6 MANAGEMENT TOOLS

Three essential tools have been identified to manage correctly the GRG and to preserve its biodiversity: 1) Zoning Plan (ZP), 2) Community-based Management (CBM), 3) Fire Management (FM), and 4) the GRG staff.

6.1 Zoning Plan

The Zoning Plan has been identified as the main tool to: a) minimize conflicts between humans and wildlife both inside and in the neighbouring of the GRG; b) preserve the biodiversity according to the *Core-Zone* a total protection regime and direct to it special efforts for management and patrol.

The zoning scheme is the primary management tool of multiple-use of the GRG and intend to: assure the vital requirement of local populations living in the boundary areas and avoid severe and unsustainable anthropogenic disturbances on the GRG environment. Specific aims of the ZP are:

1. Protect totally certain areas recognized as critical for large mammals distribution and movements
2. Protect the diversity and quality experiences available for visitors to the GRG
3. Recognise traditional/community extracting areas, providing resources for continued but controlled use
4. Provide a effective tool to avoid the arising of logging concession in the neighbouring of the GRG
5. Provide a geographic support to better evaluate the resource extraction and to monitor and review the efficiency of the present Management Plan
6. Provide a framework to focus controlling and patrolling activities to specific zone with higher level of protection

The present Zoning Plan suggests the subdivision of the GRG area in two zones with different protection regime: *Core Zone* and *Regulated-use Zones*; whereas recommends the creation of a *Buffer Zone*, adjoining the GRG. Within the proposed *Buffer Zone*, an area, which experiences the equal regime of protection and resource-use, has been identified for potential development for specified activities game ranching and professional hunting.

The Core Zone

The *Core Zone* provides the highest level of protection within the GRG. It is intended to include the area of the GRG that warrants primary conservation status and that local users could exploit

only for important and well-defined bioresources. The following criteria for the designation of the *Core Zone* have been used:

1. Areas that are in relative intact conditions and that are also representative of the main types on natural habitats found within the GRG;
2. Areas containing important levels of locally representative biodiversity;
3. Areas considered important as movement and use range for the meso- and mega-mammals;
4. Areas considered essential for the survival of locally rare or threatened species.

Within the *Core Zone* all bioresources, non-biological resources and ecosystem processes are protected by direct and unsustainable men-induced disturbances, while several non-disruptive extraction activities, as well other operations, are allowed. In Table 6.1 are summarised the permitted and non-permitted activities within the *Core Zone*.

Table 6.1 Permitted Activities and Not-Permitted Activities within the GRG *Core Zone*.

Activities	**Permitted**	**Not-Permitted**
Community exploitation of Timber	X	
Community exploitation of NTFPs		
Mushrooms	X	
Wild fruits, Plants and Grasses	X	
Roots and Tubers	X	
Honey		X
Insects and other Invertebrates	X	
Reptiles and Amphibians		X
Subsistence Hunting		
Hunting with traditional traps		X
Hunting with gin traps and fall traps		X
Professional Hunting		X
Subsistence Fishing	X	
Use of Fire		X
Commercial Exploitation of Timber		X
Mining		X
Agriculture Activities		X
Controlled Tourism	X	
Scientific Research	X	

The proposed *Core Zone* is entirely within the GRG and comprised within by the following limits:

1. The Gilé-Pebane district border from the intersection with the western border of the GRG (16º 52' S – 38º 08' E) to the intersection with the eastern border of the GRG (16º 34' S – 38º 50' E);

2. The eastern border of the GRG from the intersection with the eastern border of the GRG to the Musseia camp (16º 42' S – 38º 47' E);

3. The southern border of the GRG from the Musseia camp to the intersection with the Malema River (16º 77' S – 38º 47' E);

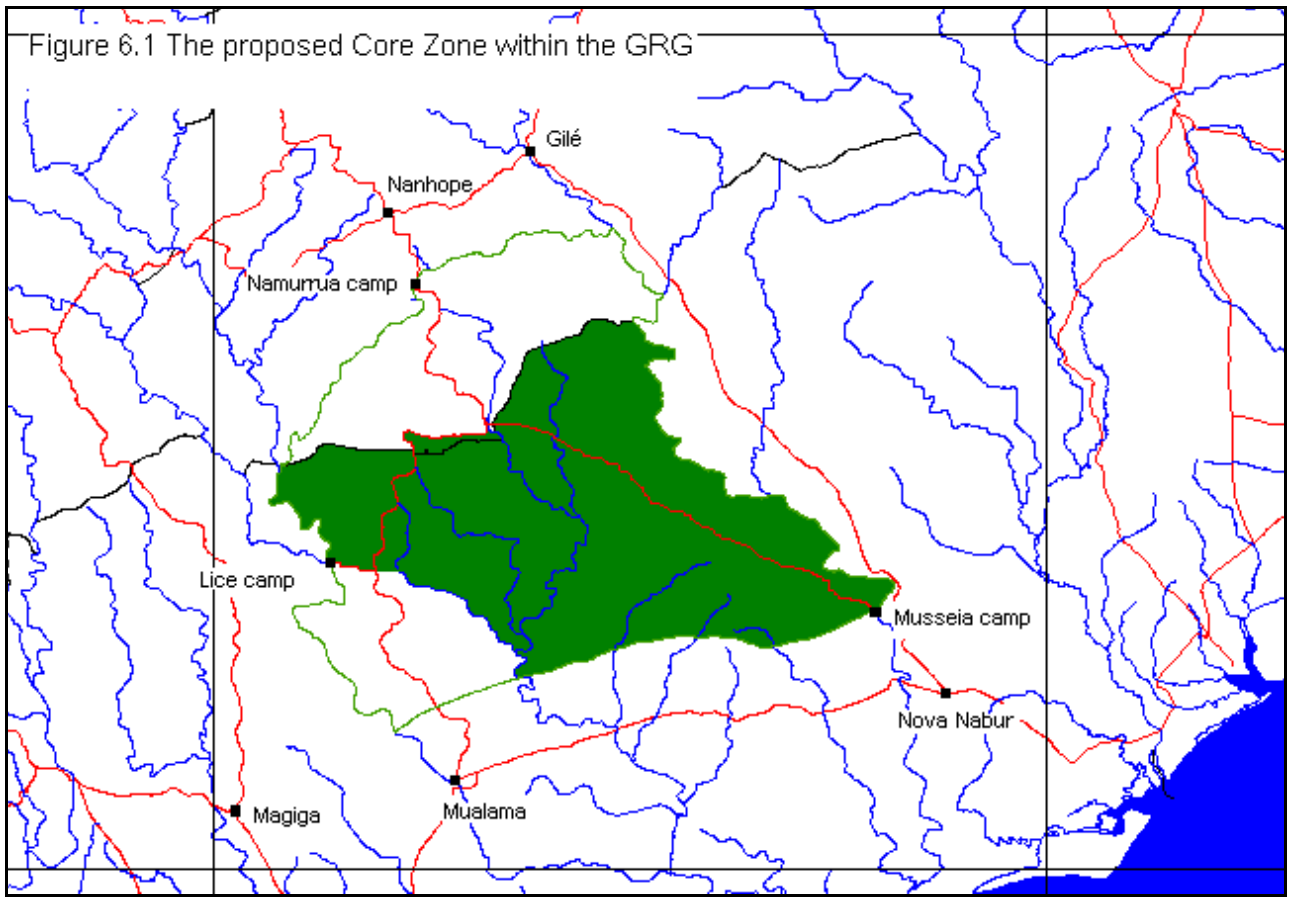
4. The Malema River from the intersection with southern border of the GRG to the confluence of the Muipige River (16º 74' S – 38º 36' E);

5. The Muipige River from the convergence to the Malema River to the proposed path to the Lice camp (16º 38' S – 38º 08' E);

6. The road connecting the Muipige River to the Lice camp;

7. The western border of the GRG from the Lice camp to the initial point.

The location of the proposed *Core Zone* is illustrated in Figure 6.1.



The *Regulated-use Zones*

The *Regulated-use Zones* provides intermediate levels of protection within the GRG. They are intended to include areas that are important for conservation but also important to local resource-users. The following criteria for the designation of the *Regulated-use Zones* have been used:

1. Their value in sustaining the livelihoods of local communities, which makes improper to avoid entirely the extraction of several bioresources;
2. Even representing areas of conservation concern, they have lesser degree of importance than the *Core Zone*.

The design of a conservation network that will incorporate both source (core) areas that receives total protection and from which natural resources continue "over flow" into sink areas (use zones) from which communities may use resources appears the correct strategy to manage the exploitation of bioresources. The policy in *Regulated-use Zones* is to prohibit activities likely to threat the biodiversity in the GRG, while allowing several extraction activities considered having an extreme importance for the subsistence of local populations, but a lower impact on the environment. The main scope of these zones is to allow hunting activities conducted with certain non-disruptive techniques. However, subsistence hunting, as underlined in Section 5.0, is to be considered permitted only during the period January/July.

Two *Regulated-use Zones* have been identified to assure access to wild resources for most of the neighbouring communities: 1) the *Regulated-use Zone* in the north sector, which comprises most of the northern sector of the GRG, could supply the populations living around the localities of Namurrua, Gilé, Nanhope and Etaga; 2) the *Regulated-use Zone* in the southern sector, which comprises a large part of the south-western sector of the GRG, could supply the populations living around the localities of Mualama and Malema.

Within the *Regulated-use Zones* several non-disruptive extraction activities, as well other operations, are allowed. In Table 6.2 are summarised the permitted and non-permitted activities within the *Regulated-use Zones*.

Table 6.2 Permitted Activities and Not-Permitted Activities within the GRG *Regulated-use Zones*.

Activities	**Permitted**	**Not-Permitted**
Community exploitation of Timber	X	
Community exploitation of NTFPs		
Mushrooms	X	
Wild fruits, Plants and Grasses	X	
Roots and Tubers	X	
Honey		X
Insects and other Invertebrates	X	
Reptiles and Amphibians		X
Subsistence Hunting		
Hunting with traditional traps	X	
Hunting with gin traps and fall traps		X
Professional Hunting		X
Subsistence Fishing	X	
Use of Fire		X
Commercial Exploitation of Timber		X
Mining		X
Agriculture Activities		X
Controlled Tourism	X	
Scientific Research	X	

The two proposed *Regulated-use Zone* are entirely within the GRG and comprised within by the following limits:

Regulated-use Zone (northern sector)

1. The border of the GRG from its western intersection with the Gilé-Pebane district border to its eastern intersection with the Gilé-Pebane district border;

2. The Gilé-Pebane district border from the intersection with the western border of the GRG to the intersection with the eastern border of the GRG.

Regulated-use Zone (southern sector)

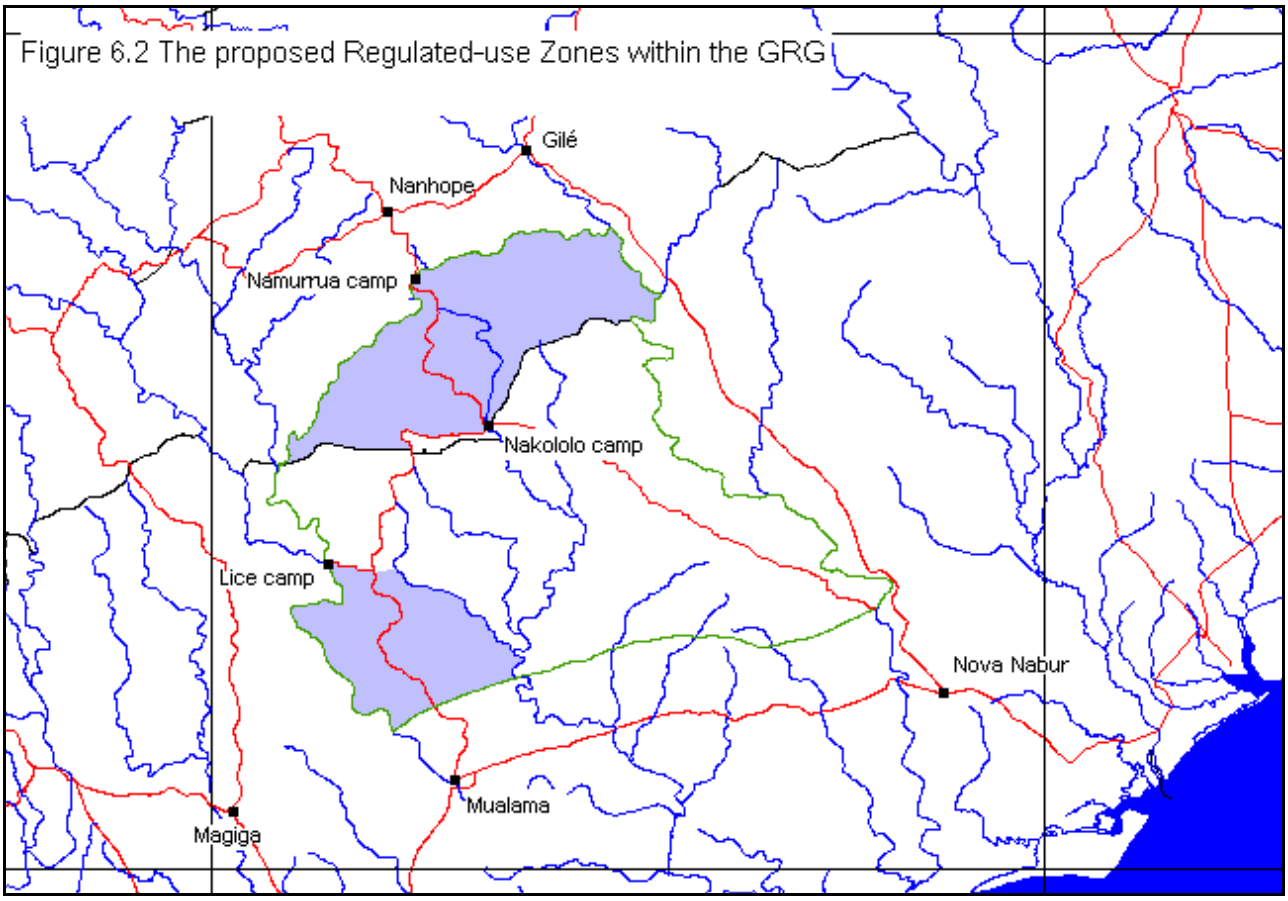
1. The road connecting the Lice camp and the Muipige River;

2. The Muipige River to the confluence to the Malema River and the Malema River to the southern border of the GRG;

3. The southern border of the GRG from the intersection with the Malema River to the intersection with the Mulela River (16º 84’ S – 38º 22’ E);

4. The western border of the GRG from the intersection with the Mulela River to the Lice camp.

The location of the proposed *Regulated-use Zones* is illustrated in Figure 6.2.



The *Buffer Zone*

The Forestry and Wildlife Act Nº 10 provides, within the Comma 3 of the Article 10, the base for the establishment of a buffer zone around the GRG.

In 1960 a buffer zone of approximately 1,800 km^2 was established all along the northern border of the GRG and was intended to protect and better manage several forested areas formerly occurring north of the reserve. Presently, such areas are largely deforested and settled and used for agriculture purposes by local populations. Given that and because the necessity to regulate some human activities all around the GRG, the establishment of a new buffer zone is proposed.

The proposed *Buffer Zone* is an area outside and adjacent the GRG intended to serve as cushion against the impact of anthropogenic activities to guarantee a functional ecosystem *in continuum* with the one of the protected area. Within the *Buffer Zone* several non-disruptive extraction activities, as well other operations, are allowed, including subsistence hunting activities during all the year, but without using unsustainable techniques. Within the *Buffer Zone* an area of potential development for cynegetic and ranching activities has been identified: the *Developing-use Zone*. As component of the *Buffer Zone*, the *Developing-use Zone* has the same protection regime.

In Table 6.3 are summarised the permitted and non-permitted activities within the *Buffer Zone*.

Table 6.3 Permitted Activities and Not-Permitted Activities within the GRG *Buffer Zone*.

Activities	Permitted	Not-Permitted
Community exploitation of Timber	X	
Community exploitation of NTFPs		
Mushrooms	X	
Wild fruits, Plants and Grasses	X	
Roots and Tubers	X	
Honey	X	
Insects and other Invertebrates	X	
Reptiles and Amphibians		X
Subsistence Hunting		
Hunting with traditional traps	X	
Hunting with gin traps and fall traps		X
Professional Hunting	X	
Subsistence Fishing	X	
Use of Fire for fields cleaning	X	
Commercial Exploitation of Timber		X
Mining		X
Agriculture Activities	X	
Controlled Tourism	X	
Scientific Research	X	

The proposed *Buffer Zone* is entirely around the GRG and comprised within the following limits:

1. An administrative line of around 37 km from the town of Gilé (Vertex 1) to the source of the Merrequela River (Vertex 2) (16º 18' S – 38º 61' E);

2. An administrative line of around 54 km from the Vertex 2 to the source of the Napaué River (Vertex 3) (16º 52' – 38º 81' E);

3. An administrative line of around 30 km from the Vertex 3 to the town of Nova Nabur (Vertex 4);

4. The stretch of the road that connects the town of Nova Nabur and the administrative post of Mualama (Vertex 5);

5. An administrative line of around 30 km from the administrative post of Mualama and the administrative post of Magiga (Vertex 6),

6. The stretch of the road that connects the administrative post of Magiga and the locality of Morrua from the administrative post of Magiga to the intersection with the Gilé-Pebane district border (Vertex 7) (16º 52' S – 37º 90' E);

7. The Gilé-Pebane district border from the Vertex 7 to the intersection with the Mulela River (Vertex 8) (16º 40' S – 38º 05' E);

8. An administrative line of around 12 km from the Vertex 8 to the confluence of the Lice River with the Naxere River (Vertex 9) (16º 39' S – 38º 04' E);

9. Part of the Naxere River from the confluence into the Lice River to the intersection with the road that connect the towns of Gilé and Mulevala (Vertex 10) (16º 25' S – 38º 13' E);

10. The stretch of the road that connect the towns of Gilé and Mulevala from the Vertex 10 to the town of Gilé.

The identified *Developing-use Zone* is comprised between Vertexes 5, 6, 7, 8, 9 and the intersection of the Lice River with the western border of the GRG (16º 52' S – 38º 08' E).

The location of the proposed *Buffer Zone* is illustrated in Figure 6.3. A general overview of the zoning scheme proposed for the GRG is reported in Figure 6.4, while summarize of the permitted and non-permitted activities within each zone is reported in Table 6.3.

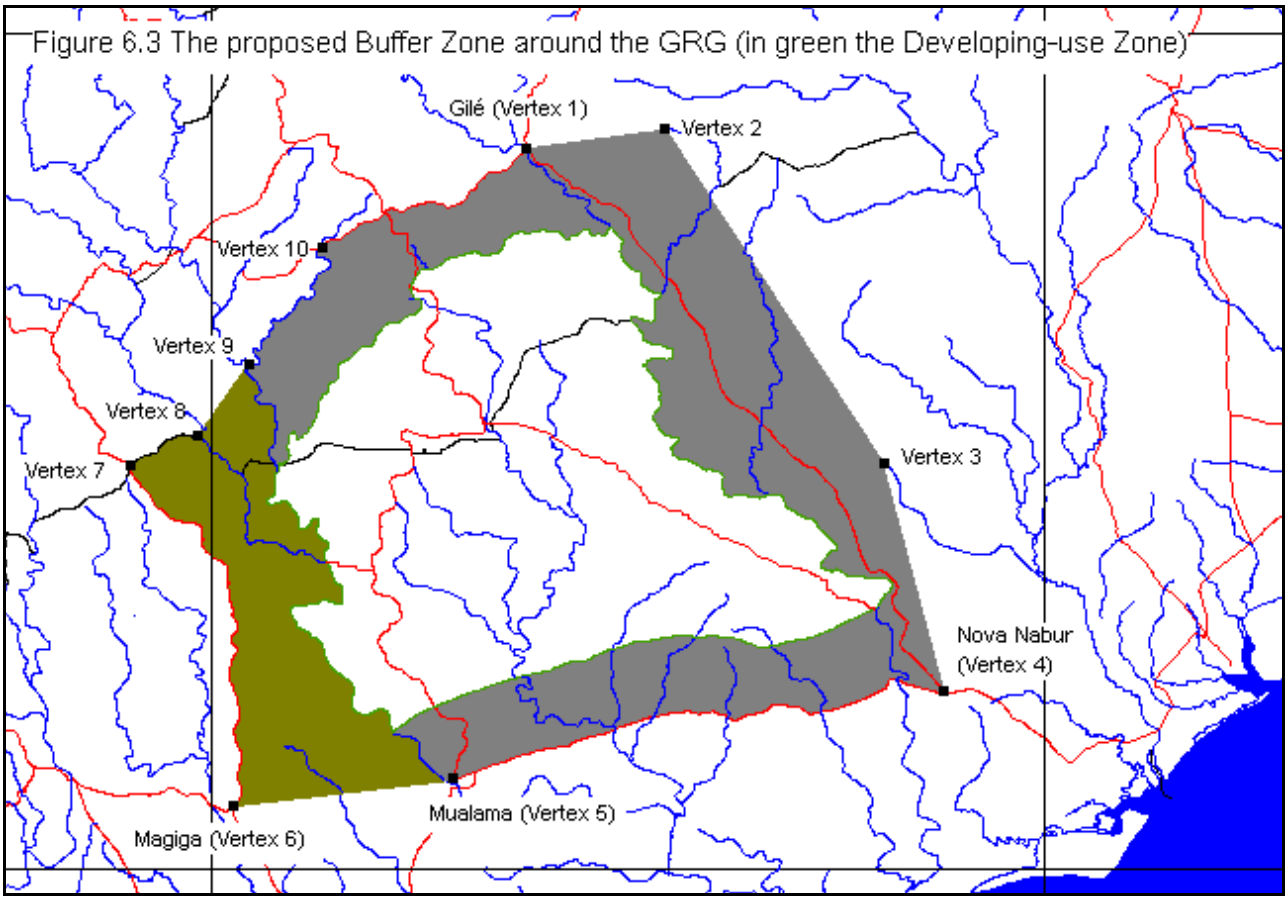


Figure 6.3 The proposed Buffer Zone around the GRG (in green the Developing-use Zone)

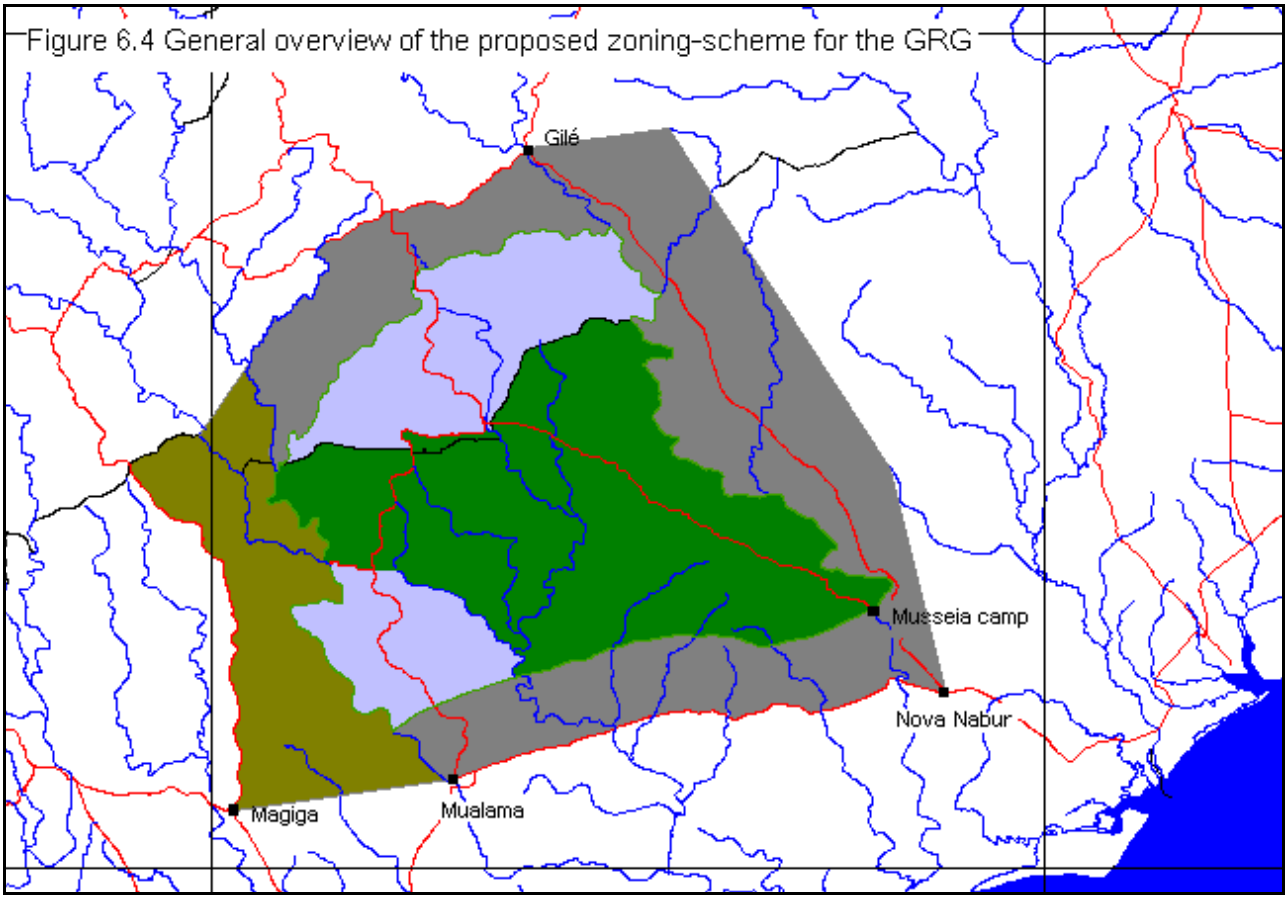


Figure 6.4 General overview of the proposed zoning-scheme for the GRG

Table 6.3 Summarize of the Permitted Activities (√) and Not-Permitted Activities (#) within the management zones of the GRG.

Activities	***Core Zone***	***Regulated-use Zones***	***Buffer Zone***
Community exploitation of Timber	√	√	√
Community exploitation of NTFPs			
Mushrooms	√	√	√
Wild fruits, Plants and Grasses	√	√	√
Roots and Tubers	√		
Honey	#	#	#
Insects and other Invertebrates	√	√	√
Reptiles and Amphibians	#	#	#
Subsistence Hunting			
Hunting with traditional traps	#	√	√
Hunting with gin traps and fall traps	#	#	#
Professional Hunting	#	#	√
Subsistence Fishing	√	√	√
Use of Fire	#	#	√ (field cleaning)
Commercial Exploitation of Timber	#	#	#
Mining	#	#	#
Agriculture Activities	#	#	√
Controlled Tourism	√	√	√
Scientific Research	√	√	√

6.2 Community-based Management

Bioresources conservation through mere preservation appears as not feasible in the case of the GRG. The *preservationist* approach for nature conservation, intended as people and their activities being "fenced" out of protected areas, essentially requires: a) very low population density inside and/or outside the protected area and low human dependence on wild resources; and/or b) very strong institutional capacity to control and manage the protected area avoiding or minimizing any kind of men-induced disturbance. Both the institutional management capacity and the socio-economic situation in the target area have not such essential requirements. Given that, a Community-based Management (CbM) profiled on the active participation of local communities on the management of the GRG, in strict collaboration with the governmental authorities, seems to be the correct strategy.

The Forestry and Wildlife Act provide the legal basis to the community participation in the management of natural resources. The Article 31 in the Comma 1 foresees the creation of "*local resources management councils constituted by the representatives of the local communities, the private sector, associations and local State authorities with the aim of protecting conserving and the promotion of sustainable use of forest and fauna resources*", whereas, in the Comma 3 provide the basis for the community exploitation of resources: "*The management shall assure the participation of the local communities in the exploitation of forest and fauna resources and in the benefit resulting from such use*".

The New Land Law recognises the rights of local populations to own their own land and attempts to privatise this resource so as to facilitate its market trading. A nation wide campaign aimed at increasing the awareness of the population about this new law and several NGOs provided advice to rural communities. However, the new law has had little effect on local livelihoods for two main reasons. First, the Government institutions that should speed up the legalisation process lack the capacity to undertake this task; the result has been that only wealthy farmers have been able to legalise their claims. Second, the new land law refers mainly to the traditional rights to arable land rather than to common property or open access resources such as forests, which are still considered Government property.

In the past, the conservation policies applied have affected access to resources. The conservation strategy pursued in the GRG was one of total prohibition of exploitation of resources. Local hunters were perceived as poachers by Government rangers. Such a policy was impossible to implement due to the limited availability of funds allocated; human resources were limited to four rangers based in Gilé-sede with no means to effectively patrol the protected area. This strategy led to intense confrontations with local dwellers that complained that monitoring activities were often carried out outside the GRG. Furthermore, rangers were accused about physical punishments, extortion of food in village visits and even of hunting with firearms within the GRG for their own benefit or while being hired by professional hunters.

Local inhabitants also have very limited knowledge about the protected status of the GRG since they have not received information from the relevant institutions. The main consequence has been that what before could be considered a common property resource has over the years become an open access resource, were none of the stakeholders has an incentive for a sustainable use, since the “owner” of the resource (i.e. the State, does not have the capacity to implement its conservation policies).

6.2.1 Objectives of the Community-based Management

The philosophy behind community conservation initiatives is that the dual objective of conservation and improvement of rural livelihoods can be achieved simultaneously and that in fact they reinforce each other. However, experience suggests that performance of such programmes have been mixed (Barrett & Arcese, 1995; Emerton, 1999; Songorwa, 1999; Hulme & Murphree, 2001; van Aarde, 2002).

In the case of the GRG, the Community-based Management should provided: 1) property rights, on the basis provided by the actual legislation, for the utilization and extraction of natural resources by dwelling people; 2) effective and active participation of local communities in the management of the GRG and its boundary areas; 3) incentives mechanism to induce changes in the actual destructive behaviour of local population.

6.2.1.1 Property Rights

Prior to the definition of the GRG, local communities had access to all the forests in their neighborhood. Traditional systems of forest preservation and land tenure were followed and the forest was an integral part of their culture and livelihoods. Following the hunting restrictions imposed by the colonial Government, communities lost their traditional rights of access to vital resources. However, the colonial Government defined other non-protected areas (a kind of buffer zone) where local inhabitants could continue exploiting natural resources. Those communal areas were lost when land tenure pass to the State afterward the independence. This rapid change in tenure rights has created conflict and probably eroded the traditional restrictions imposed on

natural resource exploitation. As a local resident pointed out "*the forest stopped being ours and became theirs*".

Although it would be naïve to believe that the livelihood strategies pursued by local communities would have been forever sustainable (especially in the case of actual fast population growth), it is also obvious that restrictive conservation policies have eroded the common property rights that previously restricted the use of forest reserves and has led communities to intensify the exploitation of resources that are not considered anymore as "*theirs*".

A policy that would directly improve relations between GRG authorities and local communities would be the devolution of certain access rights over certain forests. In the present Management Plan, a buffer zone is defined where local dwellers should be allowed to exploit at least some resources. In order to make them use the resource more sustainable it would be necessary to restrict access by outsiders and probably make them responsible for some monitoring activities. Furthermore, two areas within the GRG are proposed as use-zones within local communities are allowed to extract some resources using certain techniques. A policy that should legalise the access of local communities within the use-zones is required on the basis of the Article 12, Comma 3.

The New Land Law establishes that traditional property rights are accepted but it also promotes the formal legalisation of land by small holders so as to avoid future conflicts for access over this crucial resource. Unfortunately, the land law is relatively vague with respect to the traditional rights of communities over non-cultivated land. The Law of Wildlife and Forestry does not produce any further clarity.

One of the key components of a community conservation programme should be support for the definition of community property rights over neighbouring forested areas. Currently, timber concessions are being delivered to external individuals and companies without prior consultation with affected communities (despite the law stating that communities need to be previously contacted). Establishing community property rights in a similar manner as the way constituencies developed in Namibia would guarantee that communities benefit from their forests. If they decided to do so they could rent their communal area to game farming or companies involved in sustainable timber extraction. This would ensure that communities benefit from these developments and therefore reduce the pressure over the exploitation of GRG resources.

6.2.1.2 Participation of local communities

Active participation of local communities should be assured by the creation of local management councils. Such councils should be composed by: the administrator of the GRG, the local governmental authorities (district administrations, district bureaus of agriculture and tourism and administrative secretaries), the traditional authorities, and representatives of local communities. The presence of private investors within such management authority should be included when required.

With the creation of these councils the participation of local entities in the day-by-day management should be guaranteed through their influence in the taking-decision process. The local communities should be able to give their support regarding several issues, such as the level of exploitation of bioresources and the allocation of land for commercial activities to third parts. The creation of such management structure and their immediate involvement in the management of the GRG is explicitly recommended.

6.2.1.3 Incentive mechanisms

Incentive mechanisms are inducements that attempt to change previous destructive behaviour at global, national, and local levels. In this section we concentrate in incentive measures designed to alter community exploitation of natural resources. By economic incentives we refer both to those measures that will provide financial rewards and to those mechanisms that will change the institutional framework that has perverse effects on nature conservation.

The aim of these incentive measures is to provide additional livelihood support for impoverished communities that are forced to unsustainable exploit natural resources or to engage in natural resource exploitation in protected areas in order to meet their survival needs. These measures are usually divided in two groups: 1) direct incentive measures (they aim at improving the efficiency of natural resource exploitation in order to increase the sustainability of the activity), 2) indirect incentive measures (their objective is to diversify the range of livelihood choices available to local populations so that they become less dependent on the exploitation of wild resources).

Direct Incentives

Most of local residents reported a decline in the availability of some resources which seems to imply an unsustainable use of those resources. However, it is important to bear in mind that most comparisons refer to the period previous to the civil conflict and that trends over the last decade are more difficult to quantify.

The commrecialisation of wild products only occurs at the village level and involves relatively low quantities of the most demanded resource: game meat. World demand for all sorts of wild products has increased in recent years and an appropriate intervention would be to identify high value added niche markets for some of the resources that are widely available.

Direct incentive measures should focus on two issues: 1) providing mechanisms that ensure a more sustainable use of certain resources and 2) identifying high value added markets for the commercialisation of certain wild products widely available in neighbouring forests and in some cases inside the GRG. The following are examples of some of the activities that could be implemented. It would be necessary to acquire the services of specialised agancies that are involved in the commercialisation of wild products so as to identify other potential sources of income.

Honey

The consumption of honey in the target area is very limited at less than 3 litres per household per year despite being a very appreciated food item. Honey is mainly exploited within the NRG. The main reason for the low levels of honey collected is that the technique used for collecting it destroys hives and leads to substantial loses.

Honey production could be easily increased through the construction of artificial hives with barks of local trees. The main advantage of this technology is that it does not require significant investments other than training. This simple activity could have multiple positive effects on local livelihoods and community conservation. First, it would avoid cutting trees for collecting honey. Secondly, it would increase dietary intakes of local families. Finally, it can be used as a “carrot” to ensure community support for conservation activities.

The CbM could also introduce modern hives[15] if the initial program of bark hives is successful. Modern hives require more skills and investment than traditional ones but they can produce much larger quantities and the quality tends to be more homogeneous.

There are also three markets for the commercialization of processed or semi-processed products: 1) local, 2) national and 3) external.

Locally there is strong demand for honey in the local area. Although it would not attract high prices it has the advantage that it does not require information about external markets and that the quality requirements are much lower.

At national level most of the honey commercialised in the regional urban centres comes from South Africa. Therefore, there is a readily available market for this product. However, the product would require certain quality standards that need significant investment in processing, packaging and commercialisation training. It is better to undertake this activity collectively basing it in the existing producers' associations.

There is a niche market at external level for honey in fair trade systems that would attract high prices. However, it is important to explore and be successful in the other national markets before attempting to reach external markets as the knowledge of the product increases over time.

Mushrooms

Mushrooms are widely consumed by the local populations who also engage in simple processing techniques for storing purposes. There is no significant evidence that availability of mushrooms is declining except in those areas that are suffering from significant land clearing for agricultural purposes.

The only mushrooms available in local shops in the whole of Northern Mozambique are preserved canned mushrooms coming from South Africa and Portugal. This technology does not preserve the taste and texture characteristics of the original product and therefore are not very appreciated. However, the market would be substantially larger if this product was preserved using other techniques. There are two techniques that could be used to preserve wild mushrooms by local populations: 1) drying is a particularly good technique for preserving wild mushrooms since they have a stronger taste than cultivated mushrooms and therefore can be added more as a "condiment" rather than as a main product; 2) oil conservation is also suitable despite being more costly. Packaging is also more complicated.

It would be necessary to investigate the characteristics of all the varieties that are available in order to determine which have the strongest market potential. Wild mushrooms also attract high prices in external markets, thus it may be interesting to investigate the possibility of commercialising dried wild mushrooms through fair trade structures that are starting to operate in Nampula and Cabo Delgado Provinces.

Silk

Local populations consider imperial moth caterpillars as a delicious food item. However, recent research in Namibia has shown that there is a large demand for wild silk products. Although the species that have been identified, *Gonometa postica,* is not present in the GRG, the other species of imperial moth caterpillars may have a potential market for silk cocoons.

[15] The PRPGRG has already started such programmes in several localities outskirt the GRG.

There is also the possibility of establishing the production of natural “domesticated” silk since there is large demand for this product and rearing of caterpillars is facilitated by a forest environment. Specialised technical assistance should be sought for establishing the viability of these activities.

Medical plants

We discussed in chapter 3 the economic value that pharmaceutical companies could attach to biodiversity preservation for future genetic prospecting. However, there is a parallel market for unprocessed medicine plants that are the basis for homeopathy treatments. This market should also be further explored.

The above are just examples of different wild resources that have strong demand in regional and external markets. The list is far from being complete since there are also opportunities for other products such as wild fruits. It is necessary to seek specialised services to assist in the identification of the main markets and definition of production and marketing strategies. The existence of producers associations could facilitate the commercialisation of these products since they already some capacity to undertake collective activities that reduce transaction costs and facilitate information dissemination.

Tourism

Developing an appropriate and conscientious eco-tourism in the area would be benefit directly the local communities especially considering the possibility to develop a cultural tourism interested in visiting remote rural communities to discover their natural living style and appreciate their fascinating ethnology and traditional knowledge. The opportunity of tourism development has been already underlined in the Section 3.6.

Indirect Incentive Mechanisms

Indirect incentive interventions aim at creating alternative livelihood strategies that reduce dependence on GRG resources. There are several interventions that can be accomplished in the agricultural sector that would increase subsistence and monetary incomes for a large proportion of households.

All the target area was negatively affected by declining cashew yields in the past decade that substantially reduce agricultural monetary incomes. While it is necessary to improve cashew yields, the technologies promoted at the national level for combating Powdery Mildew are still not very appropriate for smallholders. It is necessary to promote production of alternative crops with strong regional demand (e.g. sesame, groundnuts, maize, cotton, etc.) so as to enlarge the monetary base of local agriculture.

Efforts should also be channelled at improving market prospects for agricultural production in order to reduce the dependency of rural households on wild resources. Most households in the area identify lack of market prospects and/or low prices for agricultural crops as the main constraint to increased agricultural income. The simplest way of improving market prospects is to facilitate links between traders and producers. The current programme of supporting the development of producers’ associations should receive additional support until most emerging groups can act independently in the commercialisation process.

Although it is important to increase agricultural production, care should be taken at identifying the best implementation strategy. Agricultural production and exploitation of wildlife resources represent competitive uses of land by rural populations. Although population densities in the two districts are relatively low (16 inhabitants/km^2) and forests are still widely distributed throughout the district, reported declines on wild resource availability indicate that land conversion to

agriculture may be already reducing the availability of these resources. Given the high levels of population growth (>3% annually), this pressure is likely to increase in the near future. Since wild resources will continue to be a major element of rural livelihoods, four types of strategies should be pursued to reduce the pressure exercised by agriculture on forestlands:

1) More emphasis should be placed on disseminating simple technologies to reduce post-harvest loses. Better storage technologies will have two immediate effects on forest resource utilisation;

2) Decline in the agricultural area necessary to achieve the same level of *effective* crop production. Reduction of the period of food shortages, thereby reducing dependency on NTFPs;

3) Agricultural extension messages should be focused on achieving increased production levels by augmenting yields per hectare rather than through increased use of land. This does not imply that no more forestlands should be cleared for agriculture, but that this extensification of agriculture should take place after achieving higher yields in the existing cultivated area. Ticker et al. (2001) highlight that the use of simple improved cropping practices, such as timely sowing and weeding, correct plant spacing and suitable inter-cropping can increase yields by over 35% in Northern Mozambique. Improved practices are likely to have more benefits for rural households than intensification of agriculture through the use of expensive chemical inputs;

4) Rural extension should disseminate messages on potential use of land under agro-forestry systems, which can preserve a proportion of the wild resources extracted while maintaining soil fertility.

Other Incentive Mechanisms

The previous two sections discussed the strategies to be pursued in order to directly increase income-earning opportunities of local populations. Some authors have argued that the main reasons for the poor performance of conservation programmes in Southern and Eastern Africa is that they did not directly aimed at increasing local incomes and they only provided benefits in the form of improved access to social services (Barrett & Arcese, 1995; Emerton, 1999). Though it is true that livelihood alternatives need to be devised for communities to reduce their unsustainable use of wild resources, it would be wrong to conclude that provision of social services does not contribute to nature conservation. Most studies show that delivery of basic services such as construction/rehabilitation of schools, health posts and water sources are the most important element in changing local attitudes towards conservation of protected areas (Hulme & Infield, 2001; Adams & Infield, 2001).

Improvement of social infrastructure would be particularly beneficial in the case of the GRG, where some communities were evicted from inside its borders less than two generations ago and were the level of conflict with park authorities has always been really intense. It would be a first measure to show that the benefits of conservation will also be shared with local communities and that they will be compensated for their lack of access to resources. Moreover, there is a strong base for prioritising access to basic social for communities neighbouring the GRG since they are amongst the most destitute in both Gilé and Pebane districts.

There are three critical sectors that require investment to improve human development in the target area: education, health and water. Improvements in access or in quality would directly lead to a relaxation of the tension between park authorities and local communities. Interventions in the education sector should be focused on reducing the pupil/teacher ratio by increasing the number of classrooms available and upgrading schools from local to noble materials. The choice over which intervention to undertake in the water sector, i.e. installation of water pumps over opening of wells) should be based on the capacity of the community to guarantee maintenance of equipment and on availability of spare parts locally. Although construction of health posts would be ranked

first by a majority of communities should only be undertaken after the Government allocates the relevant personnel. These interventions should be explained to the local community as one of the benefits that they might gain from helping to preserve the GRG.

6.3 Fire Management

Controlled burning is a necessary and desirable management practice to apply in the GRG. Two main reason are given to burn:

1) To maintain the vegetation in its current productive and ecologically desirable condition, including maintain the grass sward in a vigorous and palatable condition for grazing animals. The necessity for burning for this reason is given by the chemical composition of five of the most abundant and dominant grass species growing in the GRG sampled at the beginning of the dry season in a fully mature and moribund condition;

2) A correct fire management application could prevent the application of wildfires by local population by preventing the accumulation of high flammable biomass.

It is recommended that a controlled burning program be implemented in the form of an Integrated Fire Management System (IFMS). This will comprise applying point ignited patch burns based on the condition of the grass sward. The selection of areas to be burnt will be according to the grass fuel load as estimated with a Disc Pasture Meter (DPM)[16]. The criterion will be that areas with greater than 4,000 kg/ha will be selected for burning because at such fuel loads the grass sward will be in a moribund, unpalatable and non-nutritious condition (Trollope, 1989). Experience in southern Africa has shown that this should be combined with a criterion related to the compositional status of the grass sward where only areas dominated by Decreaser and/or Increaser I species should be considered for burning (Trollope, 1989). However in the NRG it was found that the grass sward in all vegetation communities fulfilled this requirement, therefore it is not necessary to use this criterion for selecting areas to be burnt.

The fire regime, comprising the type and intensity of fires and the season and frequency of burning, that is recommended for maintaining the vegetation in its current condition is:

1) Type of Fires

It is recommended that the controlled burns be applied as point ignitions in order to allow the development and occurrence of head and back surface fires. This will ensure a mosaic of effects on the grass and woody vegetation thereby promoting species and structural diversity in the vegetation and the recruitment of replacement trees into the canopy of the tree and shrub communities.

2) Fire Intensity

Fire intensity refers to the rate at which heat energy is released during a fire (kJ/s/m - kilojoules per second per metre of fire front). Four types of fires are recognized according to the energy released:

Fire Intensity (kJ/s/m)	Types of fire

[16] The DPM has been successfully tested during 2002 in the GRG and ten of these instruments have been provided to the GRG staff by the PRPGRG.

<500	Very cool
501 - 1000	Cool
1001 - 2000	Moderately hot
2001 - 3000	Hot
>3000	Extremely hot

It is recommended that cool fires (<1000 kJ/s/m) be applied in the GRG to maintain the current botanical composition and structure of the tree and shrub vegetation. The application of cool fires will minimize the impact of burning on the large trees but still maintain a significant proportion of the number of trees in the <2m "fire trap" height class. This is necessary for both aesthetic reasons and the provision of forage for browsing animals at an available height. The current physiognomy of the tree and shrub communities comprising imposing stands of large mature trees with a grassy understorey is highly attractive from an ecotourism point of view and needs to be maintained. Maintaining a significant proportion of the trees in the <1m height class is essential to provide available forage for browsing animals. Cool fires can be achieved by burning when the relative humidity is >40% during the early dry season (July/August) when the grass is still partially green. During the latter part of the dry season (September/ October) cool fires should be applied by burning when the relative humidity is >60%. This can be achieved by burning at the following times of the day:

1) Early dry season fires (July/ August) – apply cool fires by burning from 12h00 onwards during the day. These fires will extinguish themselves during the late afternoon and early evening with the rising relative humidity;

2) Late dry season fires (September/ October) – apply cool fires by burning from 16h00 onwards during the day. These fires will either extinguish themselves during the night with the rising relative humidity or if they burn during the night they will be low intensity fires because of the cooler conditions at night.

3) Season Of Burning

It is recommended that the burning season be extended over the entire dry season commencing in approximately July when the grass becomes dry enough to burn and ending with the commencement of the rainy season in November. As many fires as possible must be ignited during the early dry season in areas that qualify for controlled burning on the basis of the grass fuel load being >4000 kg/ha. The objective of this will be to break up the overall grass fuel load into a mosaic of burnt and unburnt areas that will in turn limit the spread of larger fires in the latter part of the dry season. An added reason for this ignition procedure will be to provide a series of newly burnt and recovering grass areas with highly nutritious re-growth that can provide a continuous flow of high quality grazing for the existing grazing animals in the GRG. It is intended that this strategy will provide an effective mechanism for increasing the population of large herbivores in the Reserve effectively providing for the nutritional requirements.

4) Frequency Of Burning

It is recommended that a variable frequency of burning be applied in the GGR as influenced by the rate of accumulation of grass material exceeding 4,000 kg/ha (i.e. moribund material). Based on the current standing crop of grass and the potential of the different plant communities to produce herbaceous plant material the Dambos and the Open Woodland communities will be the areas that will require the most burning because of their inherent ability to produce and accumulate more grass fuel rapidly. Therefore the focus of the controlled burning program will be largely on these two plant communities. Care, however must be taken not to neglect the ecological requirements of the Closed and Open Forest areas.

6.4 The GRG staff and Equipments

The day-by-day management and patrol of the GRG should be assured by the GRG staff, which is constituted by the GRG administrator and the GRG wardens. It is planned that one administrator and twelve wardens will compose the staff. While the administrator will be nominated by the Provincial Bureau of Tourism, the twelve wardens have been already identified and will be trained in the National Training Centre of the Gorongosa National Park. The training costs and the equipment for the wardens will be covered by the PRPGRG. Two of the identified wardens, with the secondary level of instruction, should be used as well as for administrative purposes, supporting the GRG administrator in the office matters. Presently, the presence of one account is not required.

The means of transport used during the implementation of the PRPGRG will be rehabilitated and used by the GRG staff; the following means of transport will be available:

- 2 Land Rover Defender 110 (4x4)
- 2 Motorbikes 125 cc.
- 1 Tractor (4x4)

Furthermore, the PRPGRG will provide 12 bikes for be used by the GRG wardens. The aforementioned means of transport should guarantee a correct management and patrol of the GRG and boundary areas.

To assure the correct running and development of the GRG, the PRPGRG is providing an array of materials and equipments:

- 1 generator for the main camp of Musseia
- 1 electric pump for the main camp of Musseia
- 1 radio system
- Furniture for the warden camps
- Furniture for the main camp of Musseia
- 1 PC and accessories
- 4 GPS
- 10 Camping tents
- Camping equipment, including sleeping bags, torches, backpacks, etc…
- 10 Disc Pasture Meter for reliving the grass biomass for the fire management

Will be obligation of the GRG staff to assure the correct maintenance and use of the aforementioned means of transport and materials.

The total cost for 5-years management and development of the GRG is estimated at 382,986 USD. Such cost includes the following items: a) salaries for the GRG-staff; b) training of personnel; c) rehabilitation and maintenance of infrastructures; d) means of transport; e) equipment; f) monitoring and research activities. Some 163,846 USD (43% of the estimated total) will be covered by the EU through the final implementation of the PRPGRG; such costs regard mainly rehabilitations, means of transport and equipments. The remains 219,140 USD (57% of the estimated total) will be covered directly by the Ministry of Tourism or through the founding of external donors and include the GRG-staff salaries, the maintenance of the rehabilitated infrastructures and the further monitoring and research activities required. The estimated costs per year for the period 2003-2007 are:

I year (2003)	204,974 USD
II year (2004)	55,642 USD
III year (2005)	44,128 USD
IV year (2006)	28,128 USD
V year (2007)	50,128 USD

The average annual cost to manage the GRG is estimated at 76,597.2 USD; excluding the contribution of the EU for the first year, the average annual cost to be covered by the Mozambique Government is estimated at 43,828 USD.

Considering the estimated costs for the five years period, the management cost per hectare is 1.8 USD, which means, just for instance, around 1/1,000 of the estimated value of preserving one hectare of woodland, like the GRG woodland, as carbon sink versus deforestation (see Chapter 3.3).

The estimated running and developing costs of the GRG for 5-years period (2003-2007) are summarized in Table 6.1.

Figure 6.1 Development Costs and Running Costs for the Game Reserve of Gilé (2003-2007)

		Units	Unit Price	Qty.	Total	I year	II year	III year	IV year	V year	Source
1	**PERSONNEL**										
1.1	**Salaries**										
1.1	Reserve Administrator	1	150	60	9,000	1,800	1,800	1,800	1,800	1,800	MITUR
1.2	Reserve Wardens (II level)	2	174	60	10,440	2,088	2,088	2,088	2,088	2,088	MITUR
1.3	Reserve Wardens (I level)	10	770	60	46,200	9,240	9,240	9,240	9,240	9,240	MITUR
1.4	Auxiliary Workers	1	10,000	lumpsum	10,000	2,000	2,000	2,000	2,000	2,000	MITUR
Total 1.1					**75,640**	**15,128**	**15,128**	**15,128**	**15,128**	**15,128**	
1.2	**Training**										
1.2.1	Training of 10 wardens	1	3,000	lumpsum	3,000	3,000	_	_	_	_	UE (PRPGRG)
1.2.2	Training of technicians of DPT	1	3,000	lumpsum	3,000	_	_	3,000	_	_	MITUR/External Donors
Total 1.2					**6,000**	**3,000**	_	**3,000**	_	_	
TOTAL 1					**81,640**	**18,128**	**15,128**	**18,128**	**15,128**	**15,128**	
2	**COST PRICE**										
2.1	**Infrastructures**										
2.1.1	Rehabilitation of the Etaga Camp	1	5,000	lumpsum	5,000	5,000	_	_	_	_	UE (PRPGRG)
2.1.2	Opening path from Lice crossroad to Muipige River	1	2,000	lumpsum	2,000	2,000	_	_	_	_	MITUR/External Donors
2.1.3	Opening path from the main road to Muipige River	1	3,500	lumpsum	3,500	_	3,500	_	_	_	MITUR/External Donors
2.1.4	Opening of firebreaks around the GRG *Core Zone*	2	7,000	2	14,000	7,000	7,000	_	_	_	MITUR/External Donors

2.1.5	Maintenance of road network	5	3,000	5	15,000	3,000	3,000	3,000	3,000	3,000	MITUR/External Donors
2.1.6	Maintenance of warden camps	1	10,000	lumpsum	10,000	_	_	10,000	_	_	MITUR/External Donors
Total 2.1					**49,500**	**17,000**	**13,500**	**13,000**	**3,000**	**3,000**	
2.2	**Means of Transport**										
2.2.1	Vehicles 4x4	2	21,500	lumpsum	43,000	43,000	_	_	_	_	UE (PRPGRG-existing)
2.2.2	Motorbikes 125 cc.	2	5,000	lumpsum	10,000	10,000	_	_	_	_	UE (PRPGRG-existing)
2.2.3	Tractor 4x4 and grader	1	57,000	lumpsum	57,000	57,000	_	_	_	_	UE (PRPGRG-existing)
2.2.4	Maintenance and Repairing	1	30,000	lumpsum	30,000	6,000	6,000	6,000	6,000	6,000	MITUR/External Donors
2.2.5	Fuel and lubricant	1	20,000	lumpsum	20,000	4,000	4,000	4,000	4,000	4,000	MITUR/External Donors
2.2.6	Bicycles	12	1,200	lumpsum	1,200	1,200	_	_	_	_	UE (PRPGRG)
Total 2.2					**161,200**	**121,200**	**10,000**	**10,000**	**10,000**	**10,000**	
2.3	**Equipments**										
2.3.1	Generator	1	3,000	lumpsum	3,000	3,000	_	_	_	_	UE (PRPGRG)
2.3.2	Radio System	1	5,308	lumpsum	5,308	5,308	_	_	_	_	UE (PRPGRG)
2.3.3	PC and printer	1	2,000	lumpsum	2,000	2,000	_	_	_	_	UE (PRPGRG)
2.3.4	Furniture for 5 warden camps	1	5,000	lumpsum	5,000	5,000	_	_	_	_	UE (PRPGRG)
2.3.5	Furniture for the main camp	1	8,000	lumpsum	8,000	8,000	_	_	_	_	UE (PRPGRG)
2.3.6	Water pump	1	160	lumpsum	160	160	_	_	_	_	UE (PRPGRG)
2.3.7	GPS	4	920	lumpsum	3,580	3,580	_	_	_	_	UE (PRPGRG)
2.3.8	Tents	10	950	lumpsum	9,500	9,500	_	_	_	_	UE (PRPGRG)
2.3.9	Camping equipment (sleeping-bags, backpacks, torches, mosquito nets, flasks)	1	5,438	lumpsum	5,438	5,438	_	_	_	_	UE (PRPGRG)

2.3.10	Uniforms for 12 wardens	24	2,160	lumpsum	2,160	2,160					UE (PRPGRG)
2.3.11	Disc Pasture Meters	10	50	lumpsum	500	500	_	_	_	_	UE (PRPGRG)
Total 2.3					**44,646**	**44,646**	**_**	**_**	**_**	**_**	
2.4	**Research Development**										
2.4.1	Demographic trend and local livelihood strategies	2	3,000	2	6,000	_	3,000	_	_	3,000	MITUR/External Donors/National and Foreign Research Institutes
2.4.2	Monitoring of the exploitation of natural resources	2	3,000	2	6,000	_	3,000	_	_	3,000	MITUR/External Donors/National and Foreign Research Institutes
2.4.3	Research on the invertebrate fauna	1	4,000	1	4,000	4,000	_	_	_	_	MITUR/External Donors/National and Foreign Research Institutes
2.4.5	Research and Monitoring of elephant population	2	3,000	2	6,000	_	3,000	_	_	3,000	MITUR/External Donors/National and Foreign Research Institutes
2.4.6	Research and Monitoring of meso- and mega- herbivore populations	2	4,000	2	8,000	_	4,000	_	_	4,000	MITUR/External Donors/National and Foreign Research Institutes
2.4.7	Constant monitoring of wildfires	2	4,000	2	8,000	_	4,000	_	_	4,000	MITUR/External Donors/National and Foreign Research Institutes

2.4.8	Mid-term Evaluation of the Management Plan	1	3,000	1	3,000	–	–	3,000	–	–	MITUR/External Donors/National and Foreign Research Institutes
2.4.9	Final Evaluation of the Management Plan	1	5,000	1	5,000	–	–	–	–	5,000	MITUR/External Donors/National and Foreign Research Institutes
Total 2.4					**46,000**	**4,000**	**17,000**	**3,000**	**_**	**22,000**	
TOTAL 2					**301,346**	**186,846**	**40,500**	**26,000**	**13,000**	**35,000**	
TOTAL 1+2					**382,986**	**204,974**	**55,628**	**44,128**	**28,128**	**50,128**	