

# **Illegal gold mining in the Chimanimani National Reserve: environmental and socio-economic assessment**



Mine at the so-called "Camp Nr 4"

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**Reserva Nacional de Chimanimani**

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## **Institutions involved**

The **Provincial Directorate for Mineral and Energy Resources** (DIPREME<sup>1</sup>) is a governmental institution, subordinate to both the Ministry of Mineral Resources (MIREM) and to the Ministry of Energy, responsible for planning, leading and coordinating the mineral and energy resources sector and for implementing the geological research and exploitation policy.

The **Centre for Sustainable Development of Natural Resources** (CDS-RN<sup>2</sup>) is a government institution subordinated to the Ministry for the Coordination of Environmental Action (MICOA) and was created in the context of the decentralization policy. One of the tasks of the CDS-RN is providing technical assistance to local government authorities, and to monitor and collect data in relation to natural resources management, including the establishment of a database.

The **Chimanimani National Reserve of Chimanimani** (RNC<sup>3</sup>) is a government institution, subordinate to the National Directorate for Conservation Areas of the Ministry for Tourism (MITUR), and was established by the Ministerial decree 34/2003 of August 19. The Government of Mozambique signed an agreement with the Government of Zimbabwe for the creation of the Transfrontier Conservation Area of Chimanimani, which included the RNC and the Chimanimani National Park in Zimbabwe.

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<sup>1</sup> *In Portuguese:* Direcção Provincial dos Recursos Minerais e Energia

<sup>2</sup> Centro de Desenvolvimento Sustentável para os Recursos Naturais,

<sup>3</sup> Reserva Nacional de Chimanimani

## **Summary**

The Transfrontier Conservation Area of Chimanimani includes the Chimanimani National Reserve in Mozambique and the Chimanimani National Park in Zimbabwe. Chimanimani National Reserve is internationally renowned for its high degree of biodiversity. The reserve receives financial support from the World Bank of about 2,800,000 USD for increasing the benefits for the local communities and to guarantee the conservation of nature. The sandstone and quartzite formations, which constitute the summits of the mountains, are rich in gold. When illegal miners started extracting gold in the Reserve, the Government got concerned about its environmental and socio-economic impact. Therefore, a survey was carried out to identify the geographical extent of the mining, the number of miners involved, and to assess its environmental and socio-economic impact. Previous attempts to evict the miners resulted into a reduction of their number from 10000 to 2000. The remaining miners work in three zones but in a more dispersed way thus destroying nature in more places. With a daily production of 2 to 3 grams per miner, the economic value is estimated at 32.000.000 USD per annum. Current 'law enforcement' attempts seem not to be effective, and more worrying are reports of corruption and abuse of force. Immediate measurements are required as on one side, nature continues to be destroyed while on the other side, a great economic value remains in the informal economy. It is suggested either (i) to increase efforts for withdrawing the miners or (ii) to organize their activities such that the environmental damage as well as the negative socio-economic consequences are minimized.

## **Resumo<sup>4</sup>**

*A Área de Conservação Transfronteira de Chimanimani (ACTF) engloba a Reserva Nacional de Chimanimani (RNC) em Moçambique e o Parque Nacional de Chimanimani no Zimbabwe. A Reserva Nacional de Chimanimani é uma zona de conservação da natureza, internacionalmente reconhecida pelo alto grau de biodiversidade. A RNC tem um financiamento do Banco Mundial de cerca de 2.800.000 dólares americanos destinados para incrementar os benefícios comunitários através de turismo e para assegurar a conservação da natureza. As formações de arenitos e quartzitos que constituem os picos das montanhas de Chimanimani são ricos em ouro. Quando garimpeiros (mineiros ilegais) começaram a exploração de ouro nesta área, o Governo ficou preocupado pelas perturbações ambientais e socio-económicas. Assim fez-se o levantamento sobre a localização de focos de garimpo, o efectivo dos envolvidos, e uma avaliação dos efeitos ambientais e socio-económicos. Precedentes tentativas policiais para retirar os garimpeiros resultaram numa diminuição do efectivo de 10000 a 2000 pessoas e na dispersão das zonas de exploração deteriorando assim a natureza em mais lugares. A produção diária registada é de 2 a 3 gramas por garimpeiro, e o valor económico estima-se a volta de 32.000.000 USD por ano. Acções actuais de fiscalização parecem ser menos efectivas, e ainda mais preocupante são relatos sobre corrupção e abuso de força. Medidas imediatas são necessárias porque dum lado a natureza ainda está a degradar-se e do outro lado um grande valor económico acontece numa economia informal. Sugere-se ou (i) aumentar os esforços de retirada dos garimpeiros, ou (ii) organizar as actividades de mineração de maneira que os danos ambientais tanto como socio-económicos sejam minimizados.*

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<sup>4</sup> Este relatório está igualmente disponível em Português e pode ser obtido por simples pedido ao [stefaan@teledata.mz](mailto:stefaan@teledata.mz) ou [Stefaan\\_Dondeyne@yahoo.co.uk](mailto:Stefaan_Dondeyne@yahoo.co.uk)

## Introduction

The Chimanimani National Reserve (RNC) is located in the district of Sussundenga in Central Mozambique along the border with Zimbabwe. It is an area of 1756 km<sup>2</sup> and includes the Chimanimani mountain range, of which mount Binga is the highest point of the country (Figure 1). Marshy meadows are found on the Chimanimani highlands (21,000 ha), while the hill slopes are covered with evergreen forests and miombo woodland is found in the plains and the lowest parts of the reserve. The RNC is internationally renowned for its high biodiversity and for its endemic species of fauna and flora. The highlands are also an important water catchment area for the Lucite river.

With support from the World Bank, the Mozambican Government is implementing the *Transfrontier Conservation Areas and Sustainable Tourism Development* project<sup>5</sup> (TFCA), with a total value of 34 million USD and of which 2.8 million are earmarked for the Chimanimani TFCA project. This value is intended for activities such as the construction and rehabilitation of infrastructures, including roads and bridges, the acquisition of equipment and for a fund for the development of community enterprises.

The summits of the Chimanimani mountain range consist of sandstone and quartzites rich in gold. Since November 2004, the presence of illegal Zimbabwean miners has been reported. In November 2005, Mozambican miners, mainly from Manica district, joined them. Since, the Provincial Government has been concerned about environmental and socio-economic effects, such as pollutions of rivers, destruction of vegetation and soils, gold trafficking, illegal immigration and conflicts between miners.

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<sup>5</sup> see [www.theGEF.org](http://www.theGEF.org)

## **Background**

In November 2005, police forces of Mozambique (PRM) and Zimbabwe were informed about the presence of illegal gold miners in the Reserve. In February 2006, the entrance of approximately 500 miners per day was recorded, while it was observed that miners were getting to the base of the mountains in the Reserve with public transport. The number of illegal miners was then estimated at 10.000, while daily production per miner was reported to be 5 grams.

In March 2006, a team of the *Provincial Directorate for Mineral Resources and Energy* (DIPREME) together with a journalist of Radio Mozambique visited the area, and confirmed the presence of miners along to the Muvumodzi and Munahiwa rivers. During that visit the death of 34 miners was also noted, due to a storm.

In August 2006, police, rapid intervention forces and border guards attempted to evict the miners. The operation resulted into the detention and repatriation of 52 Zimbabweans.

## **Objectives**

In the framework of a survey on the occurrence and impact of artisanal gold mining in the districts of Manica and Sussundenga, and taking into account the presence of illegal gold miners in the National Reserve of Chimanimani, a team of DIPREME, CDS-RN and the RNC was formed to investigate the current situation in the Reserve.

The general objective was to get insight into the illegal gold mining activities in the National Reserve of Chimanimani and specifically:

- to establish the geographical extent of the mining
- to assess the environmental impact and
- to assess the socio-economic implications



## **Methods**

Two visits were made to the Chimanimani highlands, a first on 17th October, a second from 12 to 16 December. Additional information was obtained during reconnaissance visits in the southern parts of the reserve in the locality of Muoko (17 November) and in the zone of Chief Zomba (6 December) (Figure 1).

During the field visits, informal interviews were held with miners on their activities, number of miners, production and on their socio-economic situation. The geographic location of the mines was determined using a handheld GPS, digital topographic maps and satellite images. Information on the type and size of the mines was also recorded and a qualitative assessment of the environmental impact was made.

## **Results**

Besides on the Chimanimani highlands, artisanal mines also occur in the northern part of the Reserve in Tsetsera, where 160 miners are active; in the southern part of the Reserve at Mafuse, with 150 miners, and outside the reserve in Munhinga with 300 miners (Figure 1). The present report focuses on the Chimanimani highlands as this area has the highest number of miners and has a special and fragile ecosystem.

### ***Extent of the mining***

Despite previous and ongoing actions of both police and park guards (Mozambicans as well as Zimbabweans), there are still illegal miners active on the Chimanimani highlands, their total number estimated at 2000. Working in groups of 4 to 10 persons, miners are still active in and around the former “camps Nr 1” and “Nr 2”, which were destroyed during the police intervention of August 2006. They are now mostly working in hidden valleys around these so-called camps (Photographs 1 and 2). The situation is similar in the camps Nr 3, 4 and 5. In the so-called “camp Nr 6” the situation is different as there still is a market, where even women and children are present.



*Photograph 1 – So-called mine “Camp Nr 1” at the springs of the Muvumodzi river*



*Photograph 2 – Mine hidden in a valley above Camp Nr 1*



*Photograph 3 – Complex of mines at “Musange”*



*Photograph 4 – Market at Musange (so-called Camp Nr 6)*

Currently, gold extraction is aggregate in a zone around the springs of the *Muvumodzi* river (around the former camps Nr 1 and Nr 2) but in a dispersed and hidden form (Photograph 2). A second zone of extraction is in *Musange*, at the southern fringes of the highlands; a third zone is at “*Ma-Ese*se” (Figure 2). These three zones are interlinked by wide footpaths (Photograph 5), from which observation it can be concluded the principal mining sites have been identified. In Table 1 estimates are presented on the numbers of miners operating in each zone.

**Table 1 – Estimates of density and number of miners in the three principal mining zones on the Chimanimani highlands (21.000 ha), December 2006**

Zone	Area (ha)	Density (miner/km <sup>2</sup> )	Number		
			Mozambican	Zimbabwean	Total
Muvumodzi	3200	50	800	700	1500
Ma-Ese	250	40	50	50	100
Musange	450	90	100	300	400
<i>Total</i>	<i>3900</i>	<i>50</i>	<i>950</i>	<i>1050</i>	<i>2000</i>

*source: field observation and interviews*

In the Muvumodzi zone there are more Mozambican miners than Zimbabweans, the Mozambicans being mostly from the district of Manica. In the zone of Musange the majority are Zimbabweans, but there are also Mozambicans, mainly from Mossurize districts and the administrative post of Dombe, Sussundenga district. In the zone of “Ma-Ese” there are about as many Mozambican as Zimbabweans. This distribution can be attributed to the difficult accessibility of Musange from Mozambican side, while there are less Zimbabweans in Muvumodzi, as they fear actions from Mozambican police or guard in this area.

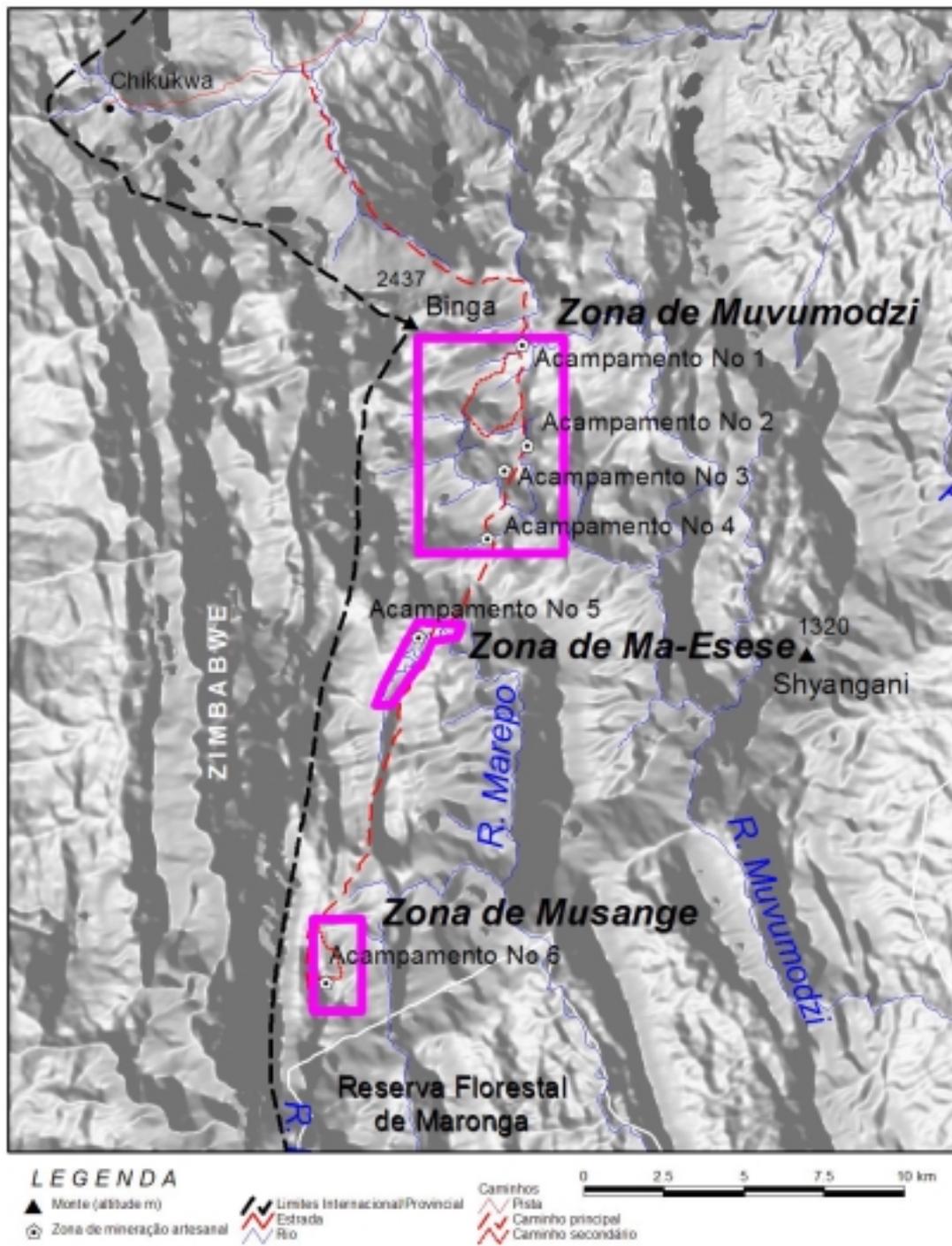


Figure 2 – Location of principal mining zones in the Chimanimani National Reserve (Dec. 2006)



*Photograph 5 – Wide footpaths interlinking the mining zones on the Chimanimani highlands*



*Photograph 6 – The soils where mining is done are mostly organic with a sandy subsoil.*

### **Environmental impact**

The gold extraction is mainly done along rivers and small streams, where the processing is directly done. The sizes of the mines vary mainly in terms of length; the width being restricted to the riverbed, while as the depth varies according to richness of the ore deposits (Table 2). The situation is more complex in the zone of Musange. Mining is done in a complex pattern of along rivers (Photograph 3) as well as in galleries (Photograph 7).

Mining along the rivers leads to the destruction of the riparian vegetation. The increased sediments loads cause turbidity, while discharge and depth of the rivers are altered. Soils are peaty (*Sapric Histosols*) but with a sandy subsoil (Photograph 6), making that suspension loads are not as high as in argillaceous areas of mining outside the reserve as for example in Nhamacuio, Munhena and Mimosa. Mercury is generally not used in the Reserve, as gold is in sufficiently high concentrations, sometimes even as nuggets. Mercury is however used where gold is extracted from rocks, as observed in Musange (Photograph 7). As it is highly toxic, in first instance mercury represents a danger to the miners, but could also be contaminate the surface waters.

Cutting of trees for firewood has also been noted, which could become a problem especially as often there are few woody species in the area. On the other side, it should be noted that despite the high number of illegal miners, no evidence was seen of poaching.

**Table 2 – Estimates of sizes of the principal mines observed in each of the three mining zones on the Chimanimani highlands ( Dec. 2006)**

Zone	Mine (Camp)	Size (m)		
		Length	Width	Depth
Muvumodzi	1	1500	100	3
	2	200	50	2
	3	300	50	2
	4	300	50	2
Ma-Esese	5	2000	30	2
Musange	6 (various)	500	50	2

### **Socio-economic impact**

The miners mentioned their prime motivation for working in the Reserve is the lack of alternative job opportunities; the Zimbabweans added the economic difficulties their country is facing. They all mentioned the high returns that can be attained in the Reserve, as the gold ore is richer, particularly when compared with mines for examples in Manica district. One Zimbabwean commented that a particular advantage of mining is that it requires no financial investments unlike for example the trading of bananas, a business he had previously been involved in.

Daily production, reported by the miners, is typically between 2 and 3 grams per miner; exceptionally 10, 15 and even up to 30 g/day can be obtained. If there were actually 2000 miners working on the Chimanimani highlands, their annual production would correspond to 1460 kg, which at the current world market price of 623 USD/ounce\* would correspond to 32.000.000 USD. Annual production values are presented in Table 3a for various scenarios of daily production. As gold prices tend to fluctuate the results for the same scenarios are presented in Table 3b at the world market price of the previous year. The corresponding values on the national market are presented in Table 3c.

The law enforcement efforts have resulted in a reduction of the number of miners, previously estimated at 10000 to the actual 2000. However, it also resulted in a dispersion of the mining activities, and further in them distrusting whoever tries to approach them. Miners reported police officers and guards to confiscate their belongings such as their tools, bags, clothes - up to the point of leaving people virtual naked - as well as taking their money and gold. They also complained about physical abuses. The most serious case of which, reported by several miners in different sites, concerns an event on the 21<sup>st</sup> November when a miner was shot by guards at the market in Musange (Photograph 8).

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\* 1 ounce = 28.35 gram



*Photograph 7 – Mining in galleries in Musange zone*



*Photograph 8 – Grave of a miner allegedly killed by guards on the 21st November 2006 on the market of Musange*

**Table 3a – Estimates of the production value of gold (USD/year) in the Chimanimani National Reserve at a world market price of 623 USD/ounce, price of December 2006**

Production /day per person (g)	Nr of Miners					
	1,000	1,500	2,000	3,000	5,000	10,000
0.5	4,010,438	6,015,656	8,020,875	12,031,313	20,052,188	40,104,375
1	8,020,875	12,031,313	16,041,750	24,062,625	40,104,375	80,208,750
1.5	12,031,313	18,046,969	24,062,625	36,093,938	60,156,563	120,313,125
2	16,041,750	24,062,625	32,083,500	48,125,250	80,208,750	160,417,500
2.5	20,052,188	30,078,281	40,104,375	60,156,563	100,260,938	200,521,875
3	24,062,625	36,093,938	48,125,250	72,187,875	120,313,125	240,626,250
5	40,104,375	60,156,563	80,208,750	120,313,125	200,521,875	401,043,750

**Table 3b - – Estimates of the production value of gold (USD/year) in the Chimanimani National Reserve at a world market price of 500 USD/ounce, price of December 2005**

Production /day per person (g)	Nr of Miners					
	1,000	1,500	2,000	3,000	5,000	10,000
0.5	3,218,753	4,828,129	6,437,505	9,656,258	16,093,763	32,187,525
1	6,437,505	9,656,258	12,875,010	19,312,515	32,187,525	64,375,050
1.5	9,656,258	14,484,386	19,312,515	28,968,773	48,281,288	96,562,575
2	12,875,010	19,312,515	25,750,020	38,625,030	64,375,050	128,750,100
2.5	16,093,763	24,140,644	32,187,525	48,281,288	80,468,813	160,937,625
3	19,312,515	28,968,773	38,625,030	57,937,545	96,562,575	193,125,150
5	32,187,525	48,281,288	64,375,050	96,562,575	160,937,625	321,875,250

**Table 3c – Estimates of the production value of gold ('000 MZN/year) in the Chimanimani National Reserve at a national price of 350 MZN/gr, price of December 2006**

Produção/dia por pessoa (g)	N° de Garimpeiros					
	1,000	1,500	2,000	3,000	5,000	10,000
0.5	63,875	95,813	127,750	191,625	319,375	638,750
1	127,750	191,625	255,500	383,250	638,750	1,277,500
1.5	191,625	287,438	383,250	574,875	958,125	1,916,250
2	255,500	383,250	511,000	766,500	1,277,500	2,555,000
2.5	319,375	479,063	638,750	958,125	1,596,875	3,193,750
3	383,250	574,875	766,500	1.149.750	1.916.250	3.832.500
5	638.750	958.125	1.277.500	1.916.250	3.193.750	6.387.500

## **Discussion**

As mentioned above, previous attempts to evict the miners from the Reserve lead to the reduction of numbers of miners from estimated 10000 to 2000 currently. The other effect is that the remaining miners operate in a geographically more dispersed mode, hence affecting more areas. Mining activities are dispersed over an area of 3900 ha spread over the zones of “Muvumodzi”, “Ma-Esese” and “Musange”. These three zones represent 20% of the Chimanimani highlands (Table 1, Figure 2).

Law enforcement efforts lead to distrust, anger and even feelings of aggression amongst the miners. As the miners are currently operating in a geographical dispersed mode, their social organisation is weak, which would render any attempt to organise them more difficult. Police and guards continue to intervene but reports of corruption and abuse of force, are most disturbing and surely counter productive. They actually do not stop the mining activities, but rather results in more scattered patterns of mining, rather aggravating the environmental impact.

The mining results in the destruction of mainly the riparian vegetation, and most worryingly, this happens simultaneously in many sites, spread over a vast area. If the activities were limited to a few sites, the vegetation would have greater capacity to regenerate when the mine would be rehabilitated. Besides, the mining results in increased turbidity of the rivers, but due to the peaty and sandy nature of the soils (Photograph 6), sediment loads are relatively low. With mitigation efforts – as applied in mines outside the Reserve, for example in Munhena and Bandira where decantation reservoirs are used – these effects could be reduced even more. Mercury is little used and risk of contamination of the surface waters is therefore not yet alarming. The risk could however be reduced even more with appropriate retort and amalgamation technologies<sup>6</sup>.

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<sup>6</sup> See e.g. Veiga MM et al. (2005) – *Pilot project for the reduction of Mercury contamination from artisanal gold mining fields in the Manica district of Mozambique*. Blacksmith Institute, New York & Global Mercury Project, GEF/UNDP/UNIDO/CDS-RN.

The prime motivation for the miners to work in the Reserve is the high returns. A daily production of 2 to 3 grams per person is higher than what is normally obtained in mines outside the reserve, which varies from 0.5 to 1.5 grams. The narration that sometimes one can get 10, 15 or even 30 grams on a single day just adds to the attraction. On the other side, current production seems to be less than the 5 grams reported in February 2006, which can be attributed to the decreased activities at the mines of Camp Nr 1 and Nr 2.

In spite of being illegal, the gold mining on the Chimanimani highlands represents an important economic activity corresponding to an annual value of 32.000.000 USD on the international market (Table 3a) and to 511 million meticaís on the national market (Table 3c). If each of the 2000 miners would have up to 9 dependants, this production would correspond to an annual income of about 2000 USD<sup>7</sup> per person, exceeding by far Mozambique's Gross National Product per capita which is estimated at 220 USD<sup>8</sup> for 2005.

## Conclusions and recommendations

International renown for its high biodiversity, the Chimanimani National Reserve is important for the conservation of nature. According to the current management plans, it could be developed for both national and international ecotourism, and ensuring benefits for the local population. In this way, the reserve would contribute to income generation of the national economy as well as for local communities.

The current situation is bad for the nature conservation as well as for the national economy. Immediate measurements are necessary as, on one side nature continues to be destroyed, while on the other side economic returns worth tens of millions USD per year remain in the informal economy.

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<sup>7</sup> Calculated with an exchange rate of 1 USD = 26.1 MZN.

<sup>8</sup> República de Moçambique, 2001. *Plano de Acção para a Redução da Pobreza Absoluta, 2001-2005*. Versão Final Aprovada pelo Conselho de Ministros Abril de 2001

### **What could be done?**

**Option 1** – Increase efforts to evict all the miners, which from the point of view of nature conservation would be the most desirable. It will however require gigantic efforts; because of the high number of miners, the difficult accessibility of the mining zones, and the rough terrain where people can easily hide. Moreover, these efforts will have to be sustained indefinitely whereby sharp control will be required to ascertain that neither police nor guards would get corrupted or would themselves get involved in mining.

**Option 2** – Taking into account the economic importance of the mining in the Reserve, contributing to poverty alleviation, one could consider organising the mining such that it can be controlled, the environmental effects minimized and the reserve's potential for tourism not jeopardized. This option would require getting the miners organised in associations to be able to control their activities and to impose environmental mitigation measures. Mining activities would preferably be concentrated in a limited number of sites. The exploitation could be made following a rotational scheme such that at any time, the affected area is minimal and that when the mining activity ceases, fauna and flora can recolonize the site from the non-affected areas. This option would nevertheless also require major costs and efforts for training, monitoring and enforcing rules.

### **Acknowledgement**

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