Fighting Forest Fires in Brazil[1]

José Carlos Mendes de Morais[2]

Abstract

Fire has been used in Brazil for many years, but the increased use of this tool, combined with natural events and the presence of large forest and agricultural areas, has led to a significant jump in the number of forest fires, most of them caused by accident. To optimize existing resources and to cope with growing demand, action levels were adopted according to the size and complexity of the incident and priorities for fighting forest fires were also set. As part of the attack readiness strategies, the Integrated Multi-agency Operational Coordination Centers (known as CIMANs in Brazil) were established in several Brazilian states, as well as the national CIMAN that involves the participation of the Ministry of the Environment, National Civil Defense, National Public Safety Force, the National Indian Foundation, the Brazilian Institute of the Environment, the Chico Mendes Institute for Biodiversity Conservation and fire departments. The main objective of the integration of response agencies is to better manage human and material resources available to fight forest fires, resulting in a reduction in response time between detection and initial attack.

***Keywords**: forest fires, firefighting policies*

Introduction

Man's use of fire dates back to ancient times. Fire control was essential for the human species to embark on its journey towards civilization. Early man's first encounters with fire must have occurred naturally through observation of natural phenomena: lightning, oil seeps and volcanic activity (Morais 2009).

Over time, man began to dominate the use of fire, providing a constant source of heat, light and protection against wild animals. Later on, man began using fire as an agropastoral tool and for transforming and processing materials.

Although accounts dating back as far as 32,200 B.C. of naturally-caused fires have been found, the appearance of man and his practice of using fire as a tool for clearing and occupying virgin land resulted in losses outweighing potential benefits,

[1] An abbreviated version of the paper was presented at the Fourth International Symposium on Fire Economics, Planning, and Policy: Climate Change and Wildfires, Nov 5-11, 2012, Mexico City, Mexico

[2] Environmental Manager, Technician Brasilian Institute of the Environment and Renewable Natural Resources, SCEN – Trecho 2 Ed. Sede del IBAMA – Bloque "C" – 70.818-900, www.ibama.gov.br, Brasil.

since the careless and/or poor use of fire causes an environmental impact of greater degree for society as a whole (Moráis 2011).

For the researcher Cornacchia (1996), fires caused by human action became more frequent than those caused by natural factors, such as lightning, thereby altering the natural fire regime. A survey by the researcher verified that fire periodically affects, and has done so since thousands of years ago, most of the world's biomes, enabling him to say that it influenced and still influences the evolution of biodiversity.

Historically, in Latin America, the use of fire as a tool has been mainly used to renew pasture or destroy tropical forests to open up new lands for agricultural and pastoral purposes (RIZINI 1976).

According to Ramos (1995), in a continent-sized country like Brazil, with one of the highest annual rates of biomass production, great diversity of vegetation and climate, and inhabited by a people with deeply-rooted cultural values, establishing a nationwide forest fire prevention and suppression program is no easy task, as it demands effort and a fairly long-term timeframe, mainly because it requires profound behavioral changes.

Changes began to be noticed in 2001 with the hiring of crews to prevent and fight forest fires in the Federal Conservation Units. In 2008, crews were also hired in critical municipalities, which were selected based on technical, social and environmental factors.

The social element is certainly a relevant factor for hiring crews. Being generally located far from major centers, with few employment opportunities, hiring crews for the six-month period coinciding with the dry season, that is, in the period between harvests when few agricultural activities are performed, has created new jobs in these regions, thus substantially contributing to income distribution and, consequently, strengthening the local economy.

Forest Fire Prevention and Suppression Crews

To contain forest fires in protected areas, the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) developed a project for the creation of forest fire prevention and suppression crews in Federal Conservation Units. The project, initiated in 2001, showed a concern at the time with the maintenance of the Conservation Units (CUs) in every aspect, preserving not only the flora and fauna, but also protecting an entire gene pool because these areas probably contain species that have not yet been cataloged or are even unknown in the scientific realm (Morais, 2004).

The year 2008 marked the extension of this line of action in cases of environmental emergencies, especially related to wildfires. IBAMA began hiring crews in critical municipalities, including forest areas unprotected by law. The main motivation was the fact that a state of environmental emergency had been declared for 14 federal units, based on climatic conditions favorable to the occurrence of forest fires.

The selection of the municipalities involved technical criteria, taking into account the concentration of hot spots detected by reference satellites, made available by the National Institute for Space Research (INPE), and superimposed on forest remnants (F). A reference satellite is a satellite whose daily hot spot data are used to compose time series over the years, enabling analysis of trends in the numbers of hot spots for the same regions, in periods of interest (http://www.inpe.br/queimadas/faq.php). The reference satellites are NOAA -12 with night passages for detections until August 9, 2007 and Aqua UMD for evening passages from this date forward.

For fine adjustment of the data, the following criteria are also used: coverage information for protected areas) (Federal Conservation Units and State Integral Protection Units (IP), Indigenous Lands (IL) and Federal Conservation Units and State Sustainable Use (SU), Settlement Projects (SP) and Forest Remnants area (R).

Finally, an index was established, taking into account the percentage of each criterion in relation to the detection of hot spots in the state and the area of the state. Different weights were attributed for each index and the indexes were added. Lastly, 5 points were added for municipalities covered by the multi-year IBAMA programs to combat deforestation in the Amazon, Caatinga and Cerrado (PPCD), establishing a Priority Index (PI).

$$PI = F\,x4 + R\,x\,3 + IP\,x\,3 + IT\,x\,2 + SU\,x\,1 + SP\,x\,1 + PPCD \quad (1)$$

Recalling that the PI values obtained are used solely for comparing municipalities in the same state, it is not possible to extrapolate its application as an index to the national level.

With the aim of making a significant improvement in the quality of suppression efforts, local residents are selected, trained and hired on a temporary basis; most of them are farmers with deep knowledge of the region and with considerable skill at using hand tools.

In 2011, on an experimental basis, the *Tiro Quente* (Hot Shot) quick response crew was formed in Brasilia. The main objective of the crew is to prevent and fight wildfires in forest remnants, support protected areas and fire departments and mainly provide quick response to other units in the federation.

Specialized units also cover the states of Rio de Janeiro and Rondônia. Based on the region's road network and the proximity of Brazilian Air Force bases, these crews can be rapidly deployed to other states as well.

The specialized *Tiro Quente* crew is essential to the success of firefighting operations. With the implementation of the crews, it is possible to cover much of the country by land routes and completely by air deployments. In addition, the National Center for Preventing and Fighting Wildfires (PREVFOGO) gains agility in fighting wildfires, thereby minimizing the impacts caused by forest fires, reducing the emission of carbon dioxide to the atmosphere, and improving responses to forest fires.

The federal crews, even those installed in critical municipalities, see action throughout Brazil, based on established priorities and activation levels.

Crew Action Priorities

Considering the large number of fires and other demands relating to fire prevention, action priorities for crews established in critical municipalities were set.

The first priority is to fight wildfires in Protected Areas, including the following:

a) Federal, state and municipal Integral Protection Conservation Units, established to ensure the maintenance of ecosystems free from alterations caused by man;

b) Permanent Protection Areas, which include protected areas whether covered or not by native vegetation. They have the environmental function of preserving water resources, the landscape, geological stability and biodiversity, facilitating the gene flow of wildlife, protecting soil resources and ensuring the welfare of human populations (Forest Code 2012).

c) In and around sustainable use CUs, where the environment is exploited but in a way that ensures the conservation of renewable environmental resources and ecological processes, maintaining biodiversity and other ecological attributes in a socially just and economically viable way. Prescribed burns are allowed in these areas (SNUC 2000).

d) Legal Reserves, which are located in the interior of a rural property (Forest Code, 2012). They were established by the Forest Code in permanent preservation areas to provide sustainable use of natural resources, conservation and rehabilitation of ecological processes, biodiversity conservation and shelter and protection of native flora and fauna.

e) Indigenous Lands, for which guidance and support are obtained from the National Indian Foundation (FUNAI) and local indigenous communities.

The second priority is to provide attack support in several areas, including the following:

a) areas where populations live in a close relationship with the natural environment, being dependent on their natural resources for their sustenance and making use of them through activities with low environmental impact;

b) areas designated for planned agrarian reform, characterized by an interdisciplinary and multi-sectoral approach, and integrated into territorial and regional development. The objective is to make rational use of physical spaces and natural resources and seek the implementation of sustainable living and production systems, all with a view to fulfilling the social function of land and to promoting economic, social and cultural development of rural workers and their families (INCRA 2012).

c) public forests, natural or planted, located in the various Brazilian biomes, in properties under the control of the federal government, the states, the municipalities, the federal district or indirectly-administered entities.

d) forest areas, in rural and urban properties, if there is no fire department in that location.

Priority 3 provides for, when requested and with the due authorization of the corresponding public agency, showing the appropriate techniques for conducting a controlled burn and controlling its implementation, if necessary. It also includes awareness-raising through environmental education, particularly in rural communities, in relation to forest fire prevention and suppression. Moreover, crews make rounds of their area and thus ward off potential arsonists. They may even perform the initial attack, thus preventing the fire from spreading.

When the crew is not carrying out any of the above tasks, it can perform socio-environmental actions such as decontaminating water sources, combating dengue fever, raising awareness among families in risk areas, and supporting anti-hunger and social equality campaigns, among others.

To publicize the actions of the IBAMA crews established in critical municipalities, a poster showing their priorities was created (Fig. 1).

Figure 1—Poster created to publicize the actions of the IBAMA crews established in critical municipalities.

Activation System

To promote both simple and complex firefighting, IBAMA puts, according to need, its structure at the disposal of these crews and coordinates with other bodies the necessary support. The activation of these resources occurs according to a predetermined sequence of actions. The activation chain, which functions without signed protocols between cooperating institutions, has operated precariously but efficiently thanks to the dedication of the technical staff recommended by the managers of the participating institutions.

To internalize and facilitate understanding, PREVFOGO adopted a tool for managing actions and resources relating to fighting wildfires, which established three activation levels.

At Level 1, the fire is considered small and can be extinguished with the crew's own resources or those of other institutions established within the city's limits. The crew boss coordinates all actions to extinguish the fire. The incident must be reported

to the state coordination office that monitors the event remotely. At the end of attack operations, the crew boss must file a fire report.

When the fire cannot be eradicated only with the crew's resources and those of its colleagues in the municipal area and requires the coordination of IBAMA's state resources and those of other institutions involved, it is given Level 2 status, where the PREVFOGO state coordinator, in order to supplement the resources already used in the incident, coordinates with a state-level body, enabling him/her to deploy closer crews, activate fire departments, request aircraft, etc.

By involving many human and material resources, it is necessary to establish a situation room, where one can quickly view all the available resources, and promote the Incident Command System (ICS).

At level 2, the state PREVFOGO coordination office must report the fire situation to the Operations and Attack Center at PREVFOGO headquarters, which takes over control of the fire and, at the end of the attack, a fire report must be drawn up.

At Level 3, the fire cannot be controlled with resources available up until then. The complexity of the operation requires the mobilization of resources held by national institutions, whether IBAMA or other cooperating agencies. The Operations and Attack Center becomes directly involved in the fire, coordinating human and material resources possessed by other states in the country to help fight the wildfire.

Due to the high costs of extended attack operations, it is essential to have efficient control over available resources such as flight hours, personnel involved, and vehicles used. To that end, the use of the Incident Command System (ICS) is recommended. Under it, the causes and origins of wildfires are investigated and an extended attack report is produced at the end of the event, detailing all activities carried out, human resources used, equipment used, costs incurred, flight hours, area reached, difficulties encountered, suggestions for improving the system and evaluation of prevention and control plans, if any.

To internalize action levels, staff developed a flowchart where the level of the event and its peculiarities, the activities to be carried out for each type of incident and the procedures to be performed can be quickly understood (Fig. 2).

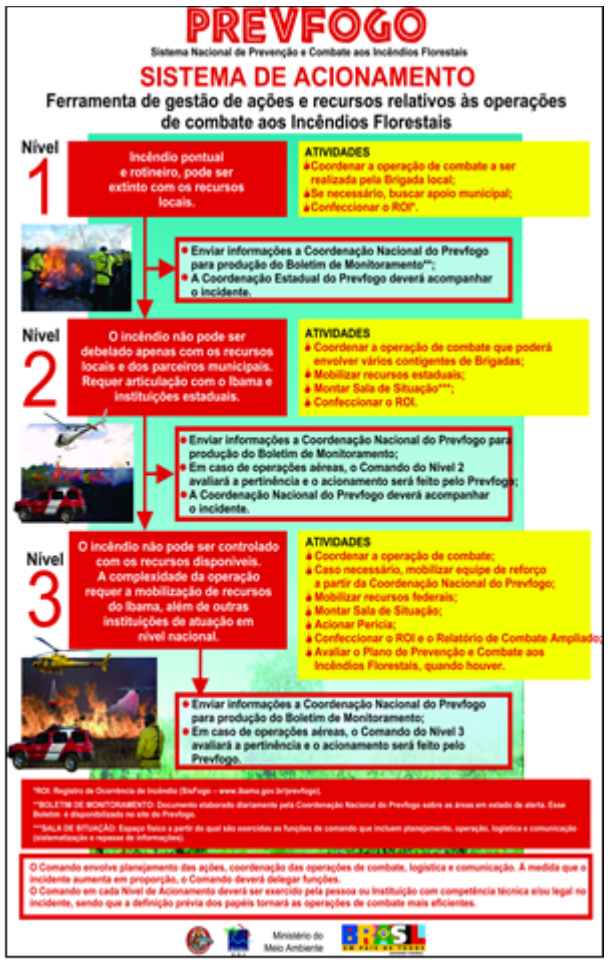

Figure 2—Flowchart where the action levels, the level of the event and its peculiarities, the activities to be carried for each type of incident and the procedures to be performed can be quickly understood.

Largely due to level-three disasters, the Ministry of the Environment, through the National Program to Reduce the Use of Fire in Wildland Areas (PRONAFOGO), arranged for technicians and managers to use the ICS and together with PREVFOGO encouraged states to organize the Integrated Multi-agency Operational Coordination Centers (CIMANS).

Integrated Multi-agency Operational Coordination Center (CIMAN)

In 2010 in the State of Roraima, the Roraima Green Operation, an initiative of the Ministry of Environment and part of the action strategy of the National Fire Reduction and Replacement Program in Wildland Areas (PRONAFOG), was implemented. The planning, coordination and implementation of integrated actions

were developed from the demands from forward firefighting bases and the deliberations and decisions taken at the Integrated Multi-agency Operational Coordination Center (CIMAN/RR) (Roraima 2010).

The Center is composed of institutions responsible for fighting forest fires and environmental crime control. The CIMAN/RR consists of representatives of the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), the Chico Mendes Institute for Biodiversity Conservation (ICMBio), State Civil Defense Coordination (CEDEC/RR), the Roraima Military Firefighters Corps (CBM/RR), the Federal District Military Firefighters Corps (CMB/DF), the Independent Environmental Monitoring Unit of the Military Police of the state of Roraima (PM/RR), and the Roraima State Foundation for the Environment, Science and Technology (FEMACT), among others, acting through joint coordination, respecting the autonomy and the legal powers of representative bodies, with the primary mission of monitoring risk areas susceptible to forest fires, detecting hot spots and activating response teams, identifying deforestation areas, and conducting monitoring activities according to the priorities established by the CIMAN/RR (Fig. 3).

Figure 3—Map of the state of Roraima with the logos of all agencies involved in forest fire management in the state.

The first CIMAN installed in Brazil aimed to promote, in a single situation room, information sharing on operations in process and to seek joint solutions among the organizations involved in it, according to the flowchart of the participating institutions (Fig. 4).

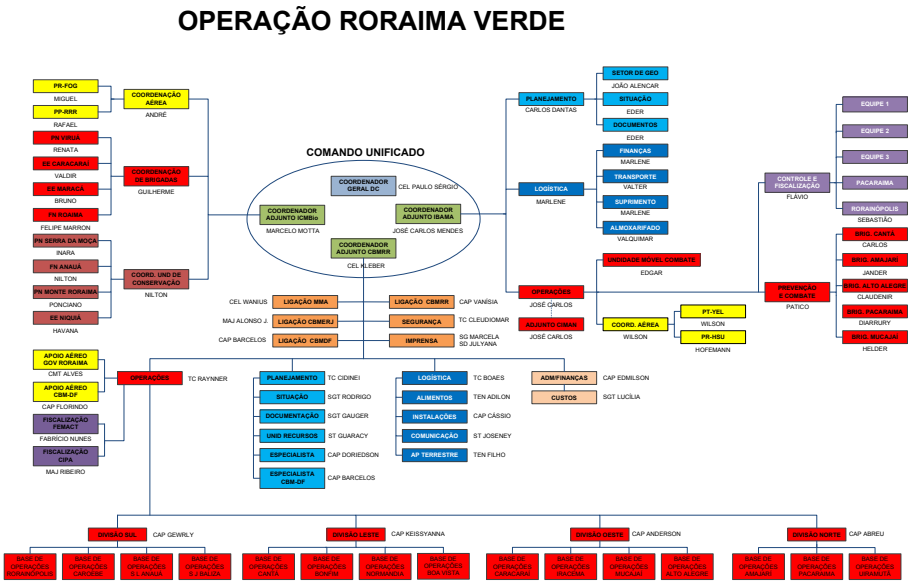

Figure 4—Roraima Verde program operational flowchart

Using some ICS tools, the results of the actions taken were evaluated in order to optimize human resources, the materials used and the strategies adopted. In daily meetings, participants developed Integrated Action Plans, which contain, among other things, guidelines, specific objectives for the operational period, activities required for each agency involved, as well as evaluation of actions taken (Fig. 4).

The ICS was developed in the 1970s, in response to a series of wildfires that virtually destroyed southwestern California. As a result, municipal, county, state and federal authorities joined forces to form the FIrefighting RESources of California Organized for Potential Emergencies, known by the acronym FIRESCOPE[3] (SCI 2011).

At the end of July 2010, a wave of large-scale wildfires occurred in central and northern Brazil. Until then, separate firefighting actions were carried out by public agencies belonging to different levels of government, each with its own working mode and according to its own operational capacity. In the first two weeks of August, the situation worsened, so the IBAMA president decided to create, albeit informally, the National CIMAN in Brasilia.

The situation room's executive group met daily at PREVFOGO headquarters until the end of September with PREVFOGO coordinating staff. Representatives of National Civil Defense, the National Public Security Force, the National Indian Foundation, the Fire Department and the Chico Mendes Institute for Biodiversity Conservation, among others, participated in the meetings. A total of 38 meetings were held (PREVFOGO 2010).

The year 2011 was a year with above average rainfall throughout the country, reducing the number of forest fires and thus necessitating only a few National CIMAN meetings.

Conclusion

Throughout Brazilian history, the use of fire has intensified and consequently there was a steady increase in forest fires which led to the need for public policies in this area, such as the important creation of the Integrated Multi-agency Operational Coordination Centers, known as CIMANs.

One of the programs that has made not only fighting fires viable but also the campaign to raise awareness of the need to use fire wisely was the creation of crews in regions of eminent risk and particularly those specialized in strategic points.

Prioritizing crew activities disciplines their services, giving importance and value to suppression operations. The operation system is making better use of available human and material resources, thereby reducing the response time in forest fires.

References

Cornacchia, G. 1996. Manejo deFogo "Parque Nacional de Brasília – **PNB**. PREVFOGO/IBAMA. Brasilia.

Código Forestal. 2012. Dispõe Sobre a Proteção da Vegetação Nativa. Ley Nº 12.651, de 25 de mayo de 2012. Brasilia.

INCRA. 2012. Modalidade de Projetos de Assentamentos Criados Pelo IncranaAtualidade. socioambiental.org. Accedido en 2012 Junio 29.disponible en: http://www.socioambiental.org/banco_imagens/pdfs/DefinioTiposdeAssentamentoeCrditos.pdf.

Morais, J.C.M. 2009. IncêndiosFlorestais e Queimadas. In: Encuentro Intercontinental Sobre la Naturaleza, Anuarios. Fortaleza.

Morais, J.C.M. 2004. Tecnologia de Combate aosIncêndiosFlorestais. Revista Floresta 34, P.211-216, Curitiba.

PREVFOGO. 2010. Relatório de Combate aosIncêndios 2010. Prevfogo, Ibama. Brasilia,

PREVFOGO. 2011. Relatório de Combate aosIncêndios 2011. Prevfogo, Ibama. Brasilia

Ramos, P.C.M. 1995. Sistema Nacional de Prevenção e Combate aosIncêndiosFlorestais. In: Fórum Nacional Sobre Incendios Forestales, Anuarios. IPEF, P. 29-38. Piracicaba.

Roraima, 2010. RelatórioOperação Roraima 2010. Prevfogo, Superintendencia del Ibama. Boa Vista, RR

Rizzini, C.T.T. 1976. Tratado de fitogeografia do Brasil. Vol. 01. USP. São Paulo,.

SCI, 2011. Manual de Sistema de Comando de Incidentes – Cuerpo de Bomberos Militar del Distrito Federal – CBMDF. Brasilia.

SNUC, 2000. Sistema de Unidades de Conservação da Natureza. Ley n° 9.985, de 18 de julio de 2000. Brasilia.