Programme «Germano-Malgache pour l'Environnement»

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Ministère de l'Environnement, des Forêts et du Tourisme

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Elaboration de document de stratégie régionale de gestion intégrée de feux pour les Régions Boeny et Diana et recommandations pour action sur le niveau national

Johann Georg Goldammer
Global Fire Monitoring Center (GFMC)
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1. Introduction

En matière de gestion de l'environnement, le problème des feux de brousse a toujours été une préoccupation nationale pour Madagascar. Les dégâts causés par les feux sont considérables en terme de disparition des ressources naturelles, de la biodiversité et d'érosion du sol causée par l'absence de couvertures végétales.

En effet, la "lutte contre les feux de brousse" n'est pas un thème nouveau dans la gestion de l'environnement à Madagascar. Depuis 1960 où les premiers textes sur les feux furent sortis, le pays s'engage de plus en plus à la lutte contre ce fléau national. Dans les années 80, la lutte contre les feux de brousse fut considérée comme un devoir national. Ce qui a incité l'Etat à entamer des actions de lutte à tous les niveaux en utilisant tous les supports nécessaires (émissions radiophoniques hebdomadaires, impression du logo sur des timbres postaux, …) pour éduquer et sensibiliser la population. Malgré toutes ces actions et ces efforts déployés, le phénomène persiste encore et constitue une des principales causes de la dégradation de l'environnement malgache à cause entre autres de la forte interaction de cette pratique avec les activités humaines (modes de culture ou de mise en valeur des sols) et les aspects socioculturels qui prévalent auprès des populations.

Pour sa deuxième phase d'intervention, la principale mission du PGM-E est d'appuyer le MEFT pour atteindre l'objectif décrit dans le Madagascar Action Plan (MAP) engagement 7. Il a pour finalité la gestion pérenne de l'environnement notamment des ressources forestières. Dans cette optique, le Programme a choisi au Nord de Madagascar deux régions pour concentrer et développer ses actions à savoir: les régions Diana et Boeny. Le programme PGM-E à travers son Antenne Nord, intervient dans plusieurs thématiques dont la gestion intégrée de feux constitue un élément prépondérant dans l'approche du Programme. L'expression «gestion intégrée de feux» au détriment de «lutte contre les feux» a été choisi à cause de la prise en considération dans la stratégie de l'existence des feux indispensables et autorisés même si la stratégie prévoit plus d'actions dans la lutte contre les feux non contrôlés. De ce fait, les actions ont été déjà commencées avec des concertations entre les entités concernées (MEFT, DREFT, Région et PGM-E) qui ont abouti à un développement d'une méthodologique utilisée pendant les ateliers régionaux.

Cette élaboration de document de stratégie régionale est bien sur la suite logique des ateliers sur la gestion des feux au niveau des deux régions. Les plans d'actions étaient déjà discutés et décrits exhaustivement lors de ces ateliers. Le Consultant International collaborait avec le PGM-E et les deux Consultants nationaux pour consolider de ces éléments de base (résultats de l'atelier) pour preparer un document de stratégie régionale aussi avec plan d'action au niveau national.

2. Short Overview on Key Activities during the Consultancy in January 2009 [1]

For the timeframe 11 to 21 January 2009 the Programme Germano-Malgache pour l'Environnement (PGM-E) commissioned a short-term consultancy to the Global Fire Monitoring Center (GFMC) to support the recently initiated project „Development of a Regional Strategy Document on Integrated Fire Management for the Regions Boeny and Diana".

The detailed itinerary of the consultancy is attached in Annex 4. The main activities, however, are highlighted as follows:

12 January 2009
Antananarivo: PGM-E staff briefing, followed by briefing by and discussions with the regional consultant teams. The first exchanges of concepts, methodological approaches and plans for the joint work during the following week was essential to provide ground for understanding project activities and possible contributions by the consultant.

Furthermore the consultant communicated with fire management staff in Botswana for a possible input for upgrading national capacities in fire monitoring and evaluation by spaceborne sensors.

The consultant also conducted a telephone conference with members of the South African "Working on Fire International" (WoF) Group[2] on a high-level meeting between the Prime Minister, the Minister for Environment Forests and Tourism (MEFT) and WoF, in Antananarivo, December 2008, with the objective to sign an MoU on a large project aimed at developing a national fire management strategy and building fire management capacities in the country.

13 January 2009
Antananarivo: Mutual briefings by and of the Director General of Environment and Forests, MEFT. The DG explained in detail the problems of wildland fires in the country, their underlying causes and the vision of the government in reducing the negative consequences of the fires as being prioritized by MAP (Annex 1).

A meeting with the JARIALA / USAID project team leader and IT /communication specialists served to inform PGM-E on the objectives, status and possible future of the fire information system based on satellite remote sensing information. The web-based system, to which anybody can subscribe via internet[3], provides near-real time information on fire activities throughout the country. Datasheets (reports with selectable dates or timeframes) can be ordered online as well the shape files for use on any mapping system. The products deliver locations of active fires at the 4-hourly overpasses of the MODIS instruments on AQUA and TERRA satellites. This is a valuable tool to determined critical zones of fire activities and – if operational fire management would use that system – information on the location of recent fires in the region of responsibility. A burned-area product cannot be generated with this information.

14-15 January 2009
Mahajanga: Initial discussions and briefing with representatives of DREFT, Boeny Region, on 13 January, followed by a Round Table on the envisaged Regional Fire Management Strategy. In this regional round table the representatives of DREFT, SRF, SRE, SRIC, Chefs Cantonnement et representatives of the fire services and the military attended. In additions representatives of communities and Fokontany reported on activities – achievements as well as failures. The regional consultants discussed in detail with all participants the approach for the development of the regional strategy.

16 January 2009
Boeny Region: Local Round Table on Fire Management at community level in Besely village Ankivonjy village with participation of village heads, presidents of local fire management communities

[1] The following part of this report is written in English
[2] http://www.wof-int.com/ and www.workingonfire.org
[3] http://firealerts.conservation.org/

and villagers. The discussions revealed that communities are overwhelmed by the tasks of combating fires and that they are expecting support by the government. Villagers complained that there is no support of basic tools available for firefight and that they have problems in participating in long-lasting firefighting as their presence at home to protect family security and actively working to support the livelihood of the family would distract the from the necessary work at home.

DREFT representatives stressed the basic legal situation that regulates the responsibilities of civil society to prevent and combat fires, regardless of financial support. Opinions were divided if additional awareness campaigns should be conducted after the last years' activities. It was stressed in both villages that fires were coming from outside and affecting negatively the villages. Pastoralists that had migrated from southern regions were blamed to be responsible for starting fires. The same refers to the charcoal makers.

In both villages interest was stressed to receive seedlings for tree / forest planting by individual families.

In continuation of discussions with the mayor of the community he stressed that almost 100% of the territory of his community (ca. 600 km^2 = 60,000 ha) was ready to burn every year. In the average about a third (20,000 ha) are burned by wildfires every year. This number is in contrast to the official DREFT reports for the period 200 to 2008, which show area burned at regional ranging from 155 ha (2002), ca. 1000 ha (2003, 2005), around 3000 ha (2006-2008) up to 4300 ha (2000) and maximum 5700 ha (2001).

17 January 2009
Mahajanga: In-depth discussion with the national consultants and the head of the PGM-E Antenne Nord. On procedures for the study and strategy development, including constraints resulting from the limited access of the region due to the wet season (flooding, high water table); this will impact the opportunity to conduct interviews with all communities in the region.

19 January 2009
Antananarivo: National Round Table on Fire Management at MEFT, with participation MEFT staff, JARIALA / CI, PGM-E / national consultants. MEFT introduced the fire information system set up by CI. GFMC briefed meeting attendees in detail on the fire situation in Sub-Saharan Africa, the state of scientific knowledge and the global significance of fires burning in the region, notably the pyrogenic emissions and their impact on atmosphere and climate.

Discussions concentrated on (a) the use of satellite remote sensing tools to assess fire impacts, (b) project and donor coordination, (c) need for the development of a national fire management policy and implementation strategy.

20 January 2009
Antananarivo: Briefing of the General Secretary, MEFT, on the objectives and status of the regional integrated fire management strategies and the visions for priority activities beyond. Central issues of discussion: (a) regional integrated fire management strategies Boeny and Diana, (b) remote sensing capabilities to be installed at national level with emphasis on burned area assessment, (c) development of a national fire management policy and implementation strategy, and (c) coordination with other processes and projects, e.g. the REDD process, alternative energy (fire charcoal / briquette production) and carbon trade projects, e.g. the project proposed by Working on Fire International.

Final debriefing with PGM-E staff. Discussion of follow-up action plan 2009.

End of on-site mission.

3. Conclusions and recommendations

Based on the thematic discussion between 11 and 21 January 2009 the following conclusions and recommendations are given:

3.1 Fire assessment at national to regional levels

It is evident that uncontrolled fires are a major driver of forest and other vegetation degradation in the country. However, fire has been used as a traditional tool in land management, particularly in pastoralism, and some vegetation stages or types are adapted to fire.[4] Kull in 2002 stated in the summary of his monograph "Madagascar aflame: landscape burning as peasant protest, resistance, or a resource management tool?":

Madagascar has a fire problem: despite a century of anti-fire repression and rhetoric, farmers and herders continue burning about half of the island's grasslands and woodlands annually. The state criminalized burning due to concern that fire destroys the island's natural resources and blocks development. Many peasants, however, rely on fire to maintain pastures and woodlands, prepare crop fields, control pests, and manage wildfires. The resultant conflict over natural resource management provides a convenient window into questions of peasant protest and resistance, and into strategies of power in resource management. Peasants have succeeded in continuing to burn unimpeded, leading to a century-long stalemate over fire, by taking advantage of first, contradictions and hesitations within the state, second, the natural character of fire (its inevitability, easy anonymity, and self-propagation), and third, the ambiguity between fire as explicit protest and fire as a livelihood technique used at politically opportune moments. This research demonstrates that models of domination (or criminalization) and resistance used to understand peasant-state relations in natural resource management are incomplete without, first, a consideration of the complex and ambiguous spaces between domination and resistance, between state and peasant, between protest and livelihood practices, and second, attention to the political-ecological context including resource ecology, rural livelihoods, and political discourse.[5]

While many of the fires or fire regimes may not be understood very well by the public authorities, as reflected by the goals of MAP to reduce the size of area burned without intending to discriminate between various fire types or regimes.

Statistics on area burned annually are not well designed and very unrealistic. As pointed out in section 2 of this report, the ground observations and reports are unreliable. A satellite-based recording system of active fires depicted by the MODIS sensor on the Terra and Aqua satellites, as described above, provides a picture of fire activities throughout the country and allows to roughly assess where fires are currently or have been recently (or in periods definable and retrievable) have been burning.

A tentative assessment of the magnitude of vegetated area affected by land-use fires and wildfires in the year 2000 has been extracted from the Global Burned Area (GBA) 2000 product (Annex 2). This product reveals that in the year 2000 about 1.3 million ha have been affected by fire.

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[4] For details see a number of dedicated papers by C. Kull:

- Kull, Christian A. (2004). Isle of Fire: the Political Ecology of Landscape Burning in Madagascar. University of Chicago Press, 324pp.
- Kull, Christian A. (2003). Fire and the management of highland vegetation. 153-57 in Natural History of Madagascar, eds. S. Goodman and J. Benstead. Chicago: University of Chicago Press.
- Kull, Christian A. (2002). Madagascar aflame: landscape burning as peasant protest, resistance, or a resource management tool? Political Geography 21 (7): 927-53.
- Kull, Christian A. (2002). Madagascar's burning issue: the persistent conflict over fire. Environment 44 (3): 8-19.
- Kull, Christian A. (1999). Observations on repressive environmental policies and landscape burning strategies in Madagascar. African Studies Quarterly 3 (2).

[5] See also Annex 2.

It was unanimously concluded at various meetings during the consultancy that a dedicated satellite-derived system to assess area burned should be made available to be imported into a vegetation cover / land use GIS to support decision making for land-use and fire management planning, as well as for fire management decision support. A relevant proposal is made in Section 4 of this report.

3.2 National Fire Management Policy

Repeated strategic visions have been developed in the country over the last decades aiming at gaining control over fire – in vain.[6]

A very important step for the country would be to develop a policy that would build on the state-of-the-art knowledge on the ecology of fire in the various natural and human-influenced ecosystems and land-use systems. A national policy shall provide a framework for that would define the fundamental approaches to fire management as an integrated part of land-use and land-use planning with participatory approaches at local / community level. A national policy would provide the basis for a legal and regulatory framework that would create the enabling conditions and strategic actions for more holistic approaches to fire management. Thus, one of the fundamental question to be addressed by the policy would be to review if the existing legal needs to be changed to meet both the ecological and economic demands of the sound use of fire. An "integrated fire management" approach, as initially suggested by PGM-E is recommended, i.e. the integration of the sound use of fire in the land management systems. The overall final objective of development would be to enable those in charge of fire management to be in control of fire, both in combat of destructive fires as well as in the safe, targeted use of controlled burning in sustainable land management.

A National Fire Management Policy should be developed in the context of a broad consensus of the society, i.e. through the participation of all government and non-government stakeholders (civil society). The creation of a National Inter-Agency Fire Management Committee (or Board) could support the development of a policy in a coordinated approach.

The review of legislation will be an important part of the process. Existing laws, decrees and other regulations must be screened and adapted if required, in order to reflect the objectives of the policy and allow its implementation.

A next step would an Implementation Strategy. In this strategy priorities for action would be defined – a process in which international organizations, notably the donor community, could assist.

The results of the regional strategies developed by PGM-E will provide a major input for the development of a policy and an implementation strategy. It must be stated clearly, however, that the regional strategies will not be able to address the very fundamental and still open questions of ecology-based "prescriptions" for specific ecosystems that still may require some research.

3.4 Basic fire management capabilities in the country

Despite of previous efforts to reduce the occurrence, size and impacts of wildfires in the country, especially through public awareness (sensibilisation) campaigns, the overall fire management capabilities in the country at all levels are very low to nil, i.e. there are no specifically trained specialists at national, regional or local level, or in the academic environment, that would be able to respond to fire and advise respectively to fire management. Classical fire prevention work through public awareness campaigns – hardly visible at all in the public – the use of agricultural hand tools for firebreak construction and firefighting with the help of tree or palm branches, are the means used by the those who are obliged by law to combat fires (all civilians starting at age of 18 – in general the poor rural population.

[6] Earlier projects in the frame of POLFOR et PDFIV, didactic materials for the regions Sofia and Antananarivo were developed and tested in 2002-2003; e.g., a fire management manual for Port Bergé (2002). These materials are available on file at the GTZ PMG-E office in Antananarivo.

Capacity building at all levels is urgently required and may include:

- Fire research and advisory personnel and teachers at university level (medium- to long-term perspective)
- Fire management specialists of central government level (immediately)
- Technical personnel at central government level responsible for handling / operating advanced information tools, i.e. fire information system with remote sensing and satellite- and weather forecast-based early warning systems (immediately)
- Fire management personnel able to take responsibility for fire management planning and decision making (immediately at least in pilot regions)
- Fire crews specialized in using / training the use of safe and ecologically sound prescribed burning techniques, firefighting and fire prevention measures (immediately at least in pilot regions)
- Heads and members of local fire management committees trained to safely using and combating fire (immediately at least in pilot communities)

This may be achieved by taking advantage of a variety of training courses offered in the region (see below).

3.5 Networking at regional (international) level

One of the goals of the mission was to inform the authorities as well as PGM-E on the existing networking structures in the Subsahara Africa Region and globally. The objectives of the Global Wildland Fire Network[7], which operates under the United Nations International Strategy for Disaster Reduction (UN-ISDR) and in particular the Regional Subsahara Wildland Fire Network (also called "AfriFireNet").[8] Another dedicated thematic network is the Southern African Fire Network (SAFNet), a regional network that fosters collaborative efforts in fire monitoring and also in fire management in southern Africa.[9]

These networks are calling for regional consultations, organize training courses and assist governments in developing national fire management capabilities. AfriFireNet is offering training courses in 2009, e.g.:

- Incident Command System ICS Training (March 2009)
- Conservation Fire Management Course in the Kruger National Park within the SavFIRE 2009 burning trial (May 2009)

More information on recent courses (reflecting the range of themes addressed) are found on the website of the "Wildland Fire Training Center Africa.[10]

Another objective of the cooperative work in the region is to foster transboundary cooperation in fire management, i.e. managing fires along common border regions between two or more countries (not relevant to Madagascar) and to develop protocols for reciprocal assistance in case of large fire disasters / emergencies.

At global level the networks are cooperating in order to share common systems, standards and procedures that allow countries to (a) communicate, (b) share resources, and (c) share knowledge. Common systems are e.g. the satellite systems or the planned Global Early Warning System for Wildland Fire.[11] One of the fora in which the international community is meeting in 4-year intervals is the series of International Wildland Fire Conferences. The last two conferenecs were held in Australia (2003, in conjunction with a Global Wildland Fire Summit) and Spain (2007). The 5th International Wildland Fire Conference will be held in South Africa in May 2011. It is strongly urged that representatives and staff of agencies that are responsible or involved in fire management in

[7] http://www.fire.uni-freiburg.de/GlobalNetworks/globalNet.html
[8] http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/Afrifirenet.html
[9] http://www.safnet.co.za/
[10] http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/WFTCA.htm
[11] http://www.fire.uni-freiburg.de/fwf/fwf.htm and http://www.fire.uni-freiburg.de/fwf/EWS.htm

Madagascar should attend the conference. It will be important, however, that those to be delegated to the conference shall hold sustainable positions related to the theme.

3.6 The broader context: Wildland fire, carbon, poverty and climate change

Throughout the vegetation zones of the world fire is a major driver of forest and other vegetation degradation. Those fires that are resulting in destruction of forests and leading to savannization contribute to the lowering of the terrestrial carbon sequestration potential and contribute to a net release of carbon the atmosphere, thus to global climate change.

There are two implications on fire management options to contribute securing the reduction of excessive carbon emissions.

First, fire management, e.g. through efficient reduction of destructive fires, can contribute to protect forests from degradation. Forest regeneration or reforestation areas, which are successfully protected from destructive fires, will return to a forests with higher biomass / carbon stocks.

Second, forest and fire management measures would include the systematic use of biomass as a source of renewable energy. The utilization of brush and shrubs for producing charcoal powder and briquettes has been demonstrated successfully in Namibia. Instead of allowing the brush to burn freely the energy potential could be used for replacing and reducing fossil fuel consumption. At the same time the controlled reduction of hazardous combustible materials ("fuels") will contribute in some ecosystems to reduce the potential of severe and intense wildfires.

This kind of alterative use of biomass has a potential for creating employment opportunities, thus may potentially contribute to poverty alleviation.

It should be noted that the sustainable use of small woody materials for charcoal production would be an alternative to the currently practiced and widely destructive uncontrolled production of charcoal that is involving cutting of trees and contributing to deforestation.

These considerations should be discussed in the frame of the development of a policy and a strategy cross-cutting with processes such as the REDD within the overall context of the post-Kyoto regime.

4. Concrete proposals for immediate / short term follow up action

Out of the above-mentioned observations several short- to medium-term actions are recommended. These are actions that should be implementable within a reasonably short time period and limited financial resources.

4.1 Regional strategies for Boeny and Diana

The draft regional strategies for Boeny and Diana will be finished by end of March 2009. This will include a review of laws and other legal instruments. It has been proposed to review the draft strategies by the international consultant. GFMC is available to do so.

In addition it is recommended to add a short follow-up assignment of the two national consultants to be verify / review their findings during the dry season (note: the current assignment is taking place in the rainy season – a period during which some key areas of the region cannot be accessed due to waterlogged and partially flooded terrain, thus interviews with local populations cannot be conducted in a representative way). The revisit with the international consultant should be in the early dry season at the time when wildfires are starting, e.g. beginning in August 2009.

4.2 Enhancement of national wildland fire monitoring and assessment capabilities

The current fire reporting system (reporting of burned area) and the existing satellite-derived information on location of active fires does not provide sufficient information on area burned and types of surfaces affected by land-use fires and wildfires. An upgrade of the currently available system of fire location counting, mapping and reporting, which is currently operated by Conservation International (CI), could be complemented with a system that has been developed in Botswana and which allows near-real time fire detection and monitoring from space using a variety of satellite sensors, and near-real time burned area assessment.

The availability of personnel trained by CI / JARIALA and the expertise of the GIS unit in Tanà provides quite enabling conditions for setting up an own advanced fire monitoring system in the country. This system would be operating at national (central) level and serve the government in monitoring and implementing the goals of national instruments / commitments, e.g. implementation and monitoring of MAP. The system would also serve the regions for monitoring and decision support in fire management.

A work proposal has been developed by GFMC and associate partners in Botswana and is attached in Annex 3. According to this proposal it would be possible to upgrade Madagascar's fire information system – currently sourced out to CI – by adding the capability of burned area assessment and near-real time fire monitoring for operational purposes. Thus, the inputs provided by JARIALA and other projects would be utilized in the best extent possible.

The required amount of expert days are totaling 4 weeks (2 persons for 2 weeks – one fire management information systems specialist, one IT / programming specialist). It is highly recommended to realize the proposed activity. The GFMC and partners in Botswana will support PGM-E in realizing the proposed system.

4.3 Training of wildland fire management experts and networking at regional Sub-Sahara Africa and global level

Options for training options in the context of Regional Subsahara Wildland Fire Network (AfriFireNet) and the Southern African Fire Network (SAFNet) have been elaborated above (Section 3.5). GFMC is available to provide offers of training through AfriFireNet and Working on Fire International.

The country is invited to formally join AfriFireNet. A focal point for Madagascar should be determined. He/she should have a sustainable position and work in the field of fire management or closely related thematic area. The same will refer to membership in SAFNet. A focal point should be a person working on the current and more importantly in the future satellite-supported national fire information system.

The country should prepare a participation at the upcoming 5th International Wildland Fire Conference in South Africa (May 2011). A country delegation should consist of those specialists who would be trained between 2009 and early 2011, and government officials from MEFT.

4.4 Establishment of a National Inter-Agency Fire Management Committee: Towards developing a national Fire Management Policy

As elaborated above, the creation of a National Inter-Agency Fire Management Committee (or Board, Council) could support the development of a policy in a coordinated approach. The coordination and lead role of such a Committee should be taken by MEFT through the office of the General Secretary. Participating agencies would include the ministries responsible for agriculture, livestock, public health, education, public safety and fire protection, emergency situations, and defense (military). Non-government organizations would take also a responsible role in the Committee.

A priority task of the Committee would be the development of a National Fire Management Policy. Such a policy should be developed based on a broad consensus of society, i.e. through the

participation of all government and non-government stakeholders (civil society) – a task to be implemented by a body that is able to work at a cross-sectoral, not to say inter-disciplinary *modus operandi*.

It is suggested to discuss the formation of the National Inter-Agency Fire Management Committee at the next mission of the international consultant. One of the main initial tasks of the Committee would be the preparation of a National Round Table Consultation for the Development of a National Fire Management Policy and Implementation Strategy, to be held tentatively by end of 2009. The policy should take advantage of and be based on the insight gained and recommendations made by the development of the Integrated Fire Management Strategies for Boeny and Diana Regions. In the preparatory process of a National Round Table it should be considered to involve a fire ecologist who is experienced and familiar with the ecological and social conditions of wildfires and fire use in the country (cf. footnote 4 and Annex 2). His task would be to develop the ecological basis for decision making of vegetation types in which prescribed fire regimes would be established / permitted opposite those forest and non-forest ecosystems from which fire has to be excluded.

5. Summary Conclusions

The expert mission revealed that the current capacities / capabilities in fire management in Madagascar are limited, particularly at regional to local levels, to deal with the magnitude of the fire problem in the country. The lack of trained experts is obvious. Many decades and approaches in fire management have resulted in a situation that is still governed by a national law that prohibits the use of fire and puts civil society under the obligation to combat all fires. In practice, however, no training, security and firefighting means are provided, resulting in very limited capacity to handle fire.

This situation must be changed urgently by

- Development of a policy that would recognize the importance of integrated fire management approaches, i.e. the ecologically and economically sound and (from the point of view of human security) safe application of controlled (prescribed) fire;
- Development of community-based fire management capacities that would go beyond the traditional public awareness campaigns and build instead knowledge on integrated fire management and technical capacity to safely use controlled fire and to suppress damaging wildfires with locally available technical means;
- Upgrading of the existing means of spaceborne fire monitoring and assessment tools; and
- Formation of fire management experts at national and regional level who will take responsibility and develop sustainable capacities in fire management long term

A modest contribution of the PGM-E could be instrumental to initiate this development within a relative short time period 2009-2001.

Freiburg, 23 January 2009

Johann G Goldammer

Annex 1

Table 1. Results of the Global Burned Area (GBA) product for Madagascar for the Year 2000. The total area burned in all three broad vegetation types is 11 336 km^2, i.e. 1.13 million hectares

	Burned Area (km^2)	**Number of Scars**	**Average Burn Scar Size (km^2)**	**% of the Category Burned Broad Vegetation Type**
Broadleaf Forests	179	100	1.8	0.2
Woodlands and Shrublands	5 272	2 610	2.0	1.8
Grasslands and Croplands	5 885	2 544	2.3	2.7

Source : GBA 2000 :
http://www-tem.jrc.it/Disturbance_by_fire/products/burnt_areas/global2000/global2000.htm

For introductory explanations and other global satellite-derived fire products see GFMC portal at:
http://www.fire.uni-freiburg.de/inventory/burnt%20area.html

Table 2. Realization of management plans to reduce the occurrence of wildland fires between 2008 and 2013 to with the overall objective to reduce degradation of national resources. Source: MAP.

Indicateur	Valeur cible 2008	2009	2010	2011	2012	2013	Justification pour l'évolution	Définition de l'indicateur et règles de calcul
Taux de réduction des surfaces incendiées (%)	33%	35%	40%	50%	60%	70%	Projection exponentielle progressive de par la prise de conscience de la population	Evaluation des données année par année par le biais d'un dispositif nommé "alert fire"

Annex 2

National Geographic News, 4 June 2004

Wildfire Fuels Debate Over Land-Burning in Africa

By John Roach

Last October Madagascar's Ibity Massif was engulfed in flames. The mountain is famous among botanists, because as many as 20 plant species found there grow nowhere else in the world.

Neither unique plants nor fire are unusual on Madagascar, an island nation off the southeast coast of Africa. An estimated 80 percent of the Madagascan flora is endemic. Fires, both natural and human-caused, have burned seasonally dry parts of the island with clockwork regularity for millennia.

But the blaze that scorched Ibity seven months ago was particularly bad—and now scientists are hoping that they can use surveys of the plant population before the fire to monitor how the mountain vegetation recovers from such a catastrophe, if at all. The fire, it is hoped, may have provided a rare opportunity to understand how burning may have contributed to the widespread destruction of Madagascar's once mighty forests and grasslands—and how plants may eventually make a comeback.

Most of Madagascar's fires are started by cowherds (to encourage the growth of tender shoots for their cattle), cattle rustlers (to hide their tracks), hunters (to flush out game), farmers (to clear the land of forest for agriculture)—or even by sparring political groups (to demonstrate that their rivals do not have control of an area). One study determined that an average of 600,000 hectares (1.5 million acres) was burned each year between 1984 and 1996.

The relentless burning of Madagascar is controversial. Some experts believe that fires started by people are the root cause of the destruction of the great majority of the island's indigenous forests and grasslands. Others believe that much of the island's vegetation has adapted to the periodic fires, and that the erosion is attributable to a combination of many causes.

Every year a portion of Ibity Massif burns, usually the result of fires intentionally lighted to encourage new grass growth. The fires are generally lighted on old pasturelands on the lower slopes and farther out on the rolling grasslands of the high plateau.

"But the October 2003 fire was unusually extensive, in that practically the whole site was burnt," said Chris Birkinshaw, a biologist with the Missouri Botanical Garden who is stationed in Antananarivo, Madagascar's capital city.

The October fire coincided with a field trip to Madagascar by members of the National Geographic Society's Committee for Research and Exploration. Stunned by the inferno, the committee awarded Birkinshaw emergency funding to study the fire's effect on Ibity's unique flora.

The fire is inseparable from the Madagascan agriculture and ranching economy. Birkinshaw said, however, that almost no research has been done to determine the effect of the frequent burning on Madagascar's native plants.

The sense among conservationists, he said, is that current rates of burning "are too frequent and impoverishing ecosystems." He hopes the current study will help reveal an answer to the question of how much fire is good for Madagascar's biodiversity.

Preliminary Results

According to preliminary results from the study, few mature plants died in the inferno and regrowth of species was rapid.

Fire is normally considered as the number one enemy of conservationists, so some here would be surprised to find out that a number of Malagasy species are adapted to fire and indeed would probably decline in the absence of this condition," Birkinshaw said.

Although the finding on mature plants is encouraging, Birkinshaw said younger vegetation may be more seriously impacted by fire. Woody rootstocks and thick bark protect mature plants, adaptations that seedlings are too young to have.

This October, Birkinshaw and his colleagues plan to burn small plots on Ibity to more closely study the impact on younger plants.

"I think one wouldn't want to give the impression that fire is good for Madagascar's biodiversity—it isn't, especially at its current frequency. But without wishing to leap to conclusions at the start of the study, we will likely find some species for which the ideal environmental conditions would include an occasional burn," he said.

Christian Kull—an environmental scientist at Monash University in Melbourne, Australia, and author of the book *Isle of Fire: The Political Ecology of Landscape Burning in Madagascar*—is not surprised by the preliminary findings.

"Since fire has always played a role in Malagasy environments, some species are favored by the presence of fire," he said. Prior to the seasonal burning of fields by farmers and ranchers, intense lightning-caused fires swept across the island, he added.

Burning Balance

When humans arrived on Madagascar about 1,500 years ago, they used fire to sculpt the landscape to their needs, according to Kull. The biggest changes were in the highlands, where a mix of woodlands, savanna, and open areas became dominated by grasslands.

When the French colonized Madagascar in 1896, administrators, conservationists, and scientists sought to control the rates of burning to stem the loss of forests and prevent soil erosion.

Laws intended to punish burning were carried over when Madagascar won independence in 1960 and are still enforced today.

However, Kull said anecdotal evidence and government data suggest that rates of burning have remained consistent for the past century. This burn rate serves Malagasy needs to renew pasture, fight brush encroachment, and prevent the buildup of fuels, he said

"The main difference is that with a hundred years of government antifire activity, people now burn out of sight, at night, when nobody is looking" he said.

Birkinshaw said that a group of about 200 local villagers, including women and children, banded together to beat out the Ibity fire last October out of social responsibility and fear of being blamed "for not doing anything".

Given the steady rates of burning over the past hundred years, conservationists are concerned it is eroding the island's biodiversity.

"The ideal frequency of burning is unknown and would depend on the desired abundance of fire-tolerant versus fire-intolerant species—something that is probably subjective. But presumably one would want to approach the natural state" Birkinshaw said.

According to Kull, determining the ideal rate of burning is a complex process. Madagascan farmers "use fire to shape biodiversity to their needs. From a botanical perspective, this probably means less species. But from a human perspective, this is what we do" he said.

Annex 3

Fire Information for Operational Fire Management Purposes and Burned Area Monitoring in Madagascar derived from Aqua-Terra MODIS and SEVIRI- MSG

Work Proposal and Terms of References for the „Programme Germano-Malgache pour l'Environnement (PGM-E), Coopération Germano-Malgache au Développement“

by

A.A. Hoffmann and Cheewai Lai
20 January 2009

Rationale

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. Holistic fire management, involving various stakeholders to implement the necessary technical, logistical, operational and social programs, is based on five principal components: analysis, prevention, preparedness, suppression and restoration. Information is the glue that links up each element and makes them interdependent.

For preparedness and suppression efforts it is important to know, where and when most fires start. To prevent fires, those concerned must know, who or what starts the fires and why. However 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. Analysis of data is essential to define the problem to then clearly address it effectively and using resources most efficiently.

The data needed are simple and relatively straightforward to collect: consistently collected data over time will help to better understand the fire problem. The data will allow better management of fire by concentrating resources for prevention, suppression and recovery where fires are most problematic. Well-collected simple data can identify the geographic focus, the major land uses affected by fire hence the key fire users and the timing of fires. This supports the development of focussed options to manage and prevent unwanted fires.

Most countries in Southern Africa lack data bases on fire events and often have no means of regular aerial or ground surveillance in place to collect consistent data over time hence fire management efforts are inadequately guided and implemented. In such circumstances, the MODIS and MSG active fire data and the MODIS satellite images are useful for gaining a better understanding of fire events and providing data to help answer the following questions:

- Where is the fire burning (location and movement)?
- When did the fire start (day)?
- When did the fire finish (day)?
- How large is the area burnt (burned area measurements)?
- What kind of vegetation/land use burnt (in conjunction with available secondary data)?
- Fire seasonality and frequency

Such data provides a major basis for analyzing the fire “problem” and defining important parameters of the existing fire regimes and carbon emission parameters. Furthermore analyzing the historical fire data in relation to land mark features and boundaries gives information on the origin of the fires and subsequently current and future fire risk. It also raises the level of awareness regarding fire occurrence and the likely ecological and economic impacts. Such information can be a major stepping stone in seeking political will and funding for the necessary development of operational fire management organizations and applicable fire policies that not only focuses on (ad hoc) fire suppression but equally on prevention efforts that involve community participation.

Active Fire data via FTP download

Currently there are three different (satellite) data sets available for fire detection and monitoring as well as for burned area delineation.

- MODIS active fire data (onboard of the AQUA & TERRA satellites)
- SEVIRI active fire data (onboard of the Meteorological Satellite Generation -MSG)
- MODIS satellite images 250m in 7,2,1 band combination

The active fire data from MODIS can be provided by the Centre for Scientific & Industrial Research (CSIR) South Africa. The active fire data from SEVIRI can be provided by the European Organisation of Exploitation of Meteorological Satellites (EUMETSAT) in Germany. The near real time satellite images of the MODIS sensor can be provided by the MODIS Rapid Response Centre (MRRC) in the United States of America. Appendix 1 provides an overview of the characteristics of the proposed data sets.

By establishing a system comprising of open-source software the data can be automatically retrieved at specific poll interval from the respective server via the Internet. The database exports user-defined files to be loaded into a GIS and thus provides near real-time fire alerts for rapid incidence response. In addition, a mosaic of MODIS images covering a specific area of interest (AOI) in 250m resolution could be requested from the MODIS Rapid Response Centre (MRRC) and automatically retrieved from their server to establish burned are measurements.

The data can be loaded into a Geographic Information System (GIS) to produce regular fire location information and maps showing land use and administrative features to inform respective authorities at various administrative levels. During the high fire season MSG data even allows for near-real time information on the movement and direction of the fire and its spread in very short time (every 15 min). Fires detected/monitored through the satellite system can be directly reported to the respective offices and other concerned stakeholders to allow them for mobilisation and strategic crew placement and movement.

Scope of Work for a satellite based Fire Information System for Madagascar

To establish and implement a GIS based Fire Information System consisting of MODIS active fire data, MSG active fire data and MODIS satellite images as well as to develop a data base for user defined fire data sets for various information purposes (fire history analysis, map provision, fire information dissemination and communication strategy, fire regime parameters etc.) certain prerequisites have to be either met or needs to be established. Therefore the scope of work entirely depends on the existing infrastructure such as hardware and software as well as the expertise and knowledge of the partner organization.

The consultancy will consist of two fields of technical expertise that are a system developer and programmer and a fire information and GIS expert. The following outlines the prerequisite for both fields.

Prerequisite for FTP download

Suitable server hosting environment

- Internet connectivity for server - 512kbps internet link for data download and server updates
- Dedicated server - licensed Windows 2003 or supported Linux distribution, e.g. CentOS, openSUSE, ubuntu, etc. - 1GB RAM –
- Minimum 20GB free hard disk space (more if archived data is to be kept online) and/or operational backup facility (tape, external drive, etc.)
- reliable power supply- adequate UPS to protect against surge and outages to prevent crashing server - good ambient temperature and humidity control

Prerequisites for GIS based fire information system

- GIS system under ArcGIS 9.x or ArcView 3.3 under Windows XP or higher
- Minimum of GIS knowledge and expertise
- MS Microsoft Excel

Deliverables

Fire Information System based on satellite data. The functionality included in the system:

- Linkage to MODIS and MSG data provider for automated data retrieval
- near-real time automated FTP download from MODIS and MSG
- downloaded fire data will be stored in MySQL database
- programmed user-defined scripts for exporting fire data from MySQL database in CSV format (individualist fire data sets for focussed analysis)
- automated download of 250m MODIS satellite images from US server for
- Fire related GIS projects for information and map production
- Provisions of training on the use of MODIS data for operational fire management, supporting elements of prevention and suppression efforts. More specifically:
    - Use of active fire data for daily, monthly, yearly fire detection and monitoring as well as fire reporting and mobilization of resources.
    - Measurements of burned area with MODIS 250m images (GIS on screen delineation), intersection with secondary GIS data (land use/cover) as shown in figure 1 example from Botswana.
    - Use of historical fire data to derive simple fire regime parameters of frequency and seasonality and produce fire statistics that are relevant to establish long term data and trends of shift in fire regimes and anticipated linkage of climate change, livelihoods and fires, as shown in Figure 2 – an example from Botswana.

Timeline

To ensure timely completion of the deliverables described above, the following timeline is proposed following finalization of contractual arrangements:

Activities	**Workdays required**
Formalize user and project requirements (consult local management and project lead)	2
Prepare server(s) for data acquisition and processing	6
Train local staff for day-to-day operation in data base and FTP system	3
Set up fire related GIS projects	2
Training in the use of satellite fire information within GIS	6
Training in the production of fire statistics and reports and burned area mapping	6

Qualifications

The Consultant(s) shall individually or collectively be able to demonstrate the following expertise:

- Extensive work experience in the field of tropical Wildland fire management and related concepts
- Work experience in Information Technology and Management with focus on the development of fire information and early warning systems (GIS & Remote Sensing)
- Extensive work experience in developing user defined scripts and programs with open-source web technologies
- Experience as IT system developer and integrator
- Experience in designing and developing IT turn-key solutions
- Experience in Training and education of local counterparts and experts in IT/RS/GIS
- Excellent report and manual writing skills

Appendix 1: Data characteristics

MODIS active fire data

MODIS (Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra and Aqua satellites. These satellite data allow near-real time fire detection throughout the country provided there are clear skies. A MODIS hotspot/fire event is the location of a thermal anomaly that was detected by MODIS using data from the middle infrared and thermal infrared bands. Terra was launched 18 December 1999; Aqua was launched 4 May 2002. High quality observations from Terra are available from November 2000 onwards.

The detectable size of a fire is subject to various conditions. According to *NASA/University of Maryland, 2002* in any given scene the minimum detectable fire size is a function of many different variables (scan angle, biome, sun position, land surface temperature, cloud cover, amount of smoke and wind direction, etc.), so the precise value will vary slightly with these conditions. Analysis of a large number of ASTER (high resolution satellite) data for a wide range of conditions over selected regions and time periods, combined with simulation results indicate that in many biomes the minimum flaming (~800-1000K) fire size typically detectable at 50% probability with MODIS is on the order of **100m^2**. Under ideal conditions performance is somewhat better. Such conditions occur when a fire is observed at (or near) nadir on a fairly homogeneous surface, no other significant fires are nearby, and the scene is free of clouds, heavy smoke and sun glint. In these circumstances the smallest flaming fire that can be routinely detected (i.e. near 100% probability of detection) is approximately **50m^2** in size.

MSG active fire data

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) currently operates a fleet of geostationary satellites, the Geostationary Operational Environmental Satellites (GEOS). The GEOS Meteosat Second Generation (MSG) has onboard the Spinning Enhanced Visible and Infrared Imager (SEVIRI) sensor that is characterized by a spatial resolution of 3km^2 and an observation frequency of 15 min. as well as spectral bands needed to employ fire detection applications. The algorithm for active fire monitoring makes use of channel 4 (IR3.9) and 9 (IR10.8) and is similar to those algorithms already in use for other instruments (e.g. MODIS). The difference between MODIS and MSG is summarized in Table 1.

Table 1. MODIS and MSG

	Repetition rate	**Resolution**
MODIS	~ 3 per day	1km^2 (fire size to be detected 10-50m$^{2)}$
MSG	Every 15 min)	3km^2

MODIS satellite images

Burned area measurements are possible, due to the availability of MODIS satellite image with a ground resolution of 250m. Data for the MODIS subsets can be acquired from the Terra (morning) and Aqua (afternoon) satellites. The band combination 7,2 and 1, is assigned to the red, green, and blue portions of the digital image. This combination is most useful for identifying burn scars in a GIS system.

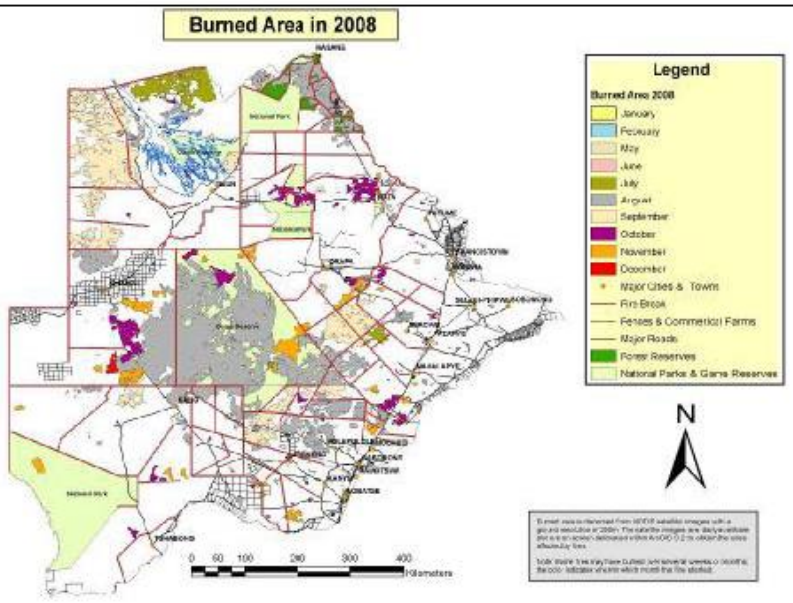

Figure 1: Example of burned area map

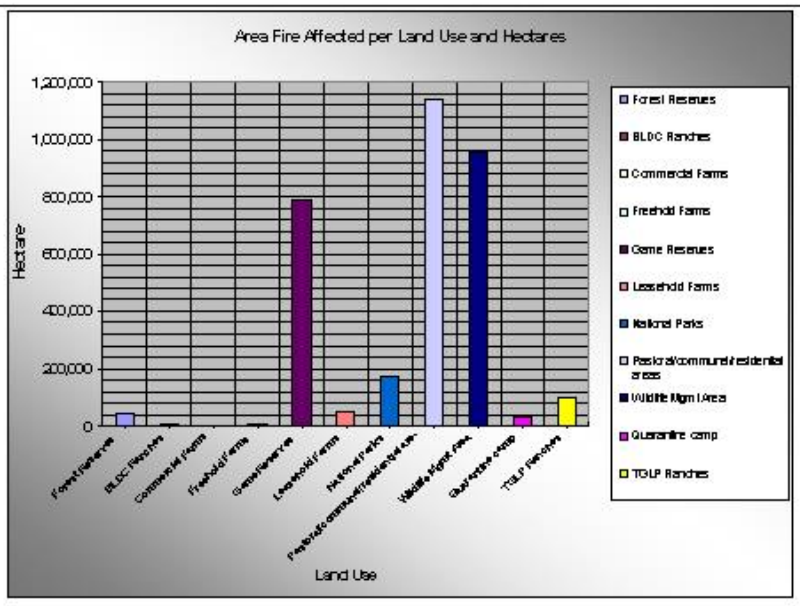

Figure 2: Land Use Fire affected

Annex 4

Calendrier de mission de l'expert international

Date	Lieu	Programme
Dimanche 11 Janvier 2009	Antananarivo	Arrivée à Madagascar
Lundi 12 Janvier 2009	Antananarivo	- Réunion avec l'équipe thématique feux de brousse/ analyse documentaire et des données issues des deux ateliers à BOENY et DIANA - Réunion de recadrage avec les consultants nationaux
Mardi 13 Janvier 2009	Antananarivo	- Visite de courtoisie auprès du MEFT (DG, DVRN) et discussion sur la possibilité d'inciter à une participation active du MEFT aux échanges et à la discussion internationale (réseau "fire management") - Briefing avec le Responsable thématique "feux de brousse"
Mercredi 14 Janvier 2009	Déplacement Antananarivo - Mahajanga	- Départ Tanà pour Mahajanga (avion)
Jeudi 15 Janvier 2009	Mahajanga	- Table ronde avec la DREFT et les partenaires techniques - Réunion avec Mme Chef de la Région
Vendredi 16 Janvier 2009	Mahajanga	- Descente sur terrain dans une zone rouge en compagnie de la DREFT et éventuellement des interview avec les responsables locaux (cantonnement, maire, …), les villageois
Samedi 17 Janvier 2009	Mahajanga	- Réunion avec les consultants nationaux - Travail individuel
Dimanche 18 Janvier 2009	Déplacement Mahajanga - Antananarivo	- Retour Tanà (avion)
Lundi 19 Janvier 2009	Antananarivo	- Table ronde avec le MEFT et les partenaires techniques (JariAla, CI, PGDRN, USAID)
Mardi 20 Janvier 2009	Antananarivo	- Travail individuel - Briefing avec le Secrétaire Général, MEFT - Débriefing avec le pool
Mercredi 21 Janvier 2009	Antananarivo	- Départ à Tanà pour Paris par le Vol Air France

Programme Boeny

14 Janvier 2009
Interview avec le Chef de Service Régional de Forêts, les Chefs Cantonnement et la Brigade Feux

15 Janvier 2009: Table Ronde Mahajanga

Horaire	Sujets	Activités
08h00 à 10h00	Superficies incendiées ces derniers temps Cause des feux Actions antérieures Structures existantes	Présentation par DREFT Discussion
10h20 à 12h30	Présentation de méthodologie	Présentation par les consultants nationaux Discussion
14h30 à 17h00	Présentation et partage d'expérience	Travaux de réflexion dirigés par l'Expert international

Participants:

- Région: 2 représentants
- DREFT: 12 personnes dont DREFT, SRF, SRE, SRIC, 6 Chefs Cantonnement et 2 représentants de la Brigade feux
- Autres STD: 4 personnes à savoir le Tribunal, la Police, la Gendarmerie et les Militaires)
- PGM-E:
    - Equipe stratégique
    - Equipe thématique
    - Secrétariat, logistique et traduction
    - Futur Stagiaire sur le feu et son encadreur
- CTD: Chefs District

16 Janvier 2009

Visite Besely (village victime de feux, à 25 km de Mahajanga, sur RN4)

- Discussion avec les paysans

Visite Ankivonjy (village ayant une VOI de reboisement)

- Discussion avec les membres de la VOI

19 Janvier 2009: Table Ronde, Ministère, Tanà

Horaire	Sujets	Présentateur
09h00 à 10h00	Superficies incendiées ces 10 dernières années Cause des feux Actions antérieures Structures existantes et moyens de lutte existants (ex: suivi satellitaire des feux) Vision et perspective de la DREFT/Région sur la gestion des feux	DVRN / SRLFB
10h20 à 12h30	Accompagnement à l'analyse de la stratégie à adopter – Partage d'expériences	Expert international

Participants

- DVRN
- PGM-E
- CI
- JARIALA
- Consultants nationaux