NORTHERN BOTSWANA

The 5th World Wildland Fire Conference In Southern Africa: 9th To 13th May 2011 At Sun City - RSA

9 - 13TH MAY 2011 - SUN CITY, RSA

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ABSTRACT

The Department of Forestry and Range Resources in Botswana maintains a cumulative length of 10,000 km (20 000 ha) of firebreaks annually. While fire behaviour principles were considered when the firebreaks were constructed, there has been no evaluation of their efficiency in reducing wildland fire spread. This study evaluated firebreak efficiency in the northern part of Botswana (Chobe and Ngamiland districts) for the period between 2006 and 2010 as well as the efficiency of road networks in acting as firebreaks in the region. Efficiency was measured as the proportion (%) of a fire that crossed a particular firebreak. Fire data acquired through the Moderate Resolution Imaging Spectro-radiometer (MODIS) for the years 2006-2009 was used. The influence of weather factors (wind direction, wind speed and temperature) and vegetation structure (type and load) were also investigated. The purpose of the analysis was therefore to propose ways to increase firebreak in order, efficiency to reduce fire spread, and to recommend firebreaks that needed re-alignment. Additionally, the findings will be used in guiding the fire management strategy and policy implementation in the country.

The results indicated that the angle at which the fire crosses a firebreak did not matter much as fire managed to cross at an angle of 90^0 as well as at diagonal angles. Roads serving as firebreaks did a better job of stopping fire as they had a wider road reserve of 30 meters on either side, and most trees on the road reserves had been removed., Therefore it is recommended that firebreaks must be widened through prescribed burning (patch burns) to reduce fuel load..

It is therefore very imperative that more studies are conducted to have well researched data on the efficiency of firebreaks in the country.

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1.0 INTRODUCTION

A firebreak is defined as a strategically located block or strip on which flammable vegetation cover has been permanently reduced or completely removed (Green, 1977), to reduce the intensity and rate of fire spread (GAFLC., 2005). Chobe and Ngamiland districts have a total firebreak length of 7980 km (15960 ha) maintained. This is out of a total of 10,000 km (20 000 ha) maintained nationwide (DFRR, End of Activity Report 2010). Firebreaks in Chobe and Ngamiland districts like in the rest of the country are designed as bare strips void of combustible material measuring 20 metres wide (NDP8). The firebreaks were designed in order to reduce the spread of fire from one side to the other, and used as anchor points where fire lines can be created. Firebreak effectiveness does not depend solely on the design of a firebreak, but also on the behaviour of a fire approaching it (Mooney, 2010), the behaviour of a wildland fire depends on many parameters such as wind speed and direction. Fire behaviour and spread also depend on fuel characteristics (load, moisture and parameters) and weather factors (wind, temperature and humidity) and topography (Alexander et al., 2006, DeBano et al., 1998, Hirschler, 1990, Keeley, 2009, Omi and Martinson, 2002), and hence in accessing firebreak effectiveness the effects of these factors are considered. Even with maintained firebreaks, dead standing trees along firebreaks pose a potential fire hazard by creating chimney fires which can shoot out through hundreds of feet to cross a firebreak. At wind speeds of more than 15 mph the probability of embers being carried across a firebreak increases (CERA, 2009). Under heavy fuel load of 1 tonne/hectare and extreme weather conditions where wind speed reaches 90 km/hr, a firebreak will not stop a fire in the absence of suppression (Fernandes and Botelho, 2003). Wind speed and direction influences the shape of a fire front which in turn influence the rate of spread (Viegas, 2006), and hence its probability to cross a firebreak. Herbaceous fuel load tends to propel eruptive fire behaviour characterised by sudden changes on the rate of spread in some sections of the fire front (Viegas, 2006).

The purpose of a firebreak is to change the behaviour of a fire as it reaches it because of the altered fuel arrangement (Agee et al., 2000), thereby protecting human life and property. In Botswana, firebreaks were constructed in 1991 with the aim of controlling the spread of wildfires (National Development Plan 8, Botswana Government, 1991), and subsequently protecting human life, property, protected areas (game reserves and forest reserves), conservation areas and pastoral lands. However, since the construction of firebreaks there has never been an attempt to access and evaluate their effectiveness. A number of fires continue to cross the firebreaks and consequently affecting more land. Therefore, the purpose of the study is to evaluate the effectiveness of firebreaks in the northern part of Botswana, covering Chobe and Ngamiland districts. It will also investigate the effects of the following factors on the effectiveness of firebreaks;

i. Firebreak orientation
ii. Weather parameters (temperature, wind speed and wind direction)
iii. Fuel load

2.0 METHODOLOGY

2.1 Study Area Description

The Chobe and Ngamiland districts receive an average annual rainfall of about 600 mm (Smith et al., 2005), and hence have a dense vegetation cover which yields fuel load above 400 kg/ha/year (Mojeremane, 2004). The region has a network of firebreaks protecting varying land use types; these being game reserves, national park, forest reserves, wildlife management areas, community based natural resources management areas (CBNRM), tourism and archaeological sites and pastoral farming (communal and commercial farming). Road networks exist in the area ranging from tarred roads to sand tracks.

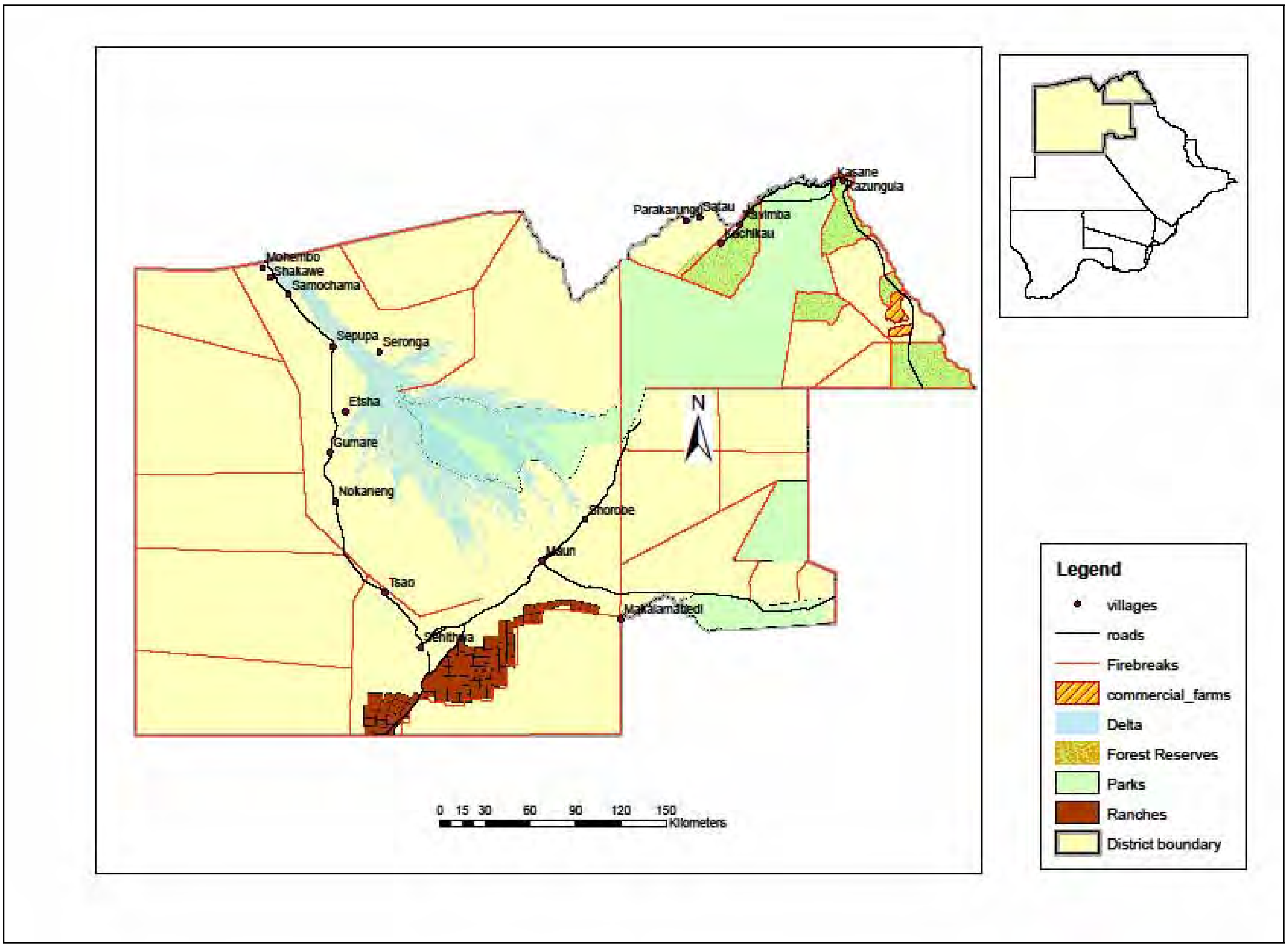

Figure 1: Firebreak Maps

Most of the firebreaks in the Ngamiland district are oriented in the East- West direction (Figure 1) which is perceived to be potential fire guides as they run along the general wind stream, even though winds in this area can be southerly at times. The firebreaks in Chobe district are mostly oriented to a North-South direction but fire can still cross them.

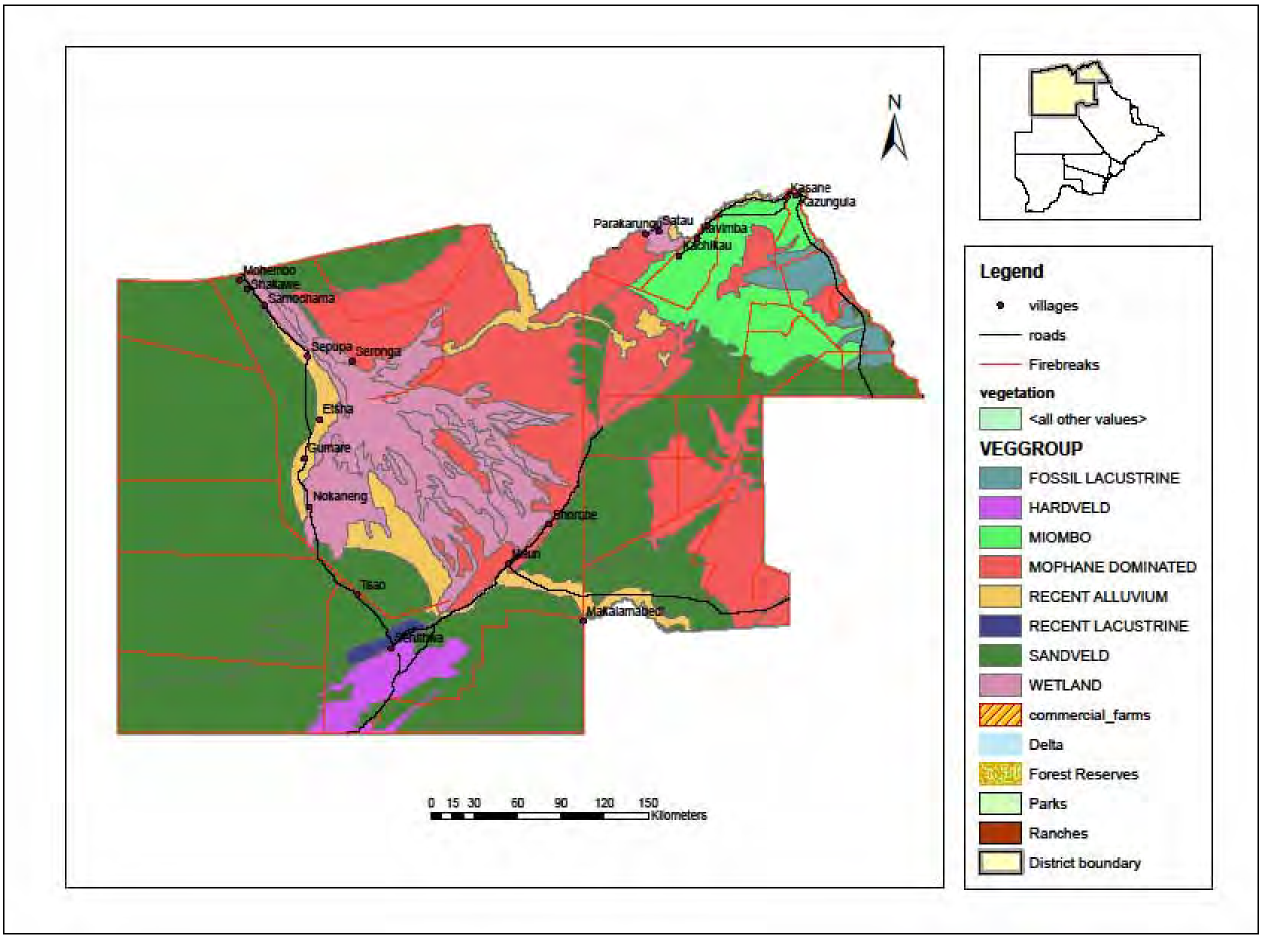

Figure 2: Different Vegetation Cover for the Study Area

The vegetation of Chobe and Ngamiland is dominated by tree and shrub savanna towards the north, gradually changing into woodland and dry deciduous forest composed of Baikiaea plurijuga (Mokusi), terrocarpus angulensis (Mukwa) and terminalia ceresia (mogonono), especially in Chobe district (Figure 2). The south is dominated by shrub savanna characterised by Acacia spp. Colophospermum mopane woodlands dominates depression areas and edges of flood plains (Ben-Shahar, 1998).

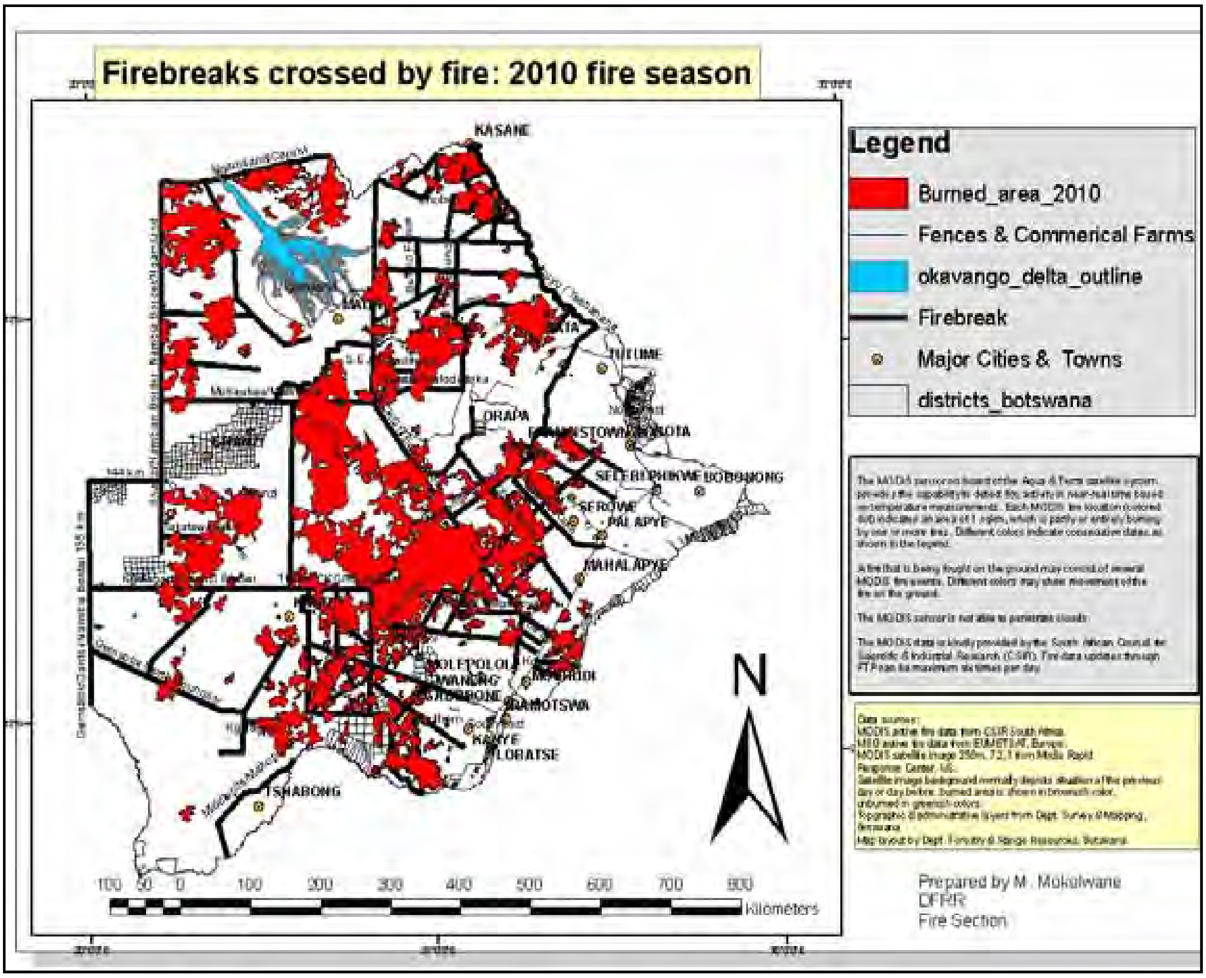

Figure 3: Firebreaks Crossed by wildland fire 2010

A significant number of firebreaks country-wide were crossed by fire from all directions (Figure 3). This scenario occurs most times when the winds are strong and the fuels are high.

2.2 Parameter Measurements

a) Firebreak Effectiveness

The effectiveness of a firebreak was measured by calculating the percentage of a fire front that crossed a firebreak as done by Price et al.,(2007). Burn scar and hotspots data obtained from MODIS was used. The data has a daily temporal resolution (http://modis.gsfc.nasa.gov, 2010). Burn scar data is delivered as raster images in 250 m, 500 m and 1000 m spatial resolution while the hotspots data is delivered as point shape-file with a resolution grid of 1000 m (http://modis.gsfc.nasa.gov, 2010, Kaufman et al., 1998, Myneni et al., 2003). It is assumed in this method that an effective firebreak will stop 100% of frontline fire against crossing a firebreak.

b) Firebreak Orientation

The effects of firebreak orientation on its effectiveness were investigated. Firebreaks orientation was classified as Westerly (W), Easterly (E), Northerly (N), Southerly (S), North-Westerly (NW), North-Easterly (NE), South-Westerly (SW) and South-Easterly (SE). An Analysis of Variance (ANOVA) statistical method was used to evaluate the effect of firebreak orientation.

c) Firebreak Efficiency

Firebreak efficiency was also compared to the efficiency of roads in stopping the spread of fires. In this research only tarred roads were used because of the limited roads data in GIS format. Comparison between roads and firebreaks was done using a t-test statistical method at 95% confidence interval (CI) and p-value =0.5 meaning that significance was $p \leq 0.05$.

d) Wind speed and Direction

The effects of wind speed and direction were investigated using data from the nearest meteorological station operated by Department of Meteorological Services (DMS), on the day a fire crossed a firebreak. Data from four weather stations located in the area were used, these being Kasane, Maun, Pandamatenga and Shakawe. Unfortunately, there was insufficient data for all the years proposed to be investigated (2006-2010). Only data for the years 2006-2007 was available but not uniform for all the four stations. Consequently, data for the year 2006 was available for three weather stations excluding Pandamatenga, while Kasane on the other hand lacked data for the year 2007 which was available for the other three stations. Therefore, the influence of wind was investigated as per the available data. An ANOVA statistical test was used to find the significance of wind factors at 95% CI and $p \leq 0.05$.

e) Determination of Biomass (fuel Load)

In the northern part of Botswana, fuel load vary spatio-temporally because of different vegetation types and varying land use types. The role played by fuel load on the effectiveness of firebreaks was investigated by estimating the biomass at fire front and firebreak interface from two hyper-temporal satellite sensors, MODIS and SPOT VEGETATION (SPOT VGT). The SPOT VGT data are composited to a 10 day time series and have a spatial resolution of 1 km (Fraser and Li, 2002, Ceccato et al., 2001, Stroppiana et al., 2003). The 1 km spatial resolution was too course for the purpose of this study, and a proposal was made to model biomass from MODIS vegetation indices which provide a spatial resolution of 250 m. The Normalised Difference Vegetation Index (NDVI) obtained from satellite data is useful in predicting biomass (Diallo et al., 1991, Al-Bakri and Abu-Zanat, 2007). Biomass was estimated from the MODIS NDVI product (MOD13Q1/MYD13Q1) at a 250 m spatial resolution. The NDVI-biomass relationship was analysed with SPOT VGT biomass as the dependent variable and MODIS NDVI as the independent variable. A regression analysis was then used to estimate biomass within a defined buffer zone of 250 m from a firebreak of interest. The buffer zone was chosen on the basis of MOD13Q1/MYD13Q1 pixel spatial resolution. It must be noted that the two products from MODIS and SPOT VGT have different spatial resolutions, and in order to do a regression analysis, the MODIS NDVI was first re-sampled to a 1 km^2 spatial resolution using a bilinear re-sampling method. This re-sampling method uses the value of the four nearest input cell centres to determine the value on the output raster. The effect of fuel load (biomass) on fire break effectiveness was also evaluated using a linear regression analysis to find if increasing load increased the probability of a fire crossing a firebreak.

f) Data Analysis

All statistical analyses were performed using R-statistical computing software (R-Development-Core-Team., 2008). GIS data including image analyses was performed using ArcGIS 9.3.

3.0 RESULTS AND DISCUSSIONS

There were a total of forty three (43) firebreaks and fire front meeting points during the investigation period (2006-2009) in the study area (Table 1)...

Mostly, fire tended to burn towards N-S and E-W oriented firebreaks (Table 1) with a few running E-W because generally winds in Botswana are easterly. However, this scenario changes most of the time in the Northern parts of the country as the wind tends to run N-S (northerly). A few wildland fires may approach diagonally oriented firebreaks (at an angle less that $90^{0)}$, that is, NE-SW and NW-SE oriented firebreaks. The average efficiency for the entire firebreak and fire front meeting point was 23.3%. Only four (4) firebreaks had 100% efficiency, while 25 firebreaks had zero efficiency for the 2006-2008 study periods. There are several factors that may affected the crossing ability of a firebreak by a particular fire incident such as wind speed, type of fuel, fuel load, temperature, humidity and time of the day. Comparing the E-W and N-S oriented firebreaks, there was no significant difference in effectiveness (p-value = 0.99) for the years 2006 -2008. Effectiveness was found to be 23.9 % and 22.64 % for E-W and N-S oriented firebreaks respectively (fig.3). There was also no significant difference between straight firebreaks (that is E-W and N-S) and diagonal firebreaks (that is NE-SW or NW-SE as shown in fig.4). The average efficiency was found to be 23.58% and 23.22% for diagonal firebreaks and straight firebreaks respectively, and a t-test resulted in a p-value of 0.979. It must be noted that even though there were a few fire encounters for diagonal firebreaks as compared to straight firebreaks, the data was comparable because an F-test for the equality of variances showed no significant difference (p-value = 0.56). Tarred roads were found to be better than ordinary firebreaks in stopping wildfires (fig.5). Tarred roads had 48.92% efficiency while ordinary firebreaks had only 15.28% (p-value <0.01). Table 1 below refers.

Table 1: summary of firebreak efficiency

Firebreak	Type	Fire Front	Crossed	Efficiency	Year	Orientation at fire/firebreak meeting Points
19 deg parallel	2	25.36	25.36	0.000	2006	E-W
Bots Zim/Moremi	2	23.8	23.80	0.000	2006	N-S
Gantsi/Ngami Bound	2	39.8	0.00	100.000	2008	E-W
Gumare/Namibia	2	5.79	5.79	0.000	2006	E-W
Gumare/Namibia	2	6.76	4.30	36.391	2007	E-W
Gumare/Namibia	2	63.8	59.50	6.740	2008	E-W
Kasane Ext	2	26.3	19.60	25.475	2007	N-S
Kazuma FR	2	6.3	0.00	100.000	2007	NE-SW
Kazuma FR	2	9.48	9.48	0.000	2007	N-S
Kuke/Mababe	2	4.7	4.70	0.000	2006	N-S
Kuke/Mababe	2	8.96	5.90	34.152	2006	N-S
Linyanti-Mababe	2	46.54	36.91	20.692	2006	N-S
Maikaelelo FR	2	40.5	40.50	0.000	2006	E-W
Maikaelelo FR	2	10.95	10.95	0.000	2006	NE-SW
Maikaelelo FR	2	8.75	8.75	0.000	2006	N-S
Maikaelelo FR	2	11.6	11.60	0.000	2007	NW-SE
Mosu/Shakawe trek	2	9.8	9.80	0.000	2006	NW-SE
Mosu/Shakawe trek	2	5	4.10	18.000	2006	NW-SE
Nata-Kasane	1	5.48	0.00	100.000	2007	N-S
Nata-Kasane	1	55.8	19.50	65.054	2006	N-S
Nata-Kasane	1	0.6	0.00	100.000	2008	N-S
Nata-Kasane	1	3.4	3.40	0.000	2008	N-S
Nata-Kasane	1	5.9	2.25	61.864	2007	N-S
Nata-Kasane	1	0.93	0.93	0.000	2008	N-S

Nata-Kasane	1	18.05	18.05	0.000	2006	N-S
Nata-Maun Road	1	15	5.80	61.333	2006	E-W
Ngoma Road	1	35.86	8.46	76.408	2007	E-W
Ngoma Road	1	18.73	14.14	24.506	2006	E-W
Ngoma-Linyanti	2	16	16.00	0.000	2006	N-S
Ngoma-Linyanti	2	14.1	14.10	0.000	2007	N-S
Ngoma-Linyanti	2	2.89	2.89	0.000	2008	NW-SE
Ngoma-Linyanti	2	14.36	4.21	70.682	2007	NW-SE
Parkline	2	11.9	11.90	0.000	2007	N-S
Parkline	2	29	29.00	0.000	2006	N-S
Sehitwa/Namibia	2	12.82	12.82	0.000	2008	E-W
Sibuyu FR	2	14.65	14.65	0.000	2007	E-W
Sibuyu FR	2	10.91	10.91	0.000	2006	E-W
Sibuyu-Maikaelelo	2	10.5	10.50	0.000	2008	NW-SE
Tsau/Xaxa	2	42.5	9.80	76.941	2006	E-W
Tsau/Xaxa	2	46.9	46.90	0.000	2006	E-W
Tsau/Xaxa	2	5.24	5.24	0.000	2008	E-W
Tsau/Xaxa	2	39	39.00	0.000	2008	E-W

Table 1 above shows that a significant number of wildland fires crossed firebreaks from the north-south direction as well as the East - West direction.

Table 2: Summarised fire front and firebreak encounter

Orientation	Firebreak-Fire Front Meeting Point
EW	16
NE-SW	2
N-S	19
NW-SE	6
Total	**43**

Table 2 above shows a summarised frequency of the meeting points of the fire front as per the firebreak orientation. The E-W and N-S firebreaks experienced more fire encounters compared to the NE-SW and NW-SE.

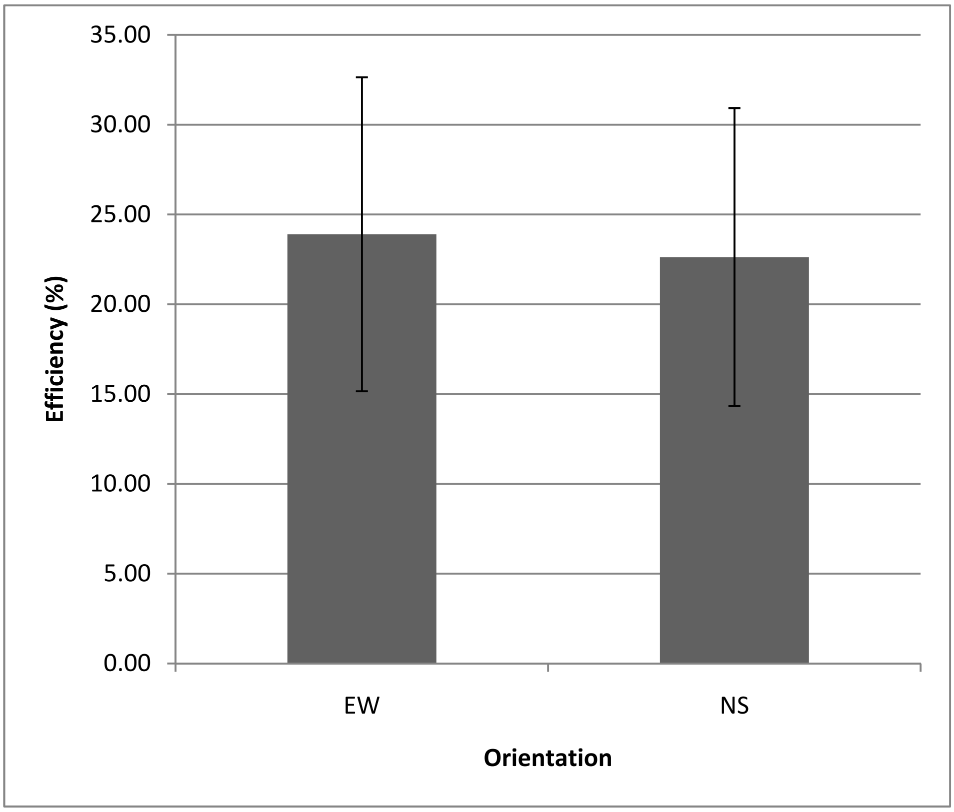

Figure 4: Graph comparing efficiency for east to west (EW) and north to south (NS) firebreak.

Orientation of the firebreaks does not have much bearing on the efficiency of firebreaks as the difference is very little (Figure 4). About 23% of the EW firebreak orientation compared to about 22% of the NS firebreak orientation, therefore other factors which were not studied may be responsible for the crossing of fire from the other sides.

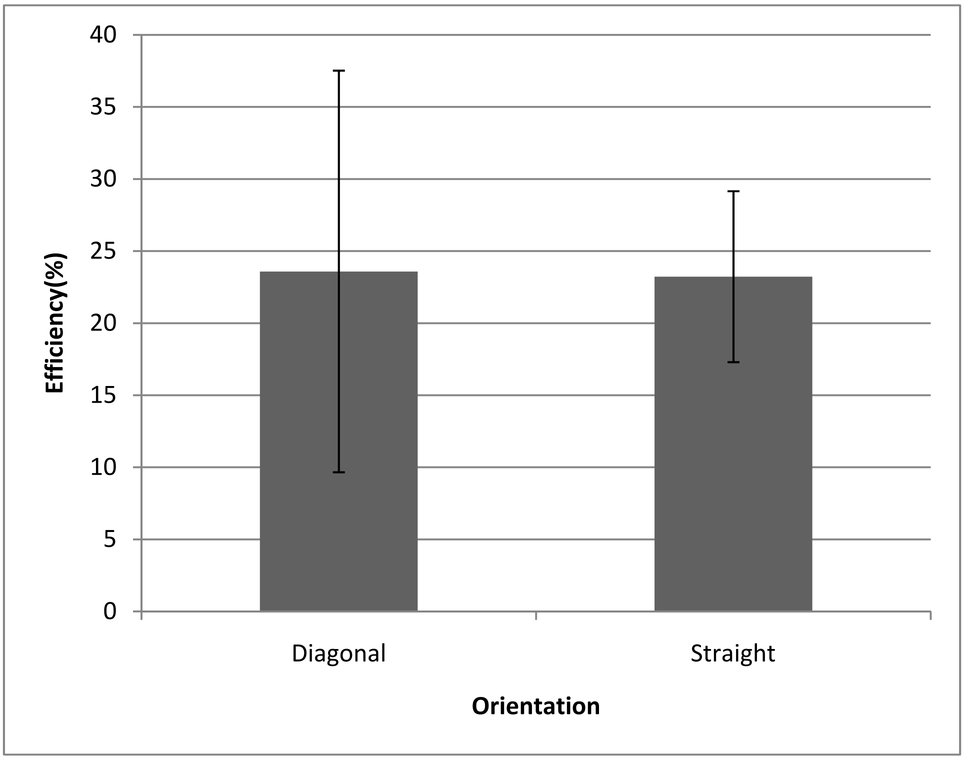

Figure 5: Graph comparing efficiency for diagonal oriented firebreaks and straight firebreaks

The same thing applies to the orientation of firebreaks, this time the study is considering the layout of the firebreak on the ground, some firebreaks were diagonal while other were straight and there was no significant difference (Figure 5).

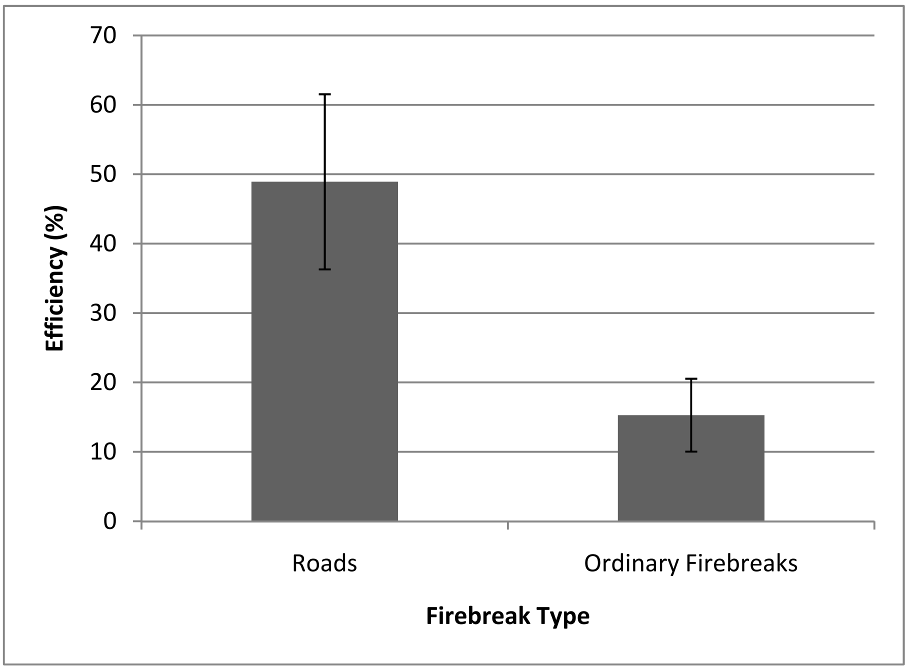

Figure 6: Graph comparing efficiency for roads and ordinary firebreaks

There was a significant variation in the types of fire when it crossed the firebreaks. Roads had a better (49%) fire stopping chance as compared to the ordinary firebreaks with about 15% chance of stopping the fires from crossing to the other side. This is probably due to the fact that road reserves are clear of tall vegetative material.

Table 3: summarised table of statistical inferences for firebreak orientation and firebreak type

		Mean	P-Value	Significance
Orientation	EW	23.89		
	NS	22.62	0.98	No
	Straight	23.22		
	Diagonal	23.59	0.56	No
Type	Roads	48.92		
	Ordinary	15.28	0.0064**	Yes

There is very little significance on orientation (direction) of a firebreak in relation to whether the fire will cross or not. In most cases fire crossed the firebreak regardless of its orientation.

Table 4: Level of Variance for the F-test (F-Value) comparison season and time

	DF	Sum SQ	Mean SQ	F-Value	Pr(>F)
Season	2	2907	1453.29	1.1646	0.3229
Time	1	4	3.56	0.0028	0.9577

Wildland fire season categorised as early, mid and late season were evaluated using ANOVA for their effects on firebreak efficiency and both time and season did not have significant effects on firebreak efficiency (Table 5).

Table 5: Generalized linear Model to explore the stop probability (Pr (>|z|)

	Estimate	Std Err	z value	Pr(>|z|)
Intercept	3.9539	2.4277	1.629	0.10338
Orientation N-S	-1.5869	1.4193	-1.118	0.26353
Orientation NE-SW	1.5267	1.7645	0.865	0.38691
Orientation NW-SE	0.2606	1.3793	0.189	0.85014
Season (Late)	-0.3478	1.5817	-0.22	0.82594
Season (Mid)	-0.5676	1.8518	-0.307	0.75921
Time (night)	-0.805	1.3715	-0.587	0.55727
Type	-1.7689	0.6577	-2.689	.00716**

A Generalised Linear Model (GLM) was used to explore the likelihood of a firebreak to stop 50% of a fire as influenced by season, time, and orientation and type. A binomial model with the tendency categorised as more than or equal to 50% efficient (1), and less than 50% efficient (0) was used. It was found that only firebreak type had an influence on wildland fires crossing the firebreaks several times.

4.0 DISCUSSION

It has been found that there is very little or no significance in the efficiency of firebreaks due to its orientation, fire season, and time of the fire. A significant difference was only found between efficiency of ordinary 20 m firebreaks and 15 m roads with 60m road reserves, with 30m on either side of the road, where roads were found to be better firebreaks. The probability of a firebreak to stop at least 50% of a fire was also influenced by firebreak type. The effectiveness of roads as firebreaks is probably influenced by maintained roads reserves which usually have less fuel load on the sides, in addition to the surfaced road itself. In the Northern part of the country, heavy fuel loads in the form of tall grass usually form walls on either side of firebreaks making spotting easier. It should be noted here, that these studies through the MODIS hotspots data did measure the effectiveness of fires moving towards a road, and thus eliminated the possibility of including fires burning away from the road as fires stopped by the road

This study did not include the influence of fuel load and weather factors such as rain, temperature and wind. It is therefore, recommended for further research to investigate the role played by these parameters. A detailed study is also needed for the whole country in order to guide policy making. Since the vegetation differs from point to point in the country, it will be beneficial to conduct individualised studies as per the regions to make proper representation of the different districts. But the same study can be replicated to other places of similar vegetation characteristics to avoid reinventing the wheel.

CONCLUSION

The orientation of the firebreaks did not have much effect on the fire crossing firebreaks. It is therefore important to bring in better management measures into play. Roads were better firebreaks as compared ordinary firebreaks. Fires would stop when they reach a road and die-out but when they reach ordinary at the same angle the fires would cross to the other side and this made them poor fire spread reducing agent compared to roads. The direction of the fire is mostly characterized by wind speed and wind direction

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REGIONAL SESSION 2 SOUTH AMERICA, MESOAMERICA AND CARIBBEAN

EFFICIENCY OF FOREST FIRES PROTECTION IN PINAR DEL RÍO, CUBA, (2000 – 2009)

by

Marcos Pedro Ramos Rodríguez [1]
Jesús María Cabrera Reina [2]

Abstract

Every year the forest administrators elaborate in their territories the forest fire protection plans. An element that contributes positively to the correct formulation of these plans is the evaluation of the efficiency achieved by the system during previous years. This work has the objective to evaluate the efficiency of forest fires protection system in Pinar del Río province, Cuba. It was considered a 10 year-old period (2000 - 2009). To evaluate this efficiency the following indicators they were used: fires density, area burned density, mean of the area burned by fire, the burned forest area per year in percent, and the fires size class. These indicators have been considered observing temporary elements (period of years selected and months of the year) and space elements (forests class and groups of species). As results they can be mentioned, among others, that in a general way in the period good values of efficiency were achieved in the different indicators except for the burned forest area per year in percent to which corresponds a stocking of 0,22% that which represents an mean of 992,53 hectares of forests. It could also be defined that the efficiency in general is smaller during the months of March to May, in the plantations and in *Pinus* sp.

Introduction

The prevention and the suppression are the two classic activities of the forest fires protection systems. Both are developed very interrelated, for that reason, to evaluate the efficiency of an or another in an independent way, can be a complex task. Due to this it is more common to evaluate the efficiency of the protection system in a general form. For this can be used indicators such as: relationship between the burnt area and the surface of the country, time of mobilization, time of combat, firefighter' number, number of hectares - man for burnt hectare, density of fires, density of burned surfaces, average of the area burned by fire, percentage of the forest surface that burns, and the fires size class.

Some of the previous indicators have been being part of the evaluations of the fires history in different territories (Çanakçioglu, 1990; DGCN, 1996a; DGCN, 1996b; CLIF, 1997; Martínez, 1998; and Vélez, 1990 and 1994). The most common indicator, and the only one that is used, is generally the mean of the area burned by fire. The second place according to its use, is occupied for the indicator fires size class. The use of such indicators as: fires density, area burned density, mean of the area burned per fire, percentage of the forest surface burned, to evaluate the efficiency of the protection has been found in Ramos and Soares (2000). Ramos *et al*. (2008) they used these indicators and they added other, the fires size. Lima and Soares (1995) they evaluated the efficiency of the combat through the indicators: time of mobilization, time of combat, firefighter' number, and number of hectares - man for burnt hectare.

The evaluation of the efficiency of the forest fires protection system is frequently made using alone one or two of the indicators mentioned previously and also, alone for a period of years. This method can camouflage certain results and not allowing an evaluation all the precise one that it is required. According to Ramos (1999) the forest fires is a phenomenon space - temporary for what the evaluation of the efficiency should be made in these two contexts, that which will permit to define when and where the protection service is more or less efficient. In correspondence with this think up the indicators of the efficiency should be evaluated observing temporary elements (period of years

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selected and months of the year) and space elements (forests class and groups of species).

The evaluation of the efficiency of the protection system gives important information's to the administrators of the forest areas and the forest fires protection service for the good assignment of resources and the taking of other decisions guided to perfect the system. This work has the objective to evaluate the efficiency of forest fires protection system in the Pinar del Río province, Cuba. It was considered a 10 year-old period (2000 - 2009).

Materials and methods

Cuba is a tropical country located in the Caribbean Sea. Its total area is 110,922.00 km^2 and it has been divided into 14 provinces. Pinar del Río is the most western province of Cuba. It had a geographical surface of 10 901 km^2. It is located between the 21^{o}45` and 23$^o$01`. The annual average of the rainfalls, temperature, and relative humidity are of 1 484.53 mm, 24,53^{o}C, and 81 % respectively. According to Köppen (1936), mentioned for Wadsworth (2000) the climate is Aw (tropical clime with colder month with temperature major to 18^{o}C and dry season of at least one month with less than 600 mm).

The statistics were obtained in the offices of the Forest Guard Corp and the Forest Service of the Pinar del Río province. It were processed with the help of the Integrated System for the Managing of Data Bases on Forest Fires (SIMBDIF in Spanish) version 1.2 (Ramos, 2002) and the Microsoft Excel.

The evaluation followed some of the methodological elements developed by Ramos (1999). The follows indicators were used:

Fires density: Amount of forest fires that occurred for each 1000 hectares of forest (Adapted of MINAG, 1982). This indicator has been used by Oharriz, *et al*. (1990), Ramos (1999), Ramos and Soares (2000), Ramos *et al*. (2008).

Area burned density: Amount of hectares of forest burned for each 1000 hectares of forest (Adapted of MINAG, 1982). This indicator has been used by Oharriz, *et al*. (1990), Ramos (1999), Ramos and Soares (2000), Ramos *et al*. (2008).

Mean of the area burned per fire: It is the relationship between the amount of hectares of forest burned and the amount of forest fires that occurred. This indicator has been used by FAO (1982), Ramos (1999), Ramos (2000), Ramos (2004), Terep (2004), Madoui (2000), Ramos and Soares (2000), Oharriz, *et al*., (1990) y Soares (1992), Ramos *et al*. (2008).

Percentage of the forest surface burned: It is expressed as the burnt surface between the forest surface for 100. This indicator has been used by Ramos (1999), Ramos and Soares (2000), Soares (1992), Ramos *et al*. (2008).

Fires size class: It is the grouping of fire according to area burned. This indicator has been used by Haltenhoff (1999), Soares (1985, 1988 and 1992), Du Maroc (2001), Ramos and Cabrera (2006), and Ramos *et al*. (2008). Several classifications of the fires exist according to their size (Ramsey and Higgins, 1981; mentioned by Soares, 1985 and for Batista, 1990; Oharriz, 1991; and Du Maroc, 2001). In this work the classification that has been used (Table 1) was proposed for Cuba by Batista, *et al.* (2001). The classification of the fires for size class is an important information to evaluate the effectiveness of the forest fire suppression service, because while major is this effectiveness, major it will be the concentration of the fires in the classes of smaller area (Soares, 1985). Also in the rest of the indicators the small values indicate bigger efficiency.

Table 1— *Fires size class (Batista, et al., 2001)*

Size class	Area (ha)	Denomination
I	0 – 1	Very small
II	1,01 – 4	Small
III	4,01 – 40	Mediun
IV	40,01 – 200	Big
V	> 200	Very Big

The indicators mentioned above were evaluated observing temporary elements (period of years selected and months of the year) and space elements (forests class and groups of species).

Result and Discussion

Period of years selected

In the table 2 are shown some indicators of efficiency for the period 2000 – 2009. The mean values obtained, except for the fire density, are superior to the values reported for Ramos and Soares (2000) for the same territory in the period 1989 - 1996. Nevertheless, all are smaller than those obtained by Ramos *et al*. (2008) for the same territory during the period 1997 - 2006. They be notable the high values shown by all the indicators during the year 2006. The value of the mean of the area burned per fire for the period is inferior to those reported by Soares (1992) for Greece of 1978 at 1982, Spain of 1977 to 1982, and Brazil of 1983 at 1987; and those reported by Madoui (2000) for Algeria of 1979 to 1987, and Ramos (2000) for Cuba of 1984 at 1998. Nevertheless, the values are being superior to those reported by Soares (1992) for France and Italy of 1977 to 1982 and Chile of 1964 at 1986; Çanakçioglu (1990) for Turkía of 1937 at 1988; and Terep (2004) for Estonia of 1999 at the 2003.

According to Soares (1992) while more efficient it is the forest fires protection in the forest areas, minor will be the relationship among the mean of area burned by year and the total of the protected area. According to this author, the good relationship in an efficient protection system should be around 0.05%, being able to arrive up to 0.1% in areas of high risk of occurrences or of extremely inflammable vegetation. In accordance with this the mean values obtained in this case doesn't indicate a good efficiency being similar to the one obtained by Ramos *et al*. (2008) and superior to the values reported by Çanakçioglu (1990) for Turkía of 1937 at 1988; and Ramos (1999) for Pinar del Río of 1989 at 1996.

Table 2— *Fires density (**FD**), area burned density (**ABD**), mean of the area burned per fire (**ABF**) and percentage of the forest surface burned (**PFS**) in Pinar del Río of 2000 at 2009*

Years	FD	ABD	ABF	PFS
2000	0.1790	2.1229	11.8606	0.2123
2001	0.2119	2.3915	11.2847	0.2392
2002	0.0876	1.1369	12.9731	0.1137
2003	0.0741	0.1721	2.3233	0.0172
2004	0.1584	1.5737	9.9362	0.1574
2005	0.1153	2.4580	21.3138	0.2458
2006	0.2228	8.4469	37.9045	0.8447
2007	0.1403	0.7757	5.5289	0.0776
2008	0.1547	0.9430	6.0962	0.0943
2009	0.2498	2.1633	8.6610	0.2163
Mean	**0.1594**	**2.2184**	**12.7882**	**0.2218**

The distribution of the forest fires according to the size class is presented in the table 3. It is possible observed that 74.34% of the same is located in the first two class. This result is similar to those reported by Soares (1992) for Brazil of 1983 at 1987; Sudáfrica of 1985 to 1989 and Canada of 1969 at 1978; and for the same area of the study (Ramos, 1999) of 1975 to 1996 and Ramos *et al*. (2008) of 1997 at the 2006.

Table 3— *Distribution of the forest fires according to the size class in Pinar del Río of 2000 at 2009*

Years	0 - 1,0		1,01 - 4,0		4,01 - 40,0		40,01 - 200,0		> 200,0		No. Total
	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	
2000	26	32.91	29	36.71	22	27.85	1	1.27	1	1.27	79
2001	27	28.72	50	53.19	14	14.89	2	2.13	1	1.06	94
2002	16	41.03	16	41.03	4	10.26	3	7.69	0	0.00	39
2003	25	75.76	4	12.12	4	12.12	0	0.00	0	0.00	33
2004	16	22.54	29	40.85	20	28.17	6	8.45	0	0.00	71
2005	17	32.69	22	42.31	10	19.23	1	1.92	2	3.85	52
2006	46	45.54	28	27.72	26	25.74	0	0.00	1	0.99	101
2007	27	42.19	23	35.94	12	18.75	2	3.13	0	0.00	64
2008	25	35.21	24	33.80	20	28.17	2	2.82	0	0.00	71
2009	42	35.90	44	37.61	26	22.22	4	3.42	1	0.85	117
Total	**267**	**37.03**	**269**	**37.31**	**158**	**21.91**	**21**	**2.91**	**6**	**0.83**	**721**

Size class (ha) spans columns 0 - 1,0 through > 200,0.

Months of the year

In the table 4 is observed that the highest values for all the indicators are presented from March to May, fire season in the province. It is also high the value of the ABF for the month of February. These results indicate the importance of taking the measures that allow increasing the efficiency of the service in these months. The high value obtained for the indicator ABF in October is due to that occurred a fire that affected 157 hectares that which represents 33.33% of the total area burned in that month.

Table 4— *Fires density (**FD**), area burned density (**ABD**), mean of the area burned per fire (**ABF**) and percentage of the forest surface burned (**PFS**) in Pinar del Río of 2000 at 2009 through the months*

Months	FD	ABD	ABF	PFS
J	0.0820	0.4181	5.0984	0.0418
F	0.1219	1.8025	14.7851	0.1802
M	0.2128	2.3732	11.1527	0.2373
A	0.2394	2.6160	10.9279	0.2616
M	0.3613	11.2541	31.1491	1.1254
J	0.1685	1.1154	6.6211	0.1115
J	0.1795	0.8942	4.9802	0.0894
A	0.1286	0.4080	3.1740	0.0408
S	0.0399	0.1957	4.9056	0.0196
O	0.0266	1.0440	39.2500	0.1044
N	0.0222	0.0702	3.1650	0.0070
D	0.0155	0.0242	1.5571	0.0024
Mean	**0.1598**	**2.2215**	**13.6766**	**0.2222**

In the table 5 are presented the distribution of the fires according to the size class through the months. It is significant that the fires located in the size class V are concentrate on the period February – May. In the case of the small classes most of the fires is distributed from March until August. This period included three months on the rainy time in which the great majority of fire is originated by lightning, those which in general don't burn extensive areas.

Forest class

The table 6 shows that the results reached in all the indicators that are evaluated, except for those corresponding to the mean of the ABF, are better for the natural forests than for the plantations. Similar result was obtained by Ramos *et al*. (2008) in the same territory of 1997 at the 2006. This is related to the difficulties that it presents the accessibility to the natural forests.

The table 7 shows that in both cases the biggest quantity of fires is grouped in the first two size class, although the percentage is smaller in the natural forest. In the last two size class are located a low percentage of fires, that which is a good indicator of efficiency. This results are lightly inferior to the one obtained by Ramos et al. (2008) in the period 1997 - 2006 for this province.

Group species

In the table 8 are shown the values of some indicators for the group species. Is important see the high values obtained for *Pinus* sp. except for the indicator FD. In this case the statistics reveal that in the period that is analyzed in these forests it occurred 65.33% of the fires, corresponding them 88.79% of the area burned by the fire. It is also observed high values for FD it and ABD it for *Eucaliptus* sp. Similar results were obtained for Ramos *et al*. (2008) in the same territory of 1997 at the 2006.

Table 5— *Distribution of the forest fires according to the size class in Pinar del Río of 2000 at 2009 through the months*

Months	Size class (ha)										No. Total
	0 - 1,0		1,01 - 4,0		4,01 - 40,0		40,01 - 200,0		> 200,0		
	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	
J	15	40.54	17	45.95	4	10.81	1	2.70	0	0.00	37
F	20	36.36	29	52.73	5	9.09	0	0.00	1	1.82	55
M	43	44.79	38	39.58	12	12.50	1	1.04	2	2.08	96
A	36	33.33	39	36.11	29	26.85	3	2.78	1	0.93	108
M	54	33.13	46	28.22	54	33.13	7	4.29	2	1.23	163
J	27	35.53	28	36.84	19	25.00	2	2.63	0	0.00	76
J	33	40.74	33	40.74	13	16.05	2	2.47	0	0.00	81
A	21	36.21	26	44.83	11	18.97	0	0.00	0	0.00	58
S	9	50.00	5	27.78	3	16.67	1	5.56	0	0.00	18
O	1	8.33	2	16.67	5	41.67	4	33.33	0	0.00	12
N	2	20.00	6	60.00	2	20.00	0	0.00	0	0.00	10
D	6	85.71	0	0.00	1	14.29	0	0.00	0	0.00	7
Total	**267**	**37.03**	**269**	**37.31**	**158**	**21.91**	**21**	**2.91**	**6**	**0.83**	**721**

Table 6— *Fires density (**FD**), area burned density (**ABD**), mean of the area burned per fire (**ABF**) and percentage of the forest surface burned (**PFS**) in Pinar del Río of 2000 at 2009 through the forest class*

Forest class	FD	ABD	ABF	PFS
Natural forest	0.5662	15.4783	27.3350	1.5478
Plantation	4.6603	41.3739	8.8779	4.1374
Mean	**2.6133**	**28.4261**	**18.1064**	**2.8426**

Table 7— *Distribution of the forest fires according to the size class in Pinar del Río of 2000 at 2009 through the forest class*

Forest class	Size class (ha)										No. Total
	0 - 1,0		1,01 - 4,0		4,01 - 40,0		40,01 - 200,0		> 200,0		
	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	
Natural forest	60	31.75	61	32.28	54	28.57	9	4.76	5	2.65	189
Plantation	208	38.03	211	38.57	108	19.74	15	2.74	5	0.91	547
Total	**268**	**36.41**	**272**	**36.96**	**162**	**22.01**	**24**	**3.26**	**10**	**1.36**	**736**

Table 8— *Fires density (**FD**), area burned density (**ABD**), mean of the area burned per fire (**ABF**) and percentage of the forest surface burned (**PFS**) in Pinar del Río of 2000 at 2009 through the group species*

Group species	FD	ABD	ABF	PFS
Pinus sp.	3.6049	68.1105	18.8941	6.8110
Eucaliptus sp.	7.8752	35.3571	4.4897	3.5357
Casuarina sp.	1.5474	8.2010	5.3000	0.8201
Otras latifolias	0.2556	1.1455	4.4817	0.1146
Mean	**3.3208**	**28.2035**	**8.2914**	**2.8204**

In the case of the size class, table 9, the best results have been obtained for the group of *Casuarina* sp., group in which 100% of the fires has been smaller than 4 hectares. It is observed that in *Pinus* sp. has been occurred all fires bigger than 200 hectares in the province in the analyzed period.

Table 9— *Distribution of the forest fires according to the size class in Pinar del Río of 2000 at 2009 through group species*

Group species	Size class (ha)										No. Total
	0 - 1,0		1,01 - 4,0		4,01 - 40,0		40,01 - 200,0		> 200,0		
	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	(No.)	(%)	
Pinus sp.	177	37.58	162	34.39	108	22.93	18	3.2	6	1.27	471
Eucaliptus sp.	54	31.40	78	45.35	38	22.09	2	1.6	0	0.00	172
Casuarina sp.	1	50.00	1	50.00	0	0.00	0	0.0	0	0.00	2
Otras latifolias	35	46.05	28	36.84	12	15.79	1	1.2	0	0.00	76
Totals	**267**	**37.03**	**269**	**37.31**	**158**	**21.91**	**21**	**2.91**	**6**	**0.83**	**721**

Conclusions

The evaluation of the efficiency of the forest fires protection in Pinar del Río, of the 2000 at the 2009 using five indicators and considering the character space - temporary of the fires, has been obtained very important elements to make decisions that permit to perfect the forest fires protection. In a general way in the period good values of efficiency were obtained in the different indicators except for the burned forest area per year in percent to which corresponds a mean of 0.22% that which represents 992.53 hectares of forests. It could also be defined that the efficiency in general is smaller during the months of March to May, in the plantations and in *Pinus* sp.

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MANEJO DEL FUEGO Y COOPERACIÓN REGIONAL EN CENTROAMÉRICA

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Resumen:

Los cambios climáticos producidos por el fenómeno de **"**El Niño**"** y las diversas acciones de deterioro al ambiente que ha originado el ser humano a través de la quema de pastizales, la agricultura tradicional, la roza, tumba y quema, o los incendios accidentales han incidido en la recurrencia de los incendios forestales en toda la región Centroamericana, afectando una gran variedad de ecosistemas naturales, poblaciones humanas y las economías nacionales.

Las actividades de desarrollo que realiza el ser humano son la principal causa en la propagación de incendios forestales que muchas veces son el resultado de una problemática de inequidad social, falta de tenencia de la tierra, falta de cultura forestal, de información, políticas gubernamentales mal orientadas o desconocimiento de las mismas, así como propuestas fuera del contexto de la realidad.

Ante esta situación por medio del grupo Centroamericano de Manejo del Fuego, adscrito al Comité Técnico de Bosques (CTB) de la Comisión Centroamericana de Ambiente y Desarrollo (CCAD) se han venido realizando grandes esfuerzos por los países para abordar esta problemática.

El grupo Centroamericano de Manejo del Fuego está compuesto por los puntos focales o coordinadores nacionales de Belice, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica y Panamá; este grupo de trabajo desde el año1996 ha efectuado doce actividades entre reuniones, foros, talleres de índole regional, lo cual ha mantenido unido al equipo de trabajo el cual ya trabajado en forma conjunta un proyecto de índole regional para el fortalecimiento de las acciones de Manejo del Fuego en la Región Centroamericana, mismo que apoyado por USAID/DOI e implementado por la CCAD.

Para ser sostenible las acciones en los países en esta temática y luego de la culminación de este proyecto regional, se ha tenido apoyo de entes de cooperación internacional, como la Oficina de Asistencia de Desastres en el Exterior del Gobiernos de los Estados Unidos de América (USAID/OFDA-LAC) la Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO) The Nature Conservancy (TNC) Programa de Pequeñas Donaciones del PNUD, Cooperación Técnica Alemana (GTZ) Agencia Española para la Cooperación Internacional y Desarrollo (AECID) la Organización Internacional de Maderas Tropicales (ITTO) para lo cual cada país ha venido ejecutando sus acciones especificas.

Centroamérica cuenta con una Estrategia Regional de Manejo del Fuego la cual se enmarca en el contexto de la integración de los países de América Central y la gestión de los incendios forestales; la cual tiene la intención de unificar criterios técnicos y establecer una dinámica global y operativa entre los países de la región Centroamericana. Esta estrategia fue aprobada por los Ministros de Ambiente de la Región; así mismo se cuenta con un Manual Centroamericano de Prevención de Incendios Forestales, el cual unifica criterios técnicos, estandariza y prioriza las acciones de prevención, como elemento fundamental dentro del triangulo de manejo del fuego. Este documento ha ayudado a fortalecer los esfuerzos de los países de la Región, grupos comunitarios, organizaciones no gubernamentales, instituciones públicas, empresas privadas, municipalidades y alcaldías.

Posterior a la realización de la IV Conferencia Internacional sobre Incendios Forestales, realizada en Mayo de 2007 en Sevilla, España; a nivel regional se han efectuados dos Foros Centroamericanos de Manejo del Fuego, los cuales se realizaron como parte de los esfuerzos que ha venido realizando la Comisión Nacional de Incendios Forestales (CNIF) de la Republica de El Salvador y el aporte que tuvieron de la GTZ de Alemania.

Estos foros se realizaron en San Salvador, El Salvador los días 30 y 31 de Octubre de 2007 y 11 y 12 de Noviembre de 2008.

Como parte de la cooperación entre los países de la región y por medio de gestión del Instituto Nacional Forestal (INAFOR) de Nicaragua, por medio de un proyecto ejecutado por esta institución se realizo en el mes de Mayo de 2009, en Managua, Nicaragua una reunión del Grupo Centroamericano de Manejo del Fuego, como producto de esta actividad se actualizo el Plan de Acción de la Estrategia Centroamericana para los próximos tres años.

Los resultados del trabajo realizado por el equipo de trabajo y el estado actual del manejo del fuego en la región se presento al Comité Técnico de Bosques de la CCAD, para lo cual este ente acepto el plan propuesto y realizaría la búsqueda de recursos para realizar las actividades.

Como se menciono en un inicio los incendios forestales son una de las principales causas del deterioro ambiental en la Región Centroamericana, producto de las acciones de los países, se cuenta con estadística de áreas afectadas por incendios forestales desde el año 1998; solamente entre el año 2008 y 2009; se vieron afectadas por el fuego más de 324.000 hectáreas. El año 2010 fue un año crítico para la Región en cuanto a la incidencia de los incendios producto de la presencia Fenómeno del Niño (sequía) acentuándose principalmente en toda la vertiente Pacifica de Centroamérica y vertiente Caribeña de Nicaragua y Honduras.

Dentro de los avances en la Región se encuentra el caso de Costa Rica, el cual después de la IV Conferencia sobre Incendios Forestales realizada en el mayo de 2007, ha venido realizando grandes esfuerzos por medio de la integración de las instituciones que conforman la Comisión Nacional sobre Incendios Forestales (CONIFOR) la cual está compuesta por 10 instituciones del Gobierno y 2 Organizaciones o Gubernamentales; producto de ello es:

- Oficialización del Sistema de Comando de Incidentes (SCI) como herramienta para el manejo de emergencias por incendios forestales

- Cuatro Ejercicios de Movilización de Brigadas Forestales, los cuales ha integrado a las brigadas nacionales sean estas voluntarias, de empresa privada y gubernamentales. En estos eventos se ha tenido la participación de una brigada de Guatemala y otra de Panamá
- Cursos sobre Comportamiento del Fuego S-290 y S-390 con el apoyo de la Comisión Nacional Forestal (CONAFOR) de México y TNC-Costa Rica.
- Elaboración del Curso Uso Efectivo del Agua en la Extinción de Incendios Forestales (CUEA-EIF) para lo cual se conto con la asesoría técnica de USAID/OFDA-LAC.
- Costa Rica fue sede de un Curso y Taller para la formación de instructores de este curso, en el cual participaron personal de Paraguay, Ecuador y Colombia.

Un aspecto importante a destacar es que los países de la región, han iniciado con la aaplicación y adopción de las Directrices Voluntarias para el Manejo del Fuego, la cual es la base para la generación de Estrategias Nacionales.

A pesar de los avances logrados en los últimos años en la consolidación y el desarrollo de Programas de Manejo del Fuego en los países de la región, se requiere a corto plazo de un mayor compromiso político y asignación de recursos financieros, con el fin de implementar una serie de acciones relacionadas con el manejo del fuego en cada país de la región; es por ello que se concluye con lo siguiente:

- Los incendios forestales son una de las mayores causas del deterioro ambiental en Centroamérica; el cual produce serios impactos en aspectos sociales, y económicos.
- Faltan políticas claras y actualizadas con respecto a la competencias, responsabilidades y recursos logísticos y económicos para llevar a cabo acciones de manejo del fuego en cada uno de los países.
- Se debe fortalecer la coordinación, planificación y articulación de acciones entre instituciones para abordar la problemática de los incendios forestales a lo interno de los países.
- La región dispone de recursos humanos entrenados, equipamientos y herramientas para el control, pero no es suficiente.
- Es necesario aún fortalecer y descentralizar actividades de prevención y control de incendios a nivel de las comunidades, municipios y organizaciones civiles.
- El cambio climático ya está teniendo impacto en la región Centroamericana por lo cual la ocurrencia y severidad de incendios forestales en los próximos años será mayor.
- Se debe de fortalecer las investigaciones asociadas al manejo del fuego.
- A través del SCI se debe fortalecer la coordinación, planificación y articulación de acciones entre instituciones para abordar la problemática de los incendios forestales a lo interno de los países
- Los planes de manejo del fuego de los países deben de buscar un enfoque hacia el manejo integral del fuego y no solo prevención y control.

REGIONAL SESSION 4 MEDITERRANEAN, NEAR EAST (incl. NORTH AFRICA), EURO ALPINE

CREATION OF NEAR EAST REGIONAL NETWORK ON FOREST AND WILDLAND FIRES

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Abstract

The changes in fire occurrence during the last decades closely reflect the recent socio-economic changes underway in several countries. Changes in traditional land-use and lifestyles, depopulation of rural areas, increases in agricultural mechanization, decreases in grazing pressure and wood gathering and increases in the urbanization of rural areas leading to the recovery of vegetation and an increase in accumulated fuel.

International agencies and unions have developed policies and strategies to promote the protection of the Mediterranean countries from forest fires. FAO developed in 2006 a voluntary guidelines on forest fires management which was exhaustively discussed and endorsed by the six Regional Forestry Commissions. However implementation of these guidelines have not been reported yet by member countries of the Near East. Treaties and agreements for cooperation exist, but only a few measures are taken on the ground. None of these policies and strategies addresses the countries in the Near East and North Africa. The issue of trans-boundary cooperation and collaboration remains a crucial aspect to be emphasized.

The Near East Regional Network on Forest and Wildland Fires (NENFIRE) seeks to promote collaboration, sharing of expertise and information, and implementation of projects to predict, combat and manage forest and wildland fires in the region, for the mutual benefit of member countries.

The overall objective of the network is to foster active bilateral, sub-regional and regional cooperation on issues related to forest and wildland fires in the Near East region, with particular attention to:

Promote the collection and dissemination of information, create awareness, and foster scientific, technical and technological exchange relevant to the fire detection, suppression and management in forests, rangelands and other natural ecosystems;

Promote the better understanding of human behaviour and how to measure changes in behaviours towards fire management (efficiency of fire awareness);

Communicate, collaborate and coordinate with existing international, regional and national organizations dealing with forest and wildland fires;

Collaborate to identify key regional challenges and strategies for addressing them.

Keywords: Forest Fires, Wildland Fires, Near East

Introduction

The changes in fire occurrence during the last decades closely reflect the recent socio-economic changes underway in several countries. Changes in traditional land-use and lifestyles, depopulation of rural areas, increases in agricultural mechanization, decreases in grazing pressure and wood gathering and increases in the urbanization of rural areas leading to the recovery of vegetation and an increase in accumulated fuel. Land-use changes produced during the present century are parallel to the changes in the fire regime, from being few in number and affecting small areas, to becoming very numerous and affecting large extensions every year. This trend is not observed in countries/regions where traditional land uses remain the major socio-economic system.

Although the main reason for fire increase in the last decades is probably changes in land use, climatic factors should be considered as a contributing factor. Fires tend to be concentrated in summer when temperatures are high and air humidity and fuel moisture are low. The climate changes that are predicted to occur in the near future as a result of releasing greenhouse gases are likely to induce increased fire risk.

International agencies and unions have developed policies and strategies to promote the protection of the Mediterranean countries from forest fires. FAO developed in 2006 a voluntary guidelines on forest fires management which was exhaustively discussed and endorsed by the six Regional Forestry Commissions. However implementation of these guidelines have not been reported yet by member countries of the Near East.
Treaties and agreements for cooperation exist, but only a few measures are taken on the ground. Most agreements concerning forest fires are part of broader forestry policies, strategies for civil protection and environmental declarations. None of these policies and strategies addresses the countries in the Near East and North Africa specifically. The issue of trans-boundary cooperation and collaboration remains a crucial aspect to be emphasized.

The Forest Fire Network of Silva Mediterranea constitutes the Regional Wildland Fire Network within the UNISDR Global Wildland Fire Network. Although this network has achieved some good results in terms of capacity building and regional cooperation, there is still a serious need to adapt these activities to the Near East and North Africa region with all its specificities and characteristics.

The increase on the number of the forest fires and the burnt area respectivelly in the Near East and North Africa countries it is a Mediterranean problem and more specifically it is a regional problem. In order to meet this problem, on request by the NEFC 16 and 18, the Near East Regional Network on Forest and Wildland Fires (NENFIRE) was created in November 2009 during a regional workshop on forest fires in the Near East, held in Lattakia, Syria.

Forest Fire Information on a regional level

Data availability is a major problem in most countries of the region. Even where it is available, it is not comparable, due to different methodologies, definitions, perception and mentalities. The differences in the forest fire data are mostly due to differences in forestry data and definitions in general.

Lack of data on forest fires and their causes are a major obstacle in understanding the nature of forest fires and design strategies and measures in national and international level. International agencies often receive wrong messages and respond in a wrong way.

Information is needed to describe the magnitude and urgency of the problem to decision makers and to make them prioritize the necessary measures.

Therefore there is a necessity to promote the collection and dissemination of information, create awareness, and foster scientific, technical and technological exchange relevant to the detection, management and suppression of forest and wildland fires in the Near East Region. More specifically the following actions must be taken:

- Archive existing country databases;
- Harmonize methodology of data collection and analysis throughout the region;
- Establish data on cost of annual awareness raising programmes compared to cost of fire damage;
- Develop annual average weather index to enable comparison of different years in relation to known fires (natural/human induced...)
- Develop annual fire occurrence data based on current and predicted population growth;
- Use geo-referenced (GIS) and cartography to standardise information to prepare country databases;
- Make available research information of relevance to the region;
- Participate in joint research activities in order to update information and knowledge base;
- Provide advice to member countries on policies and regulations conducive to the reduction of occurrence, scope and severity of forest and wildland fires;
- Update members of the network on current information about forest and wildland fires in the region.

Communication and coordination with existing and regional organizations

The problem of forest fires is too large to be controlled at a single government level. It is a Mediterranean problem and more specifically it is a regional problem, but most international associations include forest fires as a small part of their activities, as a geographical or thematic sub-unit. There is a lack of a common perception of forest fires in the region.

Regional organizations dealing with forest and wildland fires will:

- Organize regular technical and coordination meetings;
- Facilitate collaboration and exchange of expertise among member countries, including through the creation of a regional newsletter and relevant publication;
- Facilitate joint field research among the working group member countries.

Collaboration to identify key regional challenges and strategies for addressing them

Collaboration through bilateral and multilateral agreements between the Near East Regional Network of Forest and Wildland Fires and between other Mediterranean countries will:

- Provide guidance on national action plans and collection of information on forests and wildland fires;
- Provide training and capacity building on forest and wildland fires activities;
- enhancing capacities for early warning and suppression of forest and wildland fires
- assess the implementation of main international agreements and cooperation instruments;

- Explore opportunities and identify partners to provide trained experts to meet priority needs within each country;
- Raise awareness and promote participatory processes;
- Carry out country surveys to identify the most serious aggravating factors on forest and wildland fires.

Membership

Countries will be represented by the forestry, range and/or related research and academic institutions of their choice. Individual experts will be identified and invited to be involved in the network activities.

Associate membership including Universities, NGOs and private Companies will be encouraged.

Partnership

Tight operational linkages and strong collaboration mechanisms will be established and maintained with:

- The Near East Forestry Commission's Task Force
- Silva Mediterranea Working group on Fire
- Euro-Alpine Wildland Fire Network
- The Forest Fire Action Alliance
- Global Fire Monitoring Center (GFMC)
- Other Fire Networks

Position Paper

Wildfire Prevention in the Mediterranean

A key issue to reduce the increasing risks of Mediterranean wildfires in the context of Climate Change

Executive Summary

While wildfires are already a preoccupation in the Mediterranean, in the light of the scientific world's diagnosis of new climatic scenarios, managers are faced with a general trend of increased burnt areas and a rise in the frequency, intensity and severity of fires *(a wildfire is any uncontrolled fire in combustible vegetation that occurs in the countryside or a wilderness area. Other names such as brush fire, bushfire, forest fire, grass fire, hill fire, peat fire, vegetation fire, veldfire and wildland fire may be used to describe the same phenomenon depending on the type of vegetation being burned)*. Significant prevention efforts have been focused on training, investigation, awareness raising and structural prevention. As a consequence of social economic processes *(rural abandonment, aging of rural populations, changing management of production system, etc.)*, the vegetation structure has already changed drastically increasing the risk of a traditional fire use *(traditional fire is the use of fire by rural communities for land and resource management purposes based on traditional know-how).*

However, these efforts need to be intensified to deal with the consequences of climate change.

The opportunities to address wildfire prevention at international level were identified within the framework of:

1. The 4th International Conference on Wildland Fire in Seville, Spain (2007);
2. The FAO Workshop on *"Forest Fires in the Mediterranean Region"*, Sabaudia, Italy (2008);
3. The workshop on "*Assessment of Forest Fire Risks and Innovative Strategies for Fire Prevention"*, Rhodes, Greece (2010).

During those workshops, several recommendations on wildfire prevention were provided by experts from Mediterranean countries. The present position paper was prepared on the basis of the conclusions and recommendations of these previous events in the Mediterranean.

The main recommendations of this position paper on wildfire prevention are focused on:

1. Enhancement of the international cooperation on wildfire prevention (See sheet 1);
2. Integration of wildfire prevention in National Forest Programs/Policies and in National Strategies for Adaptation to climate change (See sheet 2);
3. Promotion of knowledge and education on wildfire prevention (See sheet 3)
4. Enhancement of sustainable financial mechanisms for prevention of wildfires (See sheet 4).
5. Enhancement of harmonized Information Systems to deal with new wildfire risks (See sheet 5);

This position paper on Wildfire Prevention was endorsed by the main Mediterranean stakeholders during the Second Mediterranean Forest Week organized in Avignon from 5 to 8 April 2011. This document is an opportunity to address wildfire prevention in the context of climate change and to implement these recommendations in all countries of the Mediterranean. It will also be presented as the position of Mediterranean stakeholders during regional sessions of the 5th International Wildland Fire Conference to be held in South Africa (Sun City) on May 11, 2011.

Background

Introduction

A unique opportunity to raise awareness at international level on wildfire prevention was presented by two recent workshops: one on **"Forest Fires in the Mediterranean Region: Prevention and Regional Cooperation"**, held in Sabaudia, Italy in 2008 *(See report of Sabaudia workshop on http://ec.europa.eu/enviroment/forests/studies.htm)* and another on **"Assessment of Forest Fire Risks and Innovative Strategies for Fire Prevention"**, held in Rhodes, Greece in 2010 *(See report of Rhodes workshop on www.foresteurope.org)*. The workshops' objectives were the review of current prevention systems in Mediterranean countries, the identification of new strategies and policies needed in this area and the formulation of conclusions and recommendations on prevention of wildfires. A synthesis of these conclusions and recommendations are available in this Position Paper, which will be presented during the regional sessions of the 5th International Wildland Fire Conference *(IWFC)* in South Africa *(Sun City – 11th May 2011)*.

1. Background and justification for this Position Paper

1.1. Why are wildfires so relevant in the Mediterranean?

- Wildfires destroy biodiversity, increase desertification, affect air quality, the balance of greenhouse gases and water resources. Wildfires can further have negative effects on human life and health, *(Wildfires in Greece in 2007 caused the death of 84 people)* human property and wellbeing, cultural and natural heritage, employment, recreation, economic and social infrastructures and activities,
- In the light of the scientific world's diagnosis of new climatic scenarios, managers are faced with a general trend of increased burnt areas and a rise in the frequency, intensity and severity of fires, as well as a prolonged risk seasons. Wildfires destroy around 500.000 hectares every year in the European Union, 0.7 to 1 million hectares in the Mediterranean basin. This has a serious impact on the environment and on socio-economic activities, especially in southern Europe and Northern Africa.
- One of the greatest challenges of sustainable forest management in the Mediterranean Basin is the fight against wildfires, an ever present and increasing threat because of climate change.

1.2. Causes of wildfires and increased risks in the Mediterranean

Social context and social change

One of the main causes for wildfires lies rooted in an old tradition widespread "all over the world" that uses fire as a vegetation management tool by farmers and overall stockbreeders. Rural populations still need to control the vegetation for maintaining grasslands or other lands free of scrubs. For this purpose, they use fire as a primary form of land clearing. The perception of risk is low because forests are considered as agro ecosystems of low value. This traditional use increases the risk of wildfire in the Mediterranean *(In addition, the current state of vegetation maintains and reinforces the need for traditional use of fire because its conditions make it unfavourable for traditional uses like pasturages. The current state of evolution of the Mediterranean is closely connected with the number of wildfires and with their severity. Fuel management is one of the main factors for controlling wildfires. Neither the number nor the severity of the fires can be understood without understanding the actual state of vegetation).*

- **The changing of socio-economic and environmental conditions in many European rural areas** *(e.g. Vegetation encroachment and the aging of rural population)* have increased the risk related to traditional fire use which, in turn, can result in damaging wildfires. **Fire is also used as a management tool to control and define the type of vegetation cover,** but sometimes it can spread out of control leading to large-scale wildfires with negative impacts in the Mediterranean region as well as in other countries with similar climatic characteristics.
- **The intense urbanization of our societies, the abandonment of rural lands and rural activities – such as forest management – along with the rapidly expanding of urban/forest interface are key drivers for wildfires in Europe and in the Mediterranean region.**

Background

Vegetation and vegetation dynamics

- Weather, forest structure, types of vegetation and human activity for centuries have turned the **Mediterranean forests into a very complex system in constant evolution and requiring a specific suitable management.**
- **Due to rural abandonment and to changes in production models** *(which have taken place in the last half century in many Mediterranean regions)* **vegetation is in a phase of very unfavourable development. This increases wildfire risks especially in the context of urbanization in the Mediterranean region** *(In many regions, there are large areas with high fuel loads without discontinuities. Vertical structure is also prone to high crown fires due to the high share of fine fraction both living and dead. This leads to a very high risk of catastrophic fire. This situation will be reproduced in all areas where increased urbanization and rural abandonment take place in the near future).*

Climate and climate change

- Ecosystems, all around the Mediterranean Rim, are strongly conditioned by the Mediterranean climate, characterized by hot and dry summer. They are ecologically very different from other ecosystems. Hence, these Mediterranean ecosystems need specific approaches and treatment.
- Climate change will not only impact growth conditions for Mediterranean forests, it will also have an important effect on disturbance patterns, mainly those related to **periods of higher temperature and longer drought that may become more frequent in parts of the Mediterranean region.**
- **The Joint Research Centre of the European Union in Ispra recognizes that changes in wildfire risks due to climate change will become a clear focus for the XXI Century** *(Future trends of wildfire risks in the Mediterranean region, as a consequence of climate change, will lead to the increase of temperature in the East and West of the Mediterranean, with drought and precipitations especially concentrated in other parts of the region).*

1.3. An urgent need for wildfire prevention in the Mediterranean

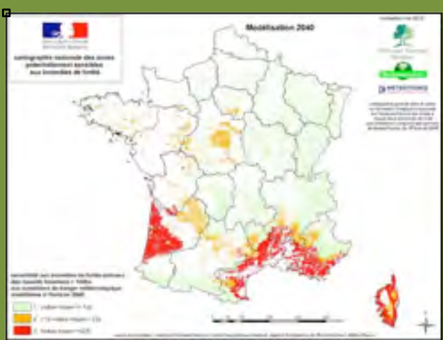
It has been widely recognized that prevention is the most effective approach to face wildfires. FAO's Fire management Voluntary Guidelines state that: *"Fire prevention may be the most cost-effective and efficient mitigation programme an agency or community can implement"*. Preventing unwanted, damaging fires is always less costly than suppressing them. Even regions with well-prepared fire brigades, equipped with sophisticated ground and aerial equipment and a substantial number of fire fighters have been unable to stop a number of large-scale disastrous wildfires in recent years. After several decades focused on wildfire suppression both at national and international level, currently, **there is a considerable deficiency in wildfire prevention.**

Although it is accepted that prevention is more efficient than suppression in wildfire fighting, it is urgent to give a major boost to wildfire prevention in particular with the following priority:

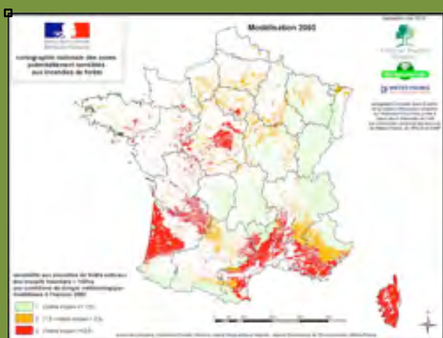
- Prevention should be focused on "sustainable forest management'' and on "sustainable rural areas management'', to limit the risk of wildfires in the Mediterranean, particularly, in the context of climate change.

Presentation on Wildfire Risks under climate change conditions in France
Alain Chaudron - Rhodes Workshop - Greece - May 2010

Risk of Wildfires 1989-2008



Risk of Wildfires in 2040



Risk of Wildfires in 2060

1.4. Why is regional integration needed between Europe and the South of the Mediterranean?

- **Owing to the transboundary nature of wildfires, the planning for their prevention should be addressed from an European and Mediterranean regional perspective**. As the ''Green Book on Forest Protection and Forest Information in the European Union'' *(European Commission)* notes, significant prevention efforts made by the EU and its member states have been focused on training, investigation, awareness and structural prevention. **However, these efforts need to be intensified to deal with the consequences of climate change. In this context the correlation between active forest management and reduction of fires is crucial.**

- **Networks** *(Silva Mediterranea working group on Forest Fires, EU Commission Expert Group on Forest Fires and EFFIS, UNECE FAO Team of Specialists on Forest Fires, etc.)* **constitute international *fora*,** sharing experiences and knowledge as well as combining and coordinating efforts to prevent and fight wildfires during the last decades.

- **Forest ecosystems play a very important role in providing multiple goods and services to all inhabitants of the Mediterranean.** Hence their conservation deserves a strong support from the European Union. Financial grants are needed to provide regional tools as, for example, the Network of Protected Areas ''Natura 2000'' *(Structural Funds and Rural Development Funds).*

BOX 1: *Silva Mediterranea* Forest Fires Working Group

Silva Mediterranea **constitutes an international forum, which through the years has allowed sharing experiences and knowledge as well as combining and coordinating efforts to prevent and fight wildfires. These important roles have been developed through the build up of a network between all the Mediterranean Basin countries. During the last decades, the work of *Silva Mediterranea* has kept promoting the exchange of information about wildfires between countries in the Mediterranean Basin. Taking into advantage the launching of the European Forest Fire Information System (EFFIS) by the European Commission, FAO, with the help of *Silva Mediterranea* and other key partners, organized several seminars to promote the idea of the necessity of gathering data that will allow a better knowledge of wildfires in the region. International Research Centres added their efforts to this objective, like the CIHEAM that coordinates, with *Silva Mediterranea*, the organization of seminars in France, Greece, Spain, Tunisia and Morocco. Nowadays, we are still working on this exchanges of experiences, sure that the importance of extending the knowledge on wildfires to face the battle in the most efficient way: this is, with a common decentralized data base, compatible with the ones the Mediterranean European countries have, which will enable the exchange and analysis of data to help the establishment of suppression and prevention strategies. As a response, the *Silva Mediterranea* Forest Fires Working Group developed a work plan for the period 2009 to 2012. Among its objectives is the extension of EFFIS to all the countries of the Mediterranean Basin, members and non-members of the European Union, to create a decentralized and common database on wildfires.**

Silva Mediterranea

CIHEAM

WWF

giz

CENTRE FORESTAL TECNOLÒGIC DE CATALUNYA

arcMED

ASSOCIATION INTERNATIONALE FORETS MEDITERRANEENNES

E F I

Mediterranean Model Forest Network

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

plan bleu

USSE

INRA

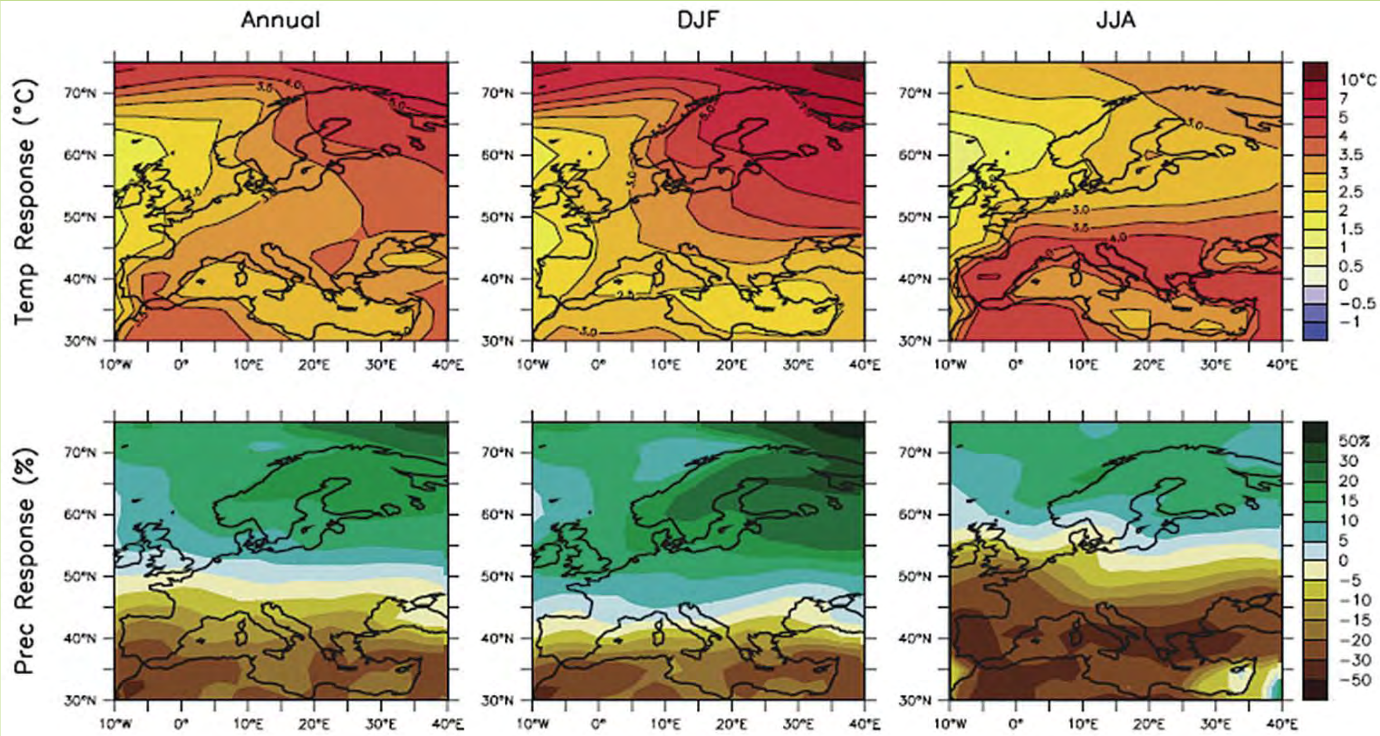
FAO FIAT PANIS

Boxes

BOX 2: Impact of climate change on risks of wildfires

In the various scenarios presented by the IPCC, the Mediterranean region has to cope with a great increase in the aridity of its climate. Even if the response of the ecosystems remains difficult to anticipate, it is certain a very considerable increase in the threat of wildfire, desertification and loss of biodiversity. Furthermore, new constraints hang over farmers, in particular the scarcity of water resources. The management of forestry and natural land will have to be more careful as we do not know where to situate the ecosystems' thresholds of resiliency beyond which irreversible deterioration could occur. It is increasingly accepted that sustainable management must be grounded on good governance, implementing guiding principles of: subsidiarity, devolution of authority, evaluation ex ante and ex post, responsibility and accountability, participation of all stakeholders and all publics concerned or involved. Even if these principles are relatively simple to state, they are not so easy to put into practice: they are often numerous administrative, legal and even psychological and sociological obstacles that ender their implementation. Climate change will contribute to raise the catastrophic wildfire risk in the Mediterranean. To reduce the risk of catastrophic wildfires it is required to manage the two following factors: the number of fires and the current vegetation structure. As the number of fires is closely related with the vegetation state a key solution would be to modify the current vegetation structure. This is an urgent issue to be addressed at a landscape level and with an ecosystem approach. An appropriate vegetation structure would also add economical value to Mediterranean forest ecosystems.

Actual and predicted climate change trends in the Mediterranean (MFRA 2010 – 2020 - Source IPCC 4th assessment report 2007)



BOX 3: Relevance of wildfire prevention in the context of climate change

It has been widely recognized that prevention is the most effective approach to face wildfires. FAO's Fire Management Voluntary Guidelines state that: *"Fire prevention may be the most cost-effective and efficient mitigation programme an agency or community can implement"*. Preventing unwanted, damaging wildfires is always less costly than suppressing them. Even regions with well-prepared fire brigades, equipped with sophisticated ground and aerial equipment and a substantial number of fire fighters have been unable to stop a number of large-scale disastrous wildfires in recent years. Those fires caused severe ecological damages, tremendous impacts on livelihoods, infrastructure, tourism and even a dramatic toll in human lives. Despite recent advancements in international initiatives *(e.g. FAO's Voluntary Guidelines, Forest Fires and The Law Review FAO)*, forest information and monitoring (e.g. European Forest Fire Information System - EFFIS- at the European level), results of large scale research projects financed by the European Commission *(e.g. FIRE PARADOX)*, and publications *(e.g. EFIMED "Living with Wildfires: what science can tell us?")*, still, for multiple causes, prevention captures a small fraction of the budgets available for wildfire management, a small share of public attention and almost no place in the news. Direct financial support for wildfire prevention is weak and fragmented *(even if in the past EU spent millions of euro for forest fire prevention under Rural Development Regulation)*. Legal frameworks are not harmonized among countries and there is a lack of comprehensive financial instruments while best practices do not expand easily from one region to another. Thus, there is a considerable room for improving and innovating in wildfire prevention programs and activities. This improvement will revert on positive effects on wildfire management. Several innovation areas have already been identified: (i) Comprehensive and participatory approaches; (ii) Political and public awareness on the potentiality and effectiveness of prevention; (iii) New financial and policy instruments; (iv) Risk assessment and early detection technologies and (v) International cooperation at the pan European & Mediterranean level.

Conclusions

2. Main conclusions of this Position Paper

Recognizing the relevance of prevention of wildfires at the Pan European and Pan Mediterranean levels and based on a synthesis of conclusions of several recent events organized in the Mediterranean for improving prevention of wildfires the main conclusions of this Position Paper adopted during the II Mediterranean Forest Week are:

- **Rural abandonment and decline of forest economy in the Mediterranean Basin** are a major concern as climate change may aggravate the natural conditions of wildfire risks;
- **Priority has to be given to a participatory approach for wildfire prevention**, in particular, to local population, as primary players in making prevention of wildfires effective, and to public and private stakeholders of the forest sector *(local approach, local actions and local analysis of causes)*.
- **Protection of forest ecosystems or other wooded lands in Europe and the Mediterranean Basin** cannot be effective if wildfire prevention strategies are not integrated in national and regional forest programs/policies in the context of climate change.
- **Wildfire prevention should be considered as an important part of sustainable forest management and should integrate a landscape approach taking into account different land uses.**
- **Wildfire in the urban interface area constitute a difficult issue to cope with in the context of socio-economic changes, which requires specific approaches in the Mediterranean.**
- **The appropriate fuel treatment (biomass reduction) is a key factor to decrease wildfire risks.** Preventive silviculture, which main target is crown fire avoidance by treating surface fuels and promoting low density and vertically discontinuous stands, should integrate the landscape approach and the choice of proper species in order to increase the resilience of forest ecosystems to wildfires. The profitability of forest ecosystems *(goods and services – payment for environmental services)* has to be promoted in order to avoid human causes of wildfires.

Prevention of wildfires is the most effective tool in a context of limited resources

Investments on prevention are needed for adaptation of Mediterranean forest ecosystems to climate change

3. List of supporting organizations of this Position Paper on prevention of wildfires:

This position paper on wildfire prevention in the Mediterranean is endorsed by:

- Representatives of members of the Collaborative Partnership on Mediterranean Forests *(CPMF Organizations and Morocco, Algeria, Syria, Tunisia, Lebanon and Turkey)*;
- Members of the FAO - *Silva Mediterranea* Enlarged Executive Committee including representatives from the following member states *(Bulgaria, France, Morocco, Turkey and Portugal)* and coordinators of the six working groups;
- Members of the FAO Working Group on Forest Fires coordinated by Spain (WG1);
- Forestry Department of FAO and the Secretariat of the Committee *Silva Mediterranea;*
- Plan Bleu (UNEP/MAP);
- EFIMED, Mediterranean Office of the European Forest Institute (EFI);
- INRA - Research Unit on Mediterranean Forest Ecology;
- International Association for Mediterranean Forests (AIFM);
- International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM);
- WWF (World Wildlife Fund) Mediterranean Programme Office;
- ARCMED: Forest Owners Association of the Mediterranean;
- USSE: Union de Sivicultores del Sur de Europa;
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ);
- Mediterranean Model Forest Network (MMFN);
- Centre Tecnòlogic Forestal de Catalunya (CTFC).

Recommendation 1

Enhancement of the International Cooperation on wildfire prevention in the Mediterranean

Proposed actions

1. Encourage agencies and groups to support the adoption of the Fire Management Voluntary Guidelines;

2. Consider existing regional networks such as the FAO *Silva Mediterranea* Working group on Forest Fires, the Regional South-East European Wildland Fire Network, the Near East Fire Network and the EU Commission Expert Group on Forest Fires competent for EFFIS, when new international cooperation activities will be developed in the Mediterranean;

3. Increase the visibility of wildfire prevention and of wildfires in forest management communication, also taking advantage of every opportunity that arises during the International Year of Forests 2011 *[by using all relevant events to draw attention on prevention of wildfires - e.g. Committee on Forestry (COFO), Mediterranean Forest Week and Ministerial Conference of Forest Europe - and the relevant work developed by expert groups such as the UNECE/FAO Forest Communicators Network];*

4. Disseminate and share experiences, build up and replicate the best practices in wildfire management, namely by promoting international exchanges between fire professionals of all levels;

5. Integrate wildfire prevention in the debate following the European Commission Green Paper on Forest Protection and Information in the "EU: Preparing forests for climate change" *(http://ec.europa.eu/environment/forests/fprotection.htm),* as well as in the future Integrated Strategy for Sustainable Management of Mediterranean Forests to be prepared by the Committee on Forestry Questions – *Silva Mediterranea* and its main partners before the end of 2012.

6. Promote exchange programmes on good practices and develop risk assessment voluntary guidelines and risk cartography with an adequate spatial and temporary resolution, as well as prevention voluntary guidelines.

Recommendation 2

Integration of Wildfire Prevention in National Forest Programs/Policies and in Adaptation Strategies to Climate Change

Proposed actions for Policy Makers

1. Prevention actions should be cross-sectorial with more coordination between all stakeholders (*land owners, civil protection, rural development, tourism, education, spatial planning and forest services*) at National, European and Mediterranean levels.
2. Legal aspects should be clarified and enhanced through the development of incentives and obligations concerning wildfire preventive actions (*land owners, building enterprises, municipalities, etc*.).
3. Development of wildfire prevention plans should be encouraged, taking into consideration the characteristics of the countries, the local conditions, the principles of sustainable landscape management *(taking into account the several uses of land in the Mediterranean territories)* and future needs due to climate change.
4. Wildfire prevention should be integrated in national adaptation strategies to climate change. A common understanding of wildfire prevention (*definition, activities*) is needed to develop and promote revised templates/voluntary guidelines for wildfire prevention plans. Strategic actions are recommended as a useful instrument to develop new policies or to adapt the existing ones with an integrated approach.
5. Attention should be paid to the role of forests in the context of climate change to raise awareness on wildfire risks and on the need for preventive measures. Prevention strategies should be dynamic, evolving according to spatial, socio-economic and natural changes, and also adapted to different socio-economic and territorial contexts, taking into consideration all influencing factors: (i) forest value; (ii) forest owners associations to promote; (iii) administrative system; (iv) territorial level for planning; (v) spatial and socio-economic dynamics and (vi) urban development.
6. Specific tools should be developed to strengthen support and implementation of wildfire prevention:
   a. Collection of data on the cost of prevention, suppression and restoration;
   b. Establishment of an interdisciplinary national committee for data collection and validation;
   c. Standardization and harmonization of data;
   d. Estimation of economic impact of wildfires;
   e. Balance in prevention and suppression policies at local level;
   f. Enhancement of cooperation between stakeholders in prevention processes including spatial planning;
   g. Promotion of forest education and applied research programmes;
   h. Development of sustainable financial instruments.
7. Integrated wildfire management approaches should be promoted *[Integrated wilffire management is a concept for planning and operational systems that includes social, economical, cultural and ecological evaluations with the objective of minimizing the damage and maximizing the benefits of fire. These systems include a combination of prevention and suppression strategies and techniques that integrate the use of technical fires (Technical fires: the controlled use of fire carried out by qualified personnel under specific environmental conditions and based on an analysis of fire behavior. Technical fires are divided into prescribed fires, wildfires within prescription and suppression fires) and regulate traditional burning (Traditional burning: the use of fire by rural communities for land and resource management purposes based on traditional know-how)].*

Recommendation 2

Integration of Wildfire Prevention in National Forest Programs/Policies and in Adaptation Strategies to Climate Change

Proposed actions for Policy Makers

8. Wildfire prevention should be promoted as an important part of sustainable forest management and, particularly, forest biomass use should be integrated and promoted in countries forest policies;

9. Special attention should be given to the new territories at risk, such as the wild land-urban interfaces, where specific preventive measures should be considered *(Development of information and training programs, development of technical support necessary to implement prevention and self-protection measures and consideration of these needs at the urban planning level).*

10. Awareness on wildfire prevention should be increased at a political level and financial resources should be invested on communication activities.

11. Both public decision-makers and private enterprises should be informed that wildfire prevention should have a higher priority given: on one hand the benefits, and on the other the social, environmental and economic impacts of disastrous fires as well as the high cost of disaster relief.

12. Due to the role that Mediterranean forests can play in the context of changing climatic conditions, wildfire prevention policies should be developed to enhance forest protection and therefore, wildfire prevention. Countries should encourage and promote the use of the existing financial resources in the context of changing climatic conditions for implementation of wildfire prevention measures.

13. Future wildfire risks scenarios under global change should be estimated (*climate change, social change, etc.*) in order to define sustainable prevention policies, action plans and budgets.

Proposed actions for Forest and Land Managers:

1. Wildfires prevention should be promoted as an integral part of sustainable landscape management *(wildfire management, including wildfire prevention and suppression, should be an integral part of sustainable forest management in coherence with all other relevant policies. In particular, wildfire management should be integrated in adaptation strategies to climate change).*

2. A minimum of essential actions should be included in the management plans such as:

   a. Fuel management in order to limit wildfire risks *(biomass reduction)*;
   b. Forest infrastructure for fire suppression *(such as roads, water points, etc.);*
   c. Prescribed use of fire *(as a prevention tool – See point 3.);*
   c. Social prevention *(public awareness, local population participation, etc.);*
   d. Spatial planning issues *(urban planning, land management, etc.).*

3. Prescribed burning should be an alternative technique, but carefully adapted to the different contexts *(territorial patterns)*: rural abandoned areas, wildland urban interface, productive rural regions, etc.

4. Wildfire prevention actions, including participatory approaches such as Community-Based Fire Management, should be stressed against an approach merely oriented toward fire suppression and should be integrated in forest and wildfire management planning.

Recommendation 3

Promotion of knowledge and education on wildfire prevention in the Mediterranean

Proposed actions for Researchers

1. The Mediterranean Forest Research Agenda *(MFRA)*, that describes the main research priorities for forestry in the Mediterranean region during the period 2010 – 2020, should be used as a reference to identify wildfire prevention research activities;

2. Studies on fire root causes related to socioeconomic changes *(including the use of fire in rural areas)* and possible preventive actions should be implemented in cooperation with the local population *(scientific research should lead to better insights of fire causes and should analyze existing prevention actions to develop new prevention approaches and share best practices).*

3. Scientific applied research programmes *(addressing the consequences of climate change, land use and land cover and socioeconomic changes on fire regimes, environment and society)* should be promoted in the Mediterranean.

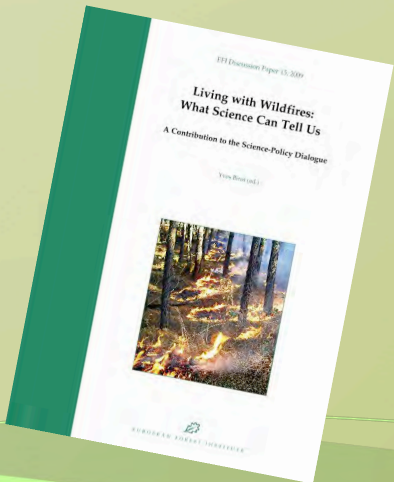
4. Harmonization of terminology on wildfire management should be promoted. A common, agreed terminology is also important as the basis for the wildfire database and should be supported with related trainings *(a good example of a piece of effort in this direction is the handbook of terms used in fire-fighting, written in six languages in the context of the Fire-4 project as well as the terminology glossaries in 4 languages on the FAO webpages regarding fire management and the Incident Command System).*

Proposed actions for Educational Specialists

1. Awareness and educational materials should be produced and distributed in several languages to implement a common awareness campaign in the Mediterranean basin targeting not only the local communities but also people visiting the region during the wildfire season *(using as reference the work of expert groups such as the UNECE/FAO Forest Communicators Network);*

2. International training courses should be developed and implemented with a harmonized training methodology on wildfire prevention for land and forest managers.

3. All education programmes should include raising awareness and education on forests and forestry. Education materials should be produced for all levels of education in order to promote wildfire prevention, especially in regions with high wildfire risks and incidence.



Recommendation 4

Enhancement of sustainable financial mechanisms for prevention of Wildfires in the Mediterranean

Proposed actions

Preventive actions should be planned with a long-term vision and as permanent activities. Even if they are not as visible as big suppression materials, preventive actions should receive more media and political attention and consequently more financial resources. In the Mediterranean regions conservation of forests is linked to improved structure, reduction of fuel loads and fuel continuities. This can only be sustainable in the long-term if adequate value chains are developed based on market goods and ecosystem services.

To achieve this objectives strong public investments are urgently needed.

1. Politicians from the Mediterranean should be aware of the importance of wildfire prevention actions. Attention should be given to wildfire prevention measures, also on specific budget allocations, with the scope to reduce the probability of wildfire occurrence and to reduce the effects of wildfires.

2. The economic dimensions of forests should be promoted in order to provide a low cost wildfire prevention;

3. European Union funds for national, sub-regional and regional prevention measures should be available for EU-Mediterranean countries *(Structural funds and Rural Development fund),* and non-EU Mediterranean countries *(Cooperation funds and, in particular, the European Neighborhood Policy Instrument).*

4. The allocation of European funds and International Cooperation in general should imply comparable information in order to evaluate and follow-up the efficiency of prevention measures *(need of indicators for monitoring prevention activities)*. The effects and the efficiency of prevention measures should be evaluated;

5. Sustainable and clear method of funding should be established in order to assure that funding reaches local actors and facilitates involvement of local communities;

6. Funding schemes should be attached to specific prevention plans and programmes.

Recommendation 5

Enhancement of harmonized Information Systems to deal with new wildfire risks in the Mediterranean

Proposed actions

1. Share updated information between countries on structural prevention issues *(e.g. area of proper protected forest, area of fuel managed each year, techniques used for fuel management, ton of biomass utilization for energy, pasture or other uses);*

2. Improve existing mechanisms of data collection and forest monitoring in order to share information and knowledge on wildfire prevention including:

    a. Improvement of knowledge on wildfire cause and motivation;
    b. Analysis of wildfire emissions and impacts on human health;
    c. Analysis of regional investments on wildfire prevention;
    d. Definition of wildfire risk areas taking into account the fire incidence, fuels, value of forests, protected areas, forest-urban interfaces and forest ownership;
    e. Studies on the silviculture condition of woodland areas, including forest fuel and biomass maps, in coordination with the National Forest Inventories. Fuel maps are regarded as highly important tools. They should be built both at regional and local level following consistent methodologies;
    f. Analysis of socio-economic impacts of wildfires.

3. Maintain, improve and enlarge the European Forest Fire Information System *(EFFIS)* with standardized procedures for data collection and develop the use of remote sensing as a tool to identify the high risk zones.

    a. EFFIS could be used beneficially also in Mediterranean non-EU countries. The inclusion of these countries should start by the designation of their national point of contact, in order to establish a communication channel between EFFIS and the national systems.
    b. EFFIS should include additional information on wildfire prevention *(including causes and motivations)* in order to identify the situation and the specific needs of each country *(Information on wildfires prevention is an important tool for exchanging ideas, approaches etc.).* Detailed databases on wildfires, consistent with the EU/Mediterranean system, should be developed at national level also in non-EU Mediterranean countries, as well as national fire danger rating systems *(The EFFIS fire database and fire danger forecast should be considered as the core scheme to be used).*
    c. EFFIS should set a risk prediction network covering all Europe and the Mediterranean Basin. The EFFIS fire risk indices should be adapted also to Southern Mediterranean countries taking into account the different range of climatic conditions *(The adaptation would require some time and data on fire will have to be available to EFFIS).*
    d. For some countries there is a lack of information on wildfires. National Forest Inventories should be reinforced to collect and share this information with EFFIS.