Prevention, control and monitoring of bush fires in the Cerrado

Projeto Cerrado-Jalapão

Prevenção, Controle e Monitoramento de Queimadas Irregulares e Incêndios Florestais no Cerrado

Consultancy Report prepared

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ABBREVIATIONS AND ACRONYMS

	English	Portuguese
BIRD	Bispectral InfraRed Detection	
CBFiM	Community Based Fire Management	
CPTEC	Center for Numerical Weather Forecast & Climate Studies	Centro de Previsão de Tempo e Estudos Climáticos
CSR	Center for Remote Sensing	Centro de Sensoriamento Remoto
DETER	Near Real Time Deforestation Monitoring system	Detecção de dematamento em tempo real
DLR	German Aerospace Centre	
FDR	Fire Danger Rating	
GHG	Greenhouse Gas	
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
ICMBio	Chico Mendes Institute for Biodiversity	Instituto Chico Mendes de Conservação da Biodiversidade
INPE	Brazilian National Institute for Space Research	Instituto Nacional de Pesquisas Espaciais
MMA	Ministry of Environment	Ministério do Meio Ambiente
MODIS	Moderate Resolution Imaging Spectroradiometer	
NATURATINS	Tocantins Nature Institute	Instituto Natureza do Tocantins
PA	Protected Area	
PREVFOGO	National System and Center for Prevention and Control of Forest Fires	Centro Nacional de Prevenção e Combate aos Incêndios Florestais
RURALTINS	Department of Rural Development	Instituto de desenvolvimento rural
SEMADES	Department of Environment and Sustainable Development	Secretaria de Meio Ambiente e Desenvolvimento Sustentável
SisFOGO	National Information System on Fire	Sistema Nacional de Informações sobre Fogo - SisFogo
TET	Technology Testing	

List of Appendices

1 Background

The Cerrado is the world's most biodiverse savannah formation. The Ecological Corridor of the Jalapão region located in northern Central Brazil is one of the largest protected areas of the Cerrado. However, in recent years the region gets increasingly under deforestation pressure accompanied with high fire risk. The second National GHG inventory from 2012 estimated that about 24% of the land use-related CO2 emissions between 2003 and 2005 emerged from the Cerrado region, predominately stemming from deforestation and bushfires.

Fire has been used in the Savannah ecosystem of Brazil for millennia to prepare the land for agricultural and pasture management purposes as well as for hunting, pest control and various other land management reasons. Fires set by local people have contributed to create and maintain the ecosystems and biodiversity of the Cerrado savannah and forest ecosystem. For rural people fire is a viable economical tool for the attainment of land management objectives and local communities often have traditional knowledge on how to manage and prevent fire. However, the intricate balance between people, fire and the environment has been upset in recent decades due to changing demographics and unsustainable land management practices. There is growing concern over the perceived rise in the number of fires negatively affecting the forests and savannah ecosystems of the Cerrado as this situation might be amplified by ongoing climate change.

The reduction in land use related emissions by 40% by 2020 in the Cerrado is part of the National Climate Change Policy and the inter-ministerial Deforestation and Fire Control Action Plan (PPCerrado).The interaction of deforestation and degradation processes, the role and use of fire as well as associated emissions is not yet well understood. In addition due to the heterogeneous composition of the vegetation in the Cerrado and the differing intensity of land uses systems, the monitoring of deforestation and degradation is far more difficult and less advanced than in Amazonia. Even less is known of how much emissions from fires in Cerrado are net emission as a large part of the area burned annually is taking place in a savannah type ecosystem and emissions from these fires may to a large extent be offset by regrowth. Both, however, constitute the basis for determining the climatic impact of the Brazilian Cerrado and achieving climate goals.

The project objective of improved prevention and control of wildfires in the region Jalapão aims to preserve the Cerrado as a globally significant carbon sink. This shall be achieved through effective fire prevention and control, improved management of protected areas and with new or improved monitoring tools for monitoring vegetation fires and deforestation in the Cerrado.

2 Objectives of the Mission

Main objective of the consultancy was to advise the project team and counterparts in the monitoring of bush fires and forest monitoring (component 3 of the project) with the following specific objectives:

1. Coordination meetings with the GIZ project team, Brasil. Space agency INPE, the national environmental agency IBAMA, the conservation authority, ICMBio and the Ministry of Environment (MMA).
2. Preparation and presentation of proposals for additional project activities and adjustments of existing project planning of the Comp3 of the project.
3. Coordination with the project team and the Counterparts of INPE, IBAMA, ICMBio and MMA in 2013 to a planned seminar on Fire Severity and draw up proposals for the preparation
4. Advise on the planned cooperation between INPE and DLR in the context of the project.

Furthermore the consultancy should advise the project team and counterparts in the field of Integrated Fire Management (component 1 and 2 of the project).

5. Coordination meetings with the GIZ project team, AMBERO, the National Environmental Agency IBAMA inspection, the conservation authority ICMBio, the Secretary of Environment of Tocantins (SEMADES) and the Ministry of Environment (MMA).
6. Preparation and presentation of proposals for additional project activities and changes of the previously announced plan of theComp1 and 2, in particular, regarding the topics:
   a) Reporting and approval procedures for controlled fire management
   b) Alternative land management practices
   c) Fire management in protected areas
   d) Fire Information Systems
7. Advise on the cooperation between the project and the Global Fire Monitoring Center(GFMC)
8. Advice the project team and the Counterparts ICMBio, IBAMA, SEMADES and MMA regarding an international event on fire management in protected areas planned for early 2013.

3 Integrated Fire Management – Approach of the Mission

Though vegetation fires have become a recent concern with regard to their negative impacts on the environment and human welfare, the impacts of fires are not uniformly negative, and not all fires are disasters. Sustaining and maintaining ecosystems and related land management and livelihoods goals through appropriate fire management practices need to consider both the beneficial and damaging effects of fires. The concept of Integrated Fire Management (IFM) offers a holistic framework for managing fires in fire-dependent ecosystems such as the savannah ecosystems providing associated co-benefits for local communities as well as sustaining ecosystem services. Integrated Fire Management consists of the five elements such as Data collection and Analysis (Research), Prevention (Risk Reduction), Preparedness (Readiness), and Suppression (Response), Restoration (through rehabilitation)[1].

- Analysis/Research – the systematic and integrated collection of data regarding the number, location, size etc. of fires, the development of an understanding of their causes, and development and analysis of appropriate prevention, response, restoration and rehabilitation actions;
- Prevention – the development of a strategy for preventing and managing unwanted fires, and controlling fire for use in sustainable land management practices;
- Preparedness – the training of personnel, the installation and maintenance of required infrastructure including fire breaks and removal of fuel; and, the monitoring of land and weather conditions, the establishment of tools such as the Fire Danger Rating System and other activities that enable fire management on a continual basis;
- Suppression – the actions taken to contain fire and prevent it from spreading,
- Restoration – the repair, replacement and rebuilding of physical and ecological assets.

These elements entail various subthemes and activities considering environmental, social, economical and political-administrative aspects involving various stakeholders on the basis of interagency cooperation for the implementation of the necessary technical, logistical, operational and social programs striving to balance between developing and conserving natural resources and managing unwanted fires while at the same time **promoting** the safe use of beneficial fires. The approach of the consultancy was to learn about the Brazilian Fire Management system from the project stakeholders and partners regarding their various roles and functions within an overall integrated fire management

[1]See appendix 2 for a more thorough description of the IFM elements

system. Against the background of the concept of Integrated Fire Management and based on the insights and information gathered during the stakeholder meetings and discussions, the consultant presented in the final workshop her observations with regard to fire management at the national level in Brazil suggesting possible further actions in the various fields of IFM.

4 Main Findings and Recommendations

Brazil has a well established Fire Management System in place. Starting in 1989, the Brazilian Institute of Environment and Natural Resources (IBAMA) developed a national system and center for prevention and control of forest fires (PREVFOGO). Since then PREVFOGO has developed numerous programs for monitoring, prevention and control of fires, including environmental education campaigns, as well as training and education of fire fighting brigades. PREVFOGO maintains a center for "Interagency cooperation and control" of fires with the three focal points of an action program for inter-sectoral cooperation, the controlled use of fire, as well as the promotion of alternatives to the use of fire. PREVFOGO was among other institutions executing partner in the successful program "Amazonia Sem Fogo" (“Amazon without fire”) with various modules on alternative fire free agriculture options.

In 2007, the Chico Mendes Institute for Biodiversity (ICMBio) was created, which has since been responsible for the management of federal protected areas, including fire management. ICMBio and IBAMA are both executive bodies under the Ministry of Environment (MMA) and therefore are in an excellent position for successful implementation of Integrated Fire Management at national, state and local level respective their mandates and seeking further cooperation with state and local level institutions such as the .

Both institutions have established fire brigades throughout the country and in their particular land management areas. Training for the brigades is carried out on regular basis normally at the beginning of the fire season by trained instructors and people for the brigades are being hired on biannual basis. Various efforts are underway to work with local communities and indigenous people and to establish fire free income agriculture opportunities.

The National Institute for Space Research (INPE) has a very sophisticated fire and forest monitoring system in place. INPE provides near-real time fire information from up to 13 satellites, all received at INPE by the Division of Environmental Satellites at Cachoeira Paulista and/or Cuiaba. The data is accessible in various file formats through webservices including user specified e-mail alerts. INPE also provides information on fire risk/danger and forecast maps in shapefile format through web services. In addition the fire group within INPE is currently developing a burned area product based on a newly developed algorithm validated with high resolution satellite data. INPE has developed DETER, a service aimed to monitor deforestation and forest degradation in the Amazon, based on satellite data of high revisiting frequency. The information generated by DETER is sent

almost daily to IBAMA, which uses the information to guide on supervision and ensure effective actions for forest clearing control. DETER uses data from MODIS Terra satellite sensor, with a 250-meters spatial resolution to detect deforestation polygons with an area larger than 25 hectares. The system is so far unprecedented!

At state level (here Tocantins)

The roles of the main stakeholders is perceived and summarized as shown in Figure 1.

Figure 1: National Project Stakeholders and Roles

4.1 OPERATIONAL FIRE MANAGEMENT (PREVENTION, PREPAREDNESS, SUPPRESSION)

Based on the stakeholder interviews that took place with PREVFOGO, ICMBio and SEMADES representatives, the following observations were made and recommendations drafted for consideration in the project planning and implementation.

4.1.1 PRESCRIBED BURNING

Most partners stated that the discussion about use of fire and positive impact of fires in e.g. savannah ecosystem has just started. There is a "no burn" regulation from 1995 in protected areas but it allows for prescribed burning mainly applied for burning fire breaks at the beginning of the season. Otherwise prescribed fire is currently rarely implemented as a land or fire management option for fuel reduction and mosaic burning.

Prescribed or controlled burning– the practice of burning deliberately - is used for conservation reasons, removal of old growth, suppression of bush encroachment and stimulation of the growth of grazing grass; and the removal of fuel burning with the aim of pre-empting dangerous wildfires at the peak of the fire season. Land use productivity and sustainability is enhanced through use of controlled burning to improve grazing, natural product harvesting and agriculture. The timing, intensity and frequency of burning are prescribed to specific land use objectives in specific areas. Typically implemented in the early dry season this creates an extensive mosaic burn pattern, minimizing the occurrence and extent of wildfires by reducing and fragmenting fuel loads. Infrastructure and sensitive resource areas are protected by strategic reduction of fuel loads around these assets. The environment is enhanced through reduction of fire intensity and diversification of fire regimes to enhance habitat and biological diversity. Engaging communities in prescribed burning activities in when, where and how fires occur, enables them to minimise negative effects and maximise the benefits of fire without costly machinery or resources. Using fire behaviour, local knowledge of the area and strategic implementation, safe and efficient controlled burning is achieved with minimal equipment.

Recommendations:

- Introduce and set up training on the practise of prescribed burning for protected area management
- Introduce and set up training on the practise of prescribed burning for communities (see also CBFiM)

4.1.2 RADIO COMMUNICATION

ICMBio expressed the need of a radio communication system for fire operation purposes. Radio communications are needed in a fire management organization to: 1.) Transfer and share information; 2.) Conduct routine daily business of the organization; 3.) Notify proper authorities of a fire occurrence; 4.) Coordinate the safe and efficient movement of equipment and personnel to the fire; 5.) Coordinate and implement tactical suppression actions on a fire.

Recommendations:

- Needs assessment/consultancy on a radio communication system for operational fire management to utilize both VHF and HF communications to achieve comprehensive long and short-range communication needs.

4.1.3 FIRE DANGER RATING

INPE is currently providing fire risk/danger information which can be accessed through the webpage and downloaded as maps and shapefiles. However it was mentioned that it is not often used for fire management purposes on the ground due to the course scale. As an element of prevention, preparedness and response the Fire Danger Rating System (FDRS) is the primary means to determine the daily fire prevention, preparedness and suppression activities of the land management agencies holding responsibilities for fire management activities. The Fire Danger Rating System provides indices for determining the likelihood of a fire ignition, the extent and the difficulty to control fire activities. Hence the system also supplies information for the safety of fire operations. As the fire managers' day-to-day-fire management tool it serves as decision basis to determine the (personnel/staff) need for fire prevention and detection activities, the readiness of prevention and suppression forces (Readiness/preparedness levels), and the strength of the initial attack of fire control forces to a reported fire. In summary FDRS information can be used:

- as a guide to determine prevention, detection needs, and the requirements of patrol and staffing level of crews and local fire centers;
- as a guide for more intense patrolling and/or burning restrictions in potentially dangerous (hazardous) areas (fuel map);
- as a guide for establishing restrictions (burning bans) for all stakeholders in a larger area;
- to support budget requests for additional funding for severe up-coming fire and haze conditions (use of drought code);
- to up-date and activate mobilization plan information in preparation of the severe fire season (drought code);
- to provide briefings to fire fighters regarding the expected conditions, seasonal trends etc.;

- is the basis to define readiness levels describing the existing state of alertness and preparedness of fire management organization. Readiness levels are the basis for recommendations to political officials, agencies, and institutions as well as Standard Operating Procedures(SOP) to local fire centres and other land management agencies
- to determines the (personnel) requirements for fire prevention and detection activities, the readiness of suppression forces and the strength of the initial attack of fire control forces.

Within ICMBio it is currently being discussed to include more weather stations as some of the protected areas –PA (~20%) have local weather stations. It was also mentioned that some PA managers have local knowledge and experiences with which they have developed localised early warning systems.

Recommendations:

- Introduction to Fire Danger Rating systems and applications for operational fire management and readiness levels
- Introduction and testing of hand held weather station (Kestrel) and related Fire Danger calculation for on the ground management purposes.
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4.2 TRAINING AND FIRE MANGEMENT STANDARDS

At the three levels (National, state, and local) an interagency coordination committee/group on fire (CIMAM) consisting of various agencies and organisation such as IBAMA, ICMBio, FUNAI, Civil Defense, MMA, Fire Brigades (Corpo de Bombeiros) and others are coordinating, during the fire season matters relating to the dispatch of human resources and equipment needs for fire control from the various level and between the levels. It was mentioned that the interagency coordination is based on the Incident Command System (ICS) a system designed to address the majority of management problems common to most complex incidents involving various departments and agencies across the various levels. In appendix 3 an overview is given about ICS is given.

Successfully applied ICS as well as human and technical resource sharing requires common training standards amongst the involved agencies for the various fire management techniques ranging from basic, advanced fire fighting, crew leader and instructor training to prescribed burning, ICS and fire prevention courses such as fire education and awareness (FireWise). Therefore investigating into a National Training and equipment standard for the various fire management techniques to qualify a person for fire management (mainly fire fighting but also fire education and awareness) within a state or

federal agency and across agencies seems to be a logical step forward to enhance the efficiency of agency cooperation in Brazil. Most prominent example is the US Red Card System[2], which can be used as an example to develop a Brazilian fire qualification system for an individual.

Recommendation:

- Development of an Interagency Fire Qualification system that would ensure a national set training and equipment standards which would be standardized across the different agenies. CIMAM should lead this process.

4.3 COMMUNITY BASED FIRE MANAGEMENT – WORK WITH COMMUNITIES

Both institution PREVFOGO and ICMBio are engaged in community work and at state level the Department of Environment and Sustainable Development (SEMADES) and Tocantins Nature Institute (NATURATINS) are tasked to work with communities. ICMBio has a specialized department to address issues related to local communities living in Protected Areas or around PA through environmental education programmes. Both institutions are hiring local people for their brigades. In pilot areas ICMBio promotes alternative fire use, it was however mentioned that due to the workload ICMBio is hampered when it comes to extensive outreach due to limited human and financial resources.

PREVFOGO has developed various modules stemming from "Amazonia sem Fogo" that include fire free alternatives in the agriculture sector, which will need to be adapted and tested in the Cerrado area in cooperation with communities and respective agriculture agencies. PrevFogo also works on indigenous land and trains trainers from indigenous communities. .

At state level it was mentioned that the biggest challenge is the land tenure problem and the lack of control local communities have over the management of the land. In the Aruagai Region this situation is made even more complex by the existing transmigration scheme and the conflicts that are created through the ethnical group mix. Communities therefore rarely feel responsible when fire is destroying natural resources as they have no legal land tenure rights that would create ownership and responsibility for fire management activities. Furthermore it was mentioned that the outreach to local communities with regard to environmental education and (fire) awareness is hampered by the unattractive working and living conditions for extension personnel and for sustainable long term success extension working conditions need to be improved.

In general it seems that there are various elements of Community based Fire Management in place however not yet put together into a framework for the Cerrado region

[2] http://www.kansasforests.org/fire/training/redcard.shtml

considering the socio-economic conditions and the underlying fire causes and fires uses by local people. The large role of humans in determining fire frequency, intensity and distribution in the Cerrado region implies that local communities have an important influence on the management of fires. The importance of participation by local communities is also reinforced by the country's vastness and its limited accessibility and infrastructure. As such, the implementation of integrated fire management in Brazil would be significantly strengthened by including a commitment to establishing community-based fire management (CBFiM) and its various elements in a systematic way. CBFiM recognizes the positive, potential role that local communities can play in fire management. It is an approach to the management of fire in the landscape that adequately includes communities in decision-making about the role, application and control of fire. It works to:

- Create sensitivity, awareness and knowledge about fire and the use of fire to improve natural resources income;
- Enable communities to manage fire for their own benefits (as by using prescribed burning) and minimize the negative impacts of fire (such as by constructing fire breaks and engaging in low cost maintenance); and
- Enable communities to develop, regulate and enforce village fire regulations, and to suppress unwanted fires through village fire crews

By enabling local people to build upon their knowledge and expertise related to fire control and prevention, CBFiM has the potential to be an important avenue for effectively managing the fires that increasingly are having a negative impact on livelihoods and ecosystems in the Cerrado region. However, for communities to play a positive role in fire management, they need to have control over natural resources and their management. Therefore the promotion of CBFiM should be undertaken as part of a broader commitment to increasing local control over surrounding natural resources. Communities however are only part of an integrated approach to fire management and it needs the involvement and commitment of all parties managing land, particularly the government and the private sector.

Recommendations:

- Carry out socio-economic study to reveal underling fire causes to then establish appropriate and fact based community programs. The study should include the mapping of the agricultural systems being applied in the Cerrado region. This would assist to identify potential partners in outreach and extension of community related fire education, awareness and fire free subsistence farming.
- Build up an overall framework/concept for CBFiM in the Cerrado region that considers the existing elements stemming from the "Amazon sem Fogo" by at the same time acknowledging the beneficial use of fire for land management and conservation purposes.

- Pilot alternative fire use but also early burning programs with selected communities and the respective committee members to (re-)introduce traditional knowledge of the use of low intensity fires by at the same time reduced wildfire hazard and improve livelihood opportunities.
- Develop “positive” award system for communities that successfully engaged in fire management activities.
- Exchange of best practice examples such the” Intalisamão example” in the south of Tocantins (CBFiM example at village level supported by local farmers)

4.4 FIRE INFORMATION AND REPORTING

INPE provides excellent satellite and weather based fire information on actual fire occurrence and fire risk throughout the country. Active fire data is provided near-real time and data on active fire data prove to be very helpful to provide information on the questions such as:

- Where is the fire burning (location)?
- When did the fire start (day)?
- When did the fire finish (day)?
- What kind of vegetation burnt (in conjunction with available secondary data)?
- Fire seasonality and frequency

A burned area product is currently being developed by INPE and will then provide answers to the questions of how large is the area burned.

Both PREVFOGO and ICMBio are using the information INPE is providing to inform managers on the ground on fire occurrence. However the concern was raised that the information of fire coordinates is sometimes overwhelming with hundreds of e-mails and ICMBio has started to cluster coordinates in and around PA to then send only the center coordinates to national park managers. ICMBio is downloading MODIS satellite images with a ground resolution of 250m from the MODIS Rapid Response Center to discern burned areas and on-screen delineate them within a GIS. The information is used for decision making for the dispatching of crews. Overall both institutions are using the INPE data for operational fire management and either have established or currently establishing user tailored fire information systems including fire reporting.

A Fire Information System to provide fire managers on the ground with necessary information normally entails to compile and analyze fire relevant data for detection, monitoring, identifying fire risk areas, assessing the current and predicted fire situation (fire danger) as well as to assess burnt areas. This information is then according to standard procedures reported to the various user groups. Depending on the end users the information will vary according to the needs (e.g. fire managers on the ground, policy makers, law enforcement purposes etc.). General reporting on fire occurrence is done daily with information from yesterday’s fire. This report is automatically generated by

INPE and disseminated by PREVFOGO. PREVFOGO maintains a National Information System on Fire (SisFOGO) which is currently being restructured and extended to the following components at national, state and local level:

1. Registering of prescribed burning/ controlled fires
2. Fire Reporting from and to the fire brigades
3. Training Content and Schedules incorporated into 1 & 2

To develop component 2 the need arises for Standard Reporting Procedures from and to the various levels, ideally developed as a joined effort of the respective institutions ICMBio, PREVFOGO and INPE as well as incorporating needs and request from state and local level and fire brigades. Cooperation amongst the respective institution would at the same time enhance user feedback on fire products. Required adjustments and refinements will attract more end users to apply and employ the systems for their respective needs as currently it was mentioned the system does not provide for data or information that is required for reporting needs for state level agencies.

Recommendations:

- Interagency expert group on use of fire information for operational fire management (e.g. feedback on active fire use on the ground, use of burned area data). Group also to exchange knowledge, ideas on fire reporting for the various levels and need.
- Develop standard reporting forms for reporting top down and bottom up (dispatch & coordination, resources allocation and request, fire reporting, fire investigation, reporting of prescribed fires) as part of the already existing SISFOGO system (
- Strengthen fire reporting system at local level through existing local committees and communication means.

4.5 STAKEHOLDER COOPERATION AND PROCESSES

Currently there is no single specific institutional structure that is appropriate for all fire management situations. Integrating fire management in a multifaceted way into existing land management agencies and their programmes, local government structures and budget schemes and consequently implementing it at local as well as at community level requires a strong and clear coordination and cooperation mechanism. Thus a high level of inter-sectoral cooperation and coordination with clear roles and tasks based on fire management functions is the success factor for integrated fire management at the various levels.

Measures should focus on strengthening the cooperation efforts of the existing agencies of IBAMA/PREVFOG, ICMBio and INPE coordinated by MMA as well as the existing CIMAN structure which coordinates fire emergencies to ensure that the already existing programms and modules are further build and being adapted using joint efforts and

synergies. This is also required considering limited human and financial resources of the institutions. Close cooperation should ensure also the integration and implementation of IFM activities in the respective programs at state level but also on ground level. Furthermore involvement of other relevant organizations and stakeholders such as communities, civil society actors and research institutions and the private sector stakeholders should be further encouraged. The existing “Protocolos Municipais” that are facilitated by PREVFOGO and implemented at the state level in Tocantins by SEAMDES and Nauratins should serve as an entry point to further the understanding and importance of IFM and ensure appropriate funding is provided to implement the protocol.

Figure 2 gives an overview of possible strategies, roles and partnerships to implement the necessary technical, logistical, operational and social programs of Integrated Fire Management.

Figure 2: Strategies, Partners and Roles in Integrated Fire Management

Recommendations:

- Support multistakeholder fora, steer and guide iterative processes to further clarify on roles, functions and tasks within an Integrated Fire Management framework at national and Federal State level. Instrumental to this process are the “Protocolos Municipais”.

These processes are inter alia supported by international workshops and conferences such as the proposed international seminar and conference on fire severity as well as Integrated Fire Management in PA to further a common understanding of and requirements for integrated fire management.

- Plan and prepare for international seminar on Fire Intensity, severity and fire impact (ecosystem response) with international experts
- Plan and prepare for International Conference on Integrated Fire Management in Protected Areas with international experts

4.6 COOPERATION BETWEEN INPE/ IBAMA AND DLR AS WELL AS OTHER GERMAN COLLABORATORS

INPE as well as IBAMA and its Center for Remote Sensing (CSR) expressed the wish to foster research and technology cooperation on satellite and remotes sensing applications in fire and forest monitoring with the German AerospaceCenter (DLR) and other cooperation partners.

Based on the experiences of the experimental small satellite BIRD (Bispectral InfraRed Detection) that was pioneering in its capacity to detect and characterize a wide range of fires from small agricultural fires to extremely large fire events. BIRD data were pivotal in the development of the Fire Radiative Power approach for biomass burning estimates. Based on the BIRD heritage, a BIRD-type sensor has been mounted on the "Technology Testing" mission TET-1 (Technologie-Erprobungstraeger 1) which was successfully launched in July 2012. BIROS (Berlin Infrared Optical System), another BIRD-type satellite will be launched in 2014 and both satellites will fly in a mini-constellation called FireBIRD. INPE has been informed that there are three stages of data availability: Phase 1: Until completion of the TET-1 On Orbit Verification experiments, images from TET-1 will be available once a week. After that in phase 2, TET-1 will dedicatedly being used for fire monitoring, and from the launch of BIROS onwards, the two satellites will act as a dedicated mini-constellation for fire monitoring. INPE hence is interested in carrying out experiments on measuring fire intensity in the Cerrado areas during the first phase, and to test-drive the FireBIRD constellation for monitoring in selected areas in the second phase. In addition INPE has been informed about the outcomes of the Fire Monitoring Constellation (FMC) study carried out by DLR, and has participated in the previous DLR study on the Fire Recognition System (FIRES) in 2005 and is interested on follow up activities that could lead to such a system become reality.

Recommendation:

- Facilitate the cooperation between INPE and DLR to receive and use data from the FireBIRD mission to pursue objectives of fire monitoring.
- Carry out a workshop or technical work meeting for an initial clarification of scientific, technical and financial issues for FMC.

The CSR of IBAMA is inter alia tasked with the monitoring of new fronts of deforestation for law enforcement and fiscalisation purposes. Therefore, under the MMA Rural Environmental Registration program Rapid-Eye data have been purchased for the entire country to detect new frontiers of deforestation and monitor rehabilitation and recovery efforts of registered farmers in order to reduce environmental fines and blacklisting. Within the project the Rapid-Eye data shall be used for vegetation classification and deforestation fronts in the Cerrado region, which proves to be more complex than the densely and homogenously forested Amazon region due to inherent vegetation types and season triggered phenology. A methodology shall be developed using a multi-sensor approach that includes MODIS, Rapid-Eye and others to monitor deforestation in the Cerrado region within 4 test sites (natural cerrado land, pasture dominated land, protected area and agricultural land). In addition, biomass measurements/carbon stock estimates of the Cerrado vegetations types shall be supported by LIDAR transecting, extrapolating with Rapid-Eye data in order to quantify CO_2 emission due to deforestation and fires in the Cerrado region.

Recommendation:

- Support for the development of such a methodology shall be facilitated by the project according to needs of the project partners.

Appendix 1

Programme of the Mission

Dia	Horário	Temas	Participantes	Objetivo / Temas	Lugar
13/8	Manhã	Reunião interna com a equipe GIZ	Angela Cordeiro, Philipp Buss	Revisão da Agenda	MMA, Sl. 201
	Tarde	Reunião com a equipe de coordenação MMA e GIZ	Juliana Simões Luciana Machado Angela Cordeiro Philipp Buss	- Ajustar as expectativas em relação à consultoria: objetivos, produtos, atividades e agenda. - Apresentação do projeto, particularmente das atividades referentes ao componente 3 e ao manejo integrado do fogo	MMA
14/8	Manhã		Angela Cordeiro Philipp Buss		MMA
	Tarde	Viagem para São José de Campos	Angela Cordeiro Philipp Buss		
15/8		Atividades do INPE no contexto do projeto Funcate	Alberto Setzer Dalton Outros representantes do INPE Angela Cordeiro Philipp Buss	Apresentação e discussão dos seguintes temas: - Metodologia de classificação da severidade de incêndios - Metodologia para associação entre dados obtidos de satélites de observação de terra e dados de estrutura de vegetação do Cerrado - Sistema de detecção de áreas queimadas	INPE
		Consolidar a agenda de cooperação entre o INPE e a DLR /	Alberto Setzer Director INPE Angela Cordeiro Philipp Buss	- Definir e concretizar uma agenda de cooperação entre o projeto / INPE e a DLR - Definir e consolidar uma agenda de cooperação entre o projeto / INPE e o GFMC	INPE
	Noite	Retorno para BSB			
16/8	Amanhã	Reunião com ICMBio / COEM	Paulo Carneiro Julia Zapata Angela Garda Luciana Machado Angela Cordeiro Philipp Buss	Apresentação e discussão dos seguintes temas: - Expectativas do ICMBio frente aos sistemas de monitoramento - Sistemas de comunicação - Manejo de fogo em áreas protegidas - Seminário internacional sobre manejo de fogo - Alternativas ao uso de fogo e queima controlada - Classificação da severidade de incêndios	ICMBio
	Tarde	Reunião com IBAMA / PREVFOGO	Lara Steil Erica	Apresentação e discussão dos seguintes temas: - Expectativas do IBAMA frente aos sistemas de	IBAMA

			Luciana Machado Angela Cordeiro Philipp Buss	monitoramento - Sistemas de autorização para queima controlada - Sistemas de comunicação - Seminário internacional sobre manejo de fogo - Alternativas ao uso de fogo e queima controlada - Classificação da severidade de incêndios Definir e consolidar uma agenda de cooperação com o GFMC	
17/8	Manhã	Tempo livre para sistematizar resultados e contribuições das conversas			
	Tarde	Reunião com a equipe de coordenação MMA e GIZ	Juliana Simões Luciana Machado Angela Cordeiro Philipp Buss	- Feedback das reuniões e conversas - Primeiras impressões e recomendações - Ajustar a agenda para a semana seguinte	MMA
20/8	Manhã	Reunião com IBAMA / CSR	Edson Sano	Apresentação e discussão: Sistema de alerta de desmatamento do Cerrado - Cooperação entre IBAMA (CSR) e INPE	IBAMA
	Tarde	Sistematização das contribuições para reuniões dos dias 21 e 22 de agosto Reunião com a equipe de coordenação MMA e GIZ	Juliana Simões Luciana Machado Angela Cordeiro Philipp Buss	Afinar agenda e contribuições para reuniões dos dias 21 e 22 de agosto	
21/8	Dia inteiro	Reunião do Componente 3	INPE (A. Setzer e Dalton) IBAMA (E. Sano) ICMBio (Angela Garda) IBAMA (Mariana) MMA (Juliana e Luciana) KfW GIZ (Angela e Philipp)	- Apresentação e discussão das recomendações da consultora - Afinar e coordenar as atividades do componente 3 entre as instituições envolvidas - Preparação do workshop internacional sobre classificação da severidade de incêndios	MMA (??)
22/8	Manhã	Reunião com SEMADES e Naturatins	SEMADES Naturatins MMA Angela Cordeiro Philipp Buss	Apresentação e discussão dos seguintes temas: - Expectativas da SEMADES e Naturatins frente aos sistemas de monitoramento - Sistemas de autorização para queima controlada - Sistemas de comunicação	Brasília (MMA o Agência GIZ)

				- Manejo de fogo - Alternativas ao uso de fogo e queima controlada	
	Tarde	“Reunião Comp. 1 e 2”	ICMBio (Paulo, Christian, Ângela Garda) IBAMA (Larah, Mariana) SEMADES Naturatins INPE (?) MMA (Juliana, Luciana) KfW GIZ (Angela, Philipp)	- Apresentação e discussão das recomendações da consultora - Preparação do seminário internacional sobre manejo de fogo - Discussão de uma agenda de cooperação com o GFMC	MMA (?)
23/8	Amanhã	Reunião com a equipe de coordenação MMA e GIZ	Juliana Luciana Ângela Philipp	Avaliação da consultoria e encaminhamentos	MMA
	Tarde	Retorno para Alemanha			

Appendix 2

Elements of IFM

Integrated Fire Management

Fire management activities are concerned with the protection of people, property and range and forest areas from unwanted fires and with the use of fire as a land management tool. The concept of Integrated Fire Management (IFM) offers a holistic framework for managing fires providing associated co-benefits for local communities as well as sustaining ecosystem services. Integrated Fire Management consists of the five elements such as Prevention (Risk Reduction), Preparedness (Readiness), and Suppression (Response), Protection, Restoration through rehabilitation), data collection and Analysis (Research).

Analysis and Information

While fire suppression capabilities are needed, they are only be effective if embedded in an integrated program with the right institutional set up and involvement of all stakeholders through educational and fire prevention/fire-use programs. Lack of available information concerning number, place, size, and location, influence of weather, fuel characteristics and causes of fire contributes strongly to an incomplete understanding of fire and its causes. To prevent fires, those concerned must know, who or what starts the fires and why.

Analysis is essential to define the problem to clearly address it effectively and using resources most efficiently. For preparedness and suppression efforts it is important to know, where and when most fires start; this includes also fire danger information, next to a comprehensive knowledge about the available fire suppression resources (equipment, trained crews etc.). That those forces used most effectively depending on vegetation and land use it must be clear which fires are wanted, and which are not.

To address aspects of restoration and rehabilitation measures and to integrate those into spatial regional and financial planning it needs to be known what has been damaged, to which degree, where, and how much. This information reported by local (fire) institutions and fire brigades is also needed for future prevention measures and equipment needs.

Prevention

Recognising that prevention is the best, and in most cases the only, effective strategy for the long-term management of fires strong emphasis should be given to the right prevention strategy to reduce the likelihood and impact of unwanted fires. Depending on the case, this can involve education and awareness raising, fuel management fuel management (reduction, removal, or other manipulation of the fuel for Fires = prescribed burning) and sound sustainable forest/land management, and law enforcement (appropriate laws and regulations, sanctions and supervision). Especially where fire is regularly used to clear land for all sorts of agricultural, fishing and cattle raising purposes fire cannot be eliminated from the landscape. Therefore focus must be given not only to eliminate fire but rather to introduce and educate the controlled and sustainable use of fire for agriculture purposes. And finally effective law enforcement based on sound fire

policy and sanctions not only against large scale companies but also against local people must be implemented as prevention measures.

Preparedness

Preparedness ensures that fires are not a surprise and that fire management is a matter that has to be dealt with not only during the dry (fire) season. The important aspects of preparedness are training and development of fire management and suppression personnel; the installation and maintenance of infrastructure such as access roads and tracks, firebreaks, fire detection systems and preparing assets and homes; fire fighting equipment purchase and maintenance; and the ongoing monitoring of weather conditions, fuels and ignition sources to provide timely advice and warnings on possible fires to ensure that resources can be effectively used. As an element of preparedness (but also prevention and response) the Fire Danger Rating System (FDRS) is an important tool to determine the daily fire prevention, preparedness and suppression activities of the land management agencies holding responsibilities for fire management activities. The Fire Danger Rating System is the basis to define readiness levels describing the existing state of alertness and preparedness of fire management organization. Readiness levels are the basis for recommendations to political officials, agencies, and institutions as well as Standard Operating Procedures (SOP) to local fire centres and other land management agencies.

Suppression/Response

Response is commonly referred to as 'fire fighting' or 'suppression' by containing a fire and prevents it from further spreading. The usual method is to cut the fire from access to new fuels by creating a fire line around the perimeter of the fire to stop the fire spread. After the fire line is completed, the fire is made safe by cooling embers and hotspots along the fire line in a process known as 'mopping up'. All fire lines operate by the same principle: removing fuel or making it less flammable. Eventually the fire will burn all of the fuel and go out. Type of vegetation, terrain, strengths of the fire and climatic conditions dictate the widths of the fire line.

Restoration/Rehabilitation

In its widest sense covers the repair, replacement or rebuilding of assets damaged by fire. This includes assets, such as plantations, houses and infrastructure, but also the restoration of fire damaged ecosystems including the re-establishment of ecosystem function, structure, productivity and natural fire regimes, all of which are part of sustainable forest and land management. Restoration can be very important to prevent future fires. Burnt areas may be more prone to fire in the years following a fire due to increased fuel and debris from burnt, dead plants. After forest/savannah vegetation is burnt, more daylight and space is available for grasses and other vegetation to grow on

the forest floor. This vegetation quickly dries out and easily burns. With regard to forests this can create a cycle rendering the forest increasingly more flammable, if the forest is not properly managed and restored after a fire outbreak.

Appendix 3

Incident Command System

Incident Command System

As a result of severe fires over a number of years, national leaders have demanded a more coordinated approach to the management of wildfires. There have been many examples over the years of large numbers of fire suppression agencies making gallant attempts to minimize the devastation of uncontrolled wildfires. However, their ability to effectively cooperate with other fire agencies was limited by organization and communication barriers.

Incident management system in one form or another exists in many countries. In most countries, local emergency operating protocols have evolved over the years to meet the specific demands of the jurisdiction. Many have been copied from the military c ommand and control models. Unfortunately, most of these models do not provide consistent procedures or organizations throughout the country. The ICS is the most widely used incident management system. It was specifically designed to address the majority of management problems common to most complex incidents. These problems included:

- Inefficient supervisory span of control.
- Competing organizational structures
- Inconsistent or non-existent incident information
- Incompatible communication systems
- Uncoordinated planning across agency lines
- Unclear lines of authority
- Competing agency incident objectives
- Inconsistent terminology.

It took a considerable investment of time and effort to design an incident management system that could address all of those issues. ICS has a proven record in many countries around the world. ICS has been fully implemented in Australia, New Zealand, Canada, the USA, South Africa and Tanzania. Mexico and Costa Rica have interpreted the ICS training course into Spanish, and have begun to teach ICS to wildland firefighters. Recently, the USA has adopted ICS as the national incident management system to manage all domestic emergency threats and responses.

The complexity of incident management, coupled with the growing need for multi-agency and multi-functional involvement at incidents has increased the need for a standard inter-agency incident management system not only within a country/state but increasing internationally. Many countries have adopted similar or common systems of addressing emergencies. In addition a number have developed firefighting agreements based on a common system enabling interoperability when lending support to other countries.

ICS was developed on four basic principles.

4. The system must be organizationally flexible to meet the needs of incidents of any size and kind.
5. Organizations must be able to use the system on a daily basis for routine situations and major emergencies.
6. The system must facilitate a common management structure that integrates personnel from different locations and from a variety of agencies.
7. The system must be cost effective.

The Incident Command System may need to be adapted to suit a country's existing political, administrative or cultural systems, customs and values. Where the primary purpose is to enhance emergency management, such adaptations are not only beneficial, but may be essential to have the ICS system adopted. Furthermore adopting ICS enhances cooperation between countries, through the sharing of resources such as fire management teams and equipment, it is highly recommended that the sending country and the receiving country both use the same emergency management system.

Incident Management

Incident management can be viewed as a system composed of inter-related components that function together to enable the best possible management of an emergency of any scale. As such, it is necessary to understand the function of individual components, as well as how they fit together.

The Incident Controller is responsible for the overall direction of the response activities in an emergency situation and is the person in charge of an incident. The Incident Controller will carry out all management functions and responsibilities until the incident assumes such a size that it requires additional functional roles to be appointed. It is important to distinguish between Incident Control, which relates to situations and operates horizontally across agencies, and Command, which operates vertically within an agency. Under ICS an incident has only one Incident Controller but a number of line commanders may be required depending on the number of agencies involved.

Why ICS?

Emergency services consume large amounts of funding each year. Safety, effectiveness and efficiency are achievable where a seamless integration of agencies is possible at an emergency. A nationally implemented ICS will improve firefighter safety, efficiency and effectiveness in management response. It will also limit damage to property and, most importantly, will save lives. ICS provides the model for command, control and co-ordination of an emergency response. It provides a means of co-ordinating the efforts of agencies as they work towards the common goal of stabilising an incident and protecting life, property, and the environment. Many emergencies, from vehicle accidents to large-scale disasters, require co-ordination across several agencies. It will also reduce the risk of agency overlap and potential confusion at an emergency through poor understanding and inadequate co-ordination. It is critical that a common global incident management system is adopted that will enable any assistance to quickly function in an effective manner. ICS is that tool which can enable that goal to be achieved.

Characteristics of ICS

Common terminology

Common terminology is essential in any emergency management system, especially when diverse or other than first-response agencies are involved in the response. When agencies have slightly different meanings for terms, confusion and inefficiency can result. In ICS, major organizational functions, facilities, and resources are pre-designated and given titles. ICS terminology is standard and consistent among all of the agencies involved.

Modular organization

A modular organization develops from the top-down organizational structure at any incident. “Top-down” means that, at the very least, the Control/Command function is established by the first-responding officer who becomes the Incident Controller. As the incident warrants, the Incident Controller delegates other functional areas. In approximately 95 percent of all incidents, the organizational structure for operations consists of command and single resources (e.g., one fire truck, an ambulance, or a tow truck). If needed, however, the ICS structure can be scaled up to multiple layers that are implemented to meet the complexity and extent of the incident.

Integrated communications

Integrated communications requires a common communications plan, standard operating procedures, clear text, common frequencies, and common terminology. Several communication networks may be established, depending on the size and complexity of the incident.

Consolidated Incident Action Plans

Incident Action Plans describe response goals, operational objectives, and support activities. The decision to have a written Incident Action Plan is made by the Incident

Controller, dependent on the duration and complexity of the incident. Incident Action Plans should cover all objectives and support activities that are needed during the entire operational period. A written plan is preferable to an oral plan because it clearly articulates responsibilities and provides documentation when requesting assistance. Incident Action Plans that include the measurable objectives to be achieved are always prepared around a timeframe called the operational period.

Manageable span of control

A manageable span of control is defined as the number of individuals or functions one person can manage effectively. In ICS, the span of control for any person falls within a range of three to seven resources, with five being the optimum.

Designated incident facilities

It is important that there are designated incident facilities with clearly defined functions to assist in the effective management of an incident. Every incident requires that control be managed from one identifiable Incident Control location. Additional facilities are designated as the complexity of an incident increases.

Comprehensive resource management

Comprehensive resource management is a means of organizing the total resource across all organizations deployed at an incident. This includes:

- maximising personnel safety
- optimising resource use
- consolidating control of single resources
- reducing the communications load
- providing accountability
- reducing freelancing
- assigning all resources to a status condition
- managing day and night shift resources
- enabling sustaining resources during long duration (campaign) incidents.

ICS Organizational Structure

Many incidents require a response from a number of different agencies, whether they are major emergencies or disasters (such as earthquakes) or more localized incidents (such as accidents or fire incidents). No single agency or department can handle every large-scale emergency situation alone.

More usually, several agencies must work together to manage multi-agency emergency response. To co-ordinate the effective use of all the available resources, agencies need a

formalized management structure that lends consistency, fosters efficiency, and provides direction during a response.

The ICS organization is built around four major components:

a) **CONTROL** – the management of the incident

b) **PLANNING** – the collection and analysis of incident information and planning of response activities

c) **OPERATIONS** – the direction of an agency's resources in combating the incident

d) **LOGISTICS** – the provision of facilities, services and materials required to combat the incident.

These four major high-level structural components (as further illustrated in Figure 3) are the foundation upon which the ICS organisation is built. They apply during a routine emergency, when preparing for a major event, or when managing a response to a major disaster.

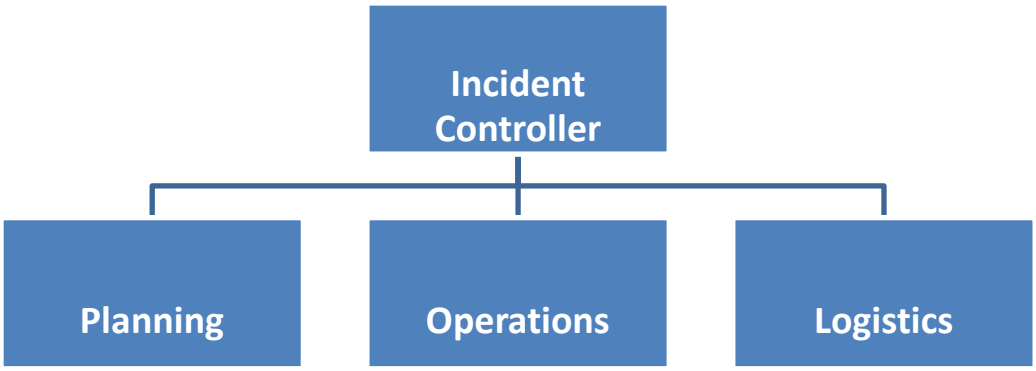

Figure 3: Four high level structural components

The ICS structure can be expanded or contracted to manage any type and size of incident. The complexity of the incident more than the geographic size is normally the determinant for the Incident Controller establishing additional members of the Incident Management Team to fulfill management functions. **ICS requires only one position to be filled – that of the Incident Controller. The Incident Controller carries out all of the management functions and responsibilities until the complexity of the incident determines that he or she assigns someone else responsible for a particular function(s).** This is only done when necessary. Figure 4 illustrates a complex organizational ICS structure for managing a complex wildland fire incident.

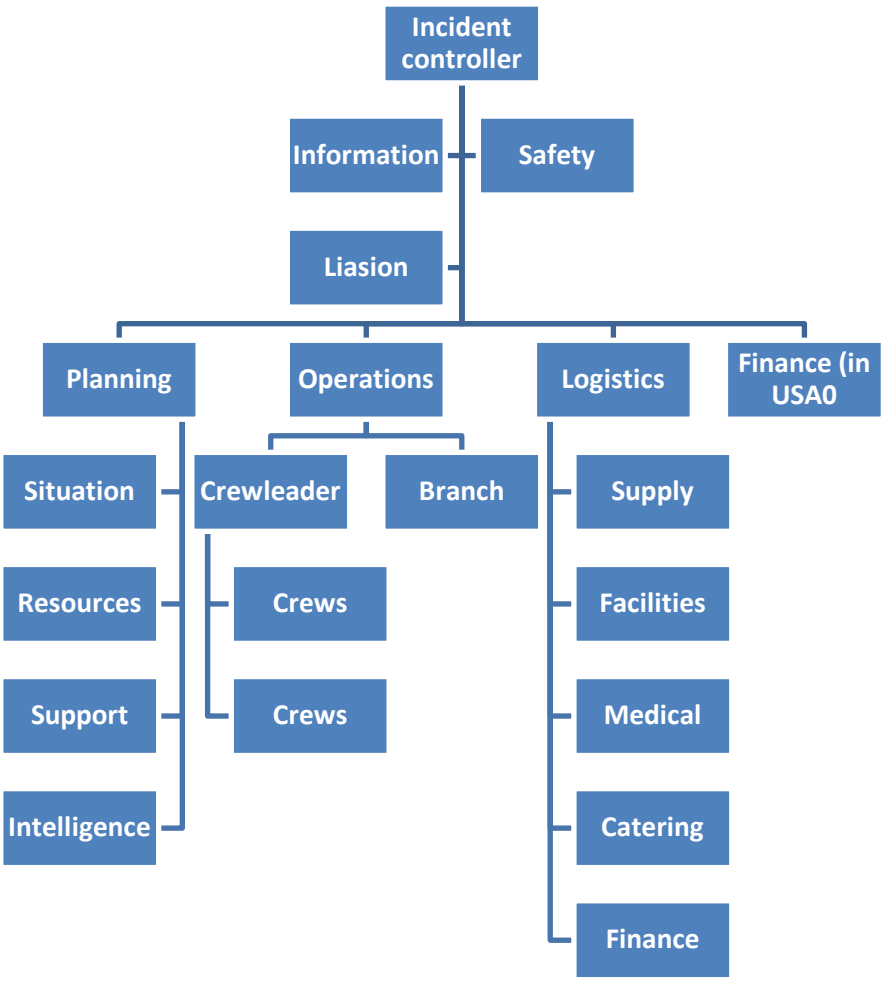

Figure 4: Complex organizational ICS structure