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BIODIVERSITY CONSERVATION VERSUS ARTISANAL GOLD MINING: A CASE STUDY OF CHIMANIMANI NATIONAL PARK, ZIMBABWE

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ABSTRACT

Artisanal gold mining plays an important role in sustainable development of rural communities. The objectives of this study were to: i) assess the environmental impacts of recent artisanal gold mining activities in Chimanimani National Park (CNP), eastern Zimbabwe, and ii) discuss the associated implications of artisanal gold mining to sustainable development in the Chimanimani area. Data were collected in January 2010 and law enforcement records kept at CNP were examined to gather trends in artisanal gold miner's arrests. Field visits to areas affected by artisanal gold mining in CNP were undertaken and key informants were interviewed. Site observations in some sections of CNP indicated that destructive methods of artisanal gold mining were used. Land degradation and water pollution were some of the recorded negative impacts of mining activities in CNP ecosystem. Our findings suggest that artisanal gold mining activities within CNP are incompatible with biodiversity conservation.

Keywords: Artisanal gold mining, biodiversity conservation, law enforcement, protected area, sustainable development, wildlife

INTRODUCTION

Africa's unique array of wildlife and ecological resources face an ever increasing set of pressures (e.g., Gandiwa, Matsvayi, Ngwenya, & Gandiwa, 2011; Haule, Johnsen, & Maganga, 2002). Efforts to find solutions to these daunting problems, in Africa and elsewhere, often revolve around attempts to reconcile economic development and conservation issues by promoting sustainable utilization of natural resources (Nelson, 2000). Article 2 of the Convention on Biological Diversity (CBD) defines sustainable use as 'the use of components of biodiversity *in a way* and *at a rate* that does not lead to the long-term decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations (Hutton & Leader-Williams, 2003).

Mining is a major economic activity in many developing countries (Kitula, 2006), particularly in rural sub-Saharan Africa (Andriamasinoro & Angel, 2012). For many centuries the small-scale mining of precious minerals has made a significant impact on the socio-economic lives of people and communities involved directly or indirectly in the sector (Amankwah & Anim-Sackey, 2003). Small-scale mining is defined as any single unit mining operation having an annual production of unprocessed material of 50,000 tons or less as measured at the entrance of the mine whereas artisanal mining is defined as an informal and unregulated system of small-scale mining which is mostly illegal (Prasetyo, Krisnayanti, Utomo, & Anderson, 2010). Artisanal small-scale mining usually involves the extraction of secondary gold from alluvial, colluvial or elluvial material, i.e., free gold that is easily concentrated by gravity processes (Hinton, Veiga,

& Veiga, 2003). Artisanal mining usually employs very simple technologies, and there is no planning for rehabilitation after the closure of the mining operation (Prasetyo, et al., 2010). Furthermore, small-scale mining is largely a poverty-driven activity, typically practiced in the poorest and most remote rural areas of mostly developing countries by a largely poorly educated populace with few employment alternatives (Aryee, Ntibery, & Atorkui, 2003).

Zimbabwe is endowed with abundant mineral resources of international value, including gold, diamonds, iron ore, copper and coal. Artisanal and small-scale mining has long been an important economic sector and a contentious arena for policy making in Zimbabwe (Spiegel, 2009). The history of small-scale mining in Zimbabwe dates back to the period well before colonisation in the late 1890s (Maponga & Ngorima, 2003; Mberengwa, 2010). Despite the immense growth of small-scale mining over the years, especially since Zimbabwe's independence in 1980, the sector has essentially remained subsistence and a significant complimentary activity to communal and small-scale resettlement agriculture (Murwendo, Rusinga, & Zinhiva, 2011). Zimbabwe experienced an upsurge in artisanal gold mining in the 1990s, largely as a result of a deteriorating agricultural sector and the layoff of public sector workers following implementation of a series of economic structural adjustment programs (Dreschler, 2001). As a whole, small-scale mining is an important sector in the mineral production system in Zimbabwe, as miners work on economic deposits often below the threshold levels of the larger operators. The mining systems used in the sector are low-tech, labour-intensive and feature manual procedures using homemade tools such as hoes and panning dishes (Hilson, 2012). Small-scale mining in Zimbabwe includes both legal and illegal operators, mechanised and semi-mechanised miners of varying sizes in terms of output, employment and capitalization. Small-scale miners however, face a host of technical, financial and socio-economic problems that adversely affect productive capacity, capability and compliance with mining, safety and environmental regulations (Maponga & Ngorima, 2003).

The global concern over the degradation of the world's natural resource base prompted the United Nations to set up the World Commission on Environment and Development (WCED) that proposed the concept of sustainable development in 1987 (World Commission on Environment and Development, 1987). Sustainable development is defined by the WCED as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987). In relation to wildlife resources, sustainable development implies a situation where the wildlife resources are harvested or utilised to meet the needs of the present generations without jeopardising the wildlife resource needs of future generations (Mbaiwa, 2005).

Extraction and processing of minerals is, however, associated with a number of sustainable development challenges, including various economic, environmental and social issues (Azapagic, 2004). For example, environmental impacts, such as heavy metal contamination of streams and soils, historical pollution problems, acid drainage, and tailing impoundment-associated risks have long been a topic of concern, especially for natural science-oriented studies (Dogaru, et al., 2009). Artisanal gold mining is a cause for concern when it encroaches to areas designated for biodiversity conservation and tourism such as Chimanimani National Park (CNP), eastern Zimbabwe. Like many other protected areas, CNP is faced with the challenge of managing issues of illegal artisanal gold mining that surfaced in the park since 2006 following the discovery of alluvial gold in some parts of the park and adjacent areas in Chimanimani district and Mozambique. Specifically, the objectives of this study were to: i) assess the environmental impacts of recent artisanal

gold mining activities in CNP and ii) discuss the associated implications of artisanal gold mining to sustainable development in the Chimanimani area.

MATERIALS AND METHODS

Study area

Chipinge National Park shares boundaries with Mozambique to the east, Chipinge communal area to the south, Rusitu valley to the west and Cashel Valley to the north. The park has a total area of approximately 171 km^2 in extent (Fig. 1). CNP is characterised by mountainous and highly undulating terrain with peaks of altitudes up to 2,400 m above sea level. The mountain range is composed of quartzite ridges. CNP is one of Zimbabwe's finest mountainous wilderness area and a very popular hiking destination. Close to the Chimanimani town are the scenic Bridal Veil Falls, and Chirinda forest, a Tropical Rainforest, harbouring several unique endemic species. The vegetation of Chimanimani Mountains is provided by Phipps & Goodier (1962).

Development in CNP has been limited in order to preserve the natural, pristine beauty and wild landscapes of this mountainous area. Wildlife species found in this area include antelopes such as eland (*Taurotragus oryx*), sable (*Hippotragus niger*) and klipspringer (*Oreotragus oreotragus*). Almost all of the Chimanimani endemic plants occur on quartzites (Wild, 1964). CNP is part of the Chimanimani Transfrontier Conservation Area. The Chimanimani Mountains form an ecologically important watershed area between the coastal lowlands of Mozambique and the highland plateau of Zimbabwe. The international border between the two countries follows a natural line provided by the watershed (Virtanen, 2005).

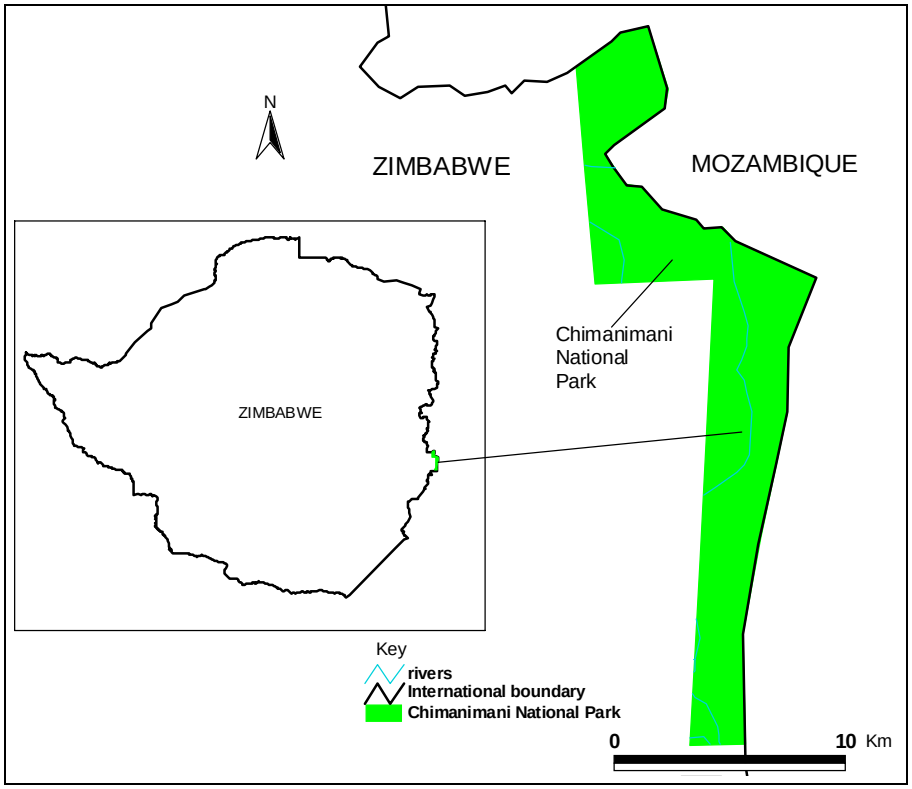

Fig. 1. Location and map of Chimanimani National Park in eastern Zimbabwe

Data collection

Data were collected in January 2010. We used a multi-method approach to gather data: i) we examined law enforcement records kept at CNP to gather statistics on trends in artisanal gold miners in the park; (ii) we undertook field visits to areas affected by artisanal gold mining both within and outside CNP, and (iii) we interviewed key informants using protocols outlined by Gandiwa (2012). Specifically, we visited the Skeleton Pass area of CNP, covering an area of at least 30 km^2, where there was evidence of past artisanal gold mining activities based on local knowledge of park rangers. Moreover, visits were made to Vimba communal area outside CNP to establish downstream river pollution. The main focus of the observation exercise was to establish the key environmental issues of land degradation and pollution of the rivers emanating from artisanal gold mining activities in CNP and surrounding areas.

FINDINGS

Impacts of artisanal gold mining

Site observations particularly in the Skeleton Pass area within CNP indicated that destructive methods of gold mining were used. River channels were excavated during the gold mining or panning process. Some key informants cited muddiness of water downstream and river bank instability resulting in flow changes as negative impacts of artisanal gold mining. Additional issues raised by key informants included reduced opportunities for fishing and domestic use of water. Table 1 shows the major impacts of artisanal gold mining activities in the CNP ecosystem.

Table 1. Main types of impacts and their severity resulting from artisanal gold mining in CNP

Nature of impact	Severity of impact
Loss of vegetation cover in the areas where artisanal gold mining activities occurred	High
Land degradation and surface instability due to loose rocks	Medium
Disturbance of the soil structure and soil profile	High
Disturbance to wildlife habitat and dispersal	Medium
Reduced quality of water for downstream water users	Very high
Various forms of water pollution affecting the physical and chemical characteristics of water in the streams and rivers	Very high
Possible ground water contamination	Medium
Increased sediment load in flowing rivers	Very high
Opening-up of unauthorised roads and exposure of vulnerable and sensitive ecosystem to human disturbance	Medium
Increased human immigration to the local communities around CNP for the 'gold rush' putting more pressure on the park to extract resources	High
Reduced opportunities for game viewing in the CNP due to human disturbance	Medium
Increased risk of illegal hunting, illegal harvesting of forest products and introduction of invasive alien species in CNP ecosystem	Medium
Impacts on other PA values from altered landscapes, noise and visual intrusion, arising from both artisanal gold mining and associated activities	High
Abandoned pit scars left by gold panners pose serious hazards to wildlife and park rangers in the area	High

Notes: Very high – means very high negative impact; High – means high negative impact and Medium – means intermediate negative impact. Source: Fieldwork, January 2010.

Impact of artisanal gold mining activities on landscape in the Skeleton Pass area

Landscape disturbances left by artisanal gold panners were highly visible mostly at Skeleton Pass in CNP as shown in Fig. 2. These changes in landscape had a negative impact on the scenic beauty of CNP.

Fig. 2. Evidence of landscape degradation and water pollution in Chimanimani National Park, Zimbabwe, in areas were artisanal gold mining activities were carried out and also downstream rivers. Photo credits: P. Gandiwa. Source: Fieldwork, January 2010.

Trends in illegal activities in CNP, Zimbabwe between 2006 and 2009

Table 2 presents the statistics of arrests in CNP between 2006 and 2009. Artisanal gold mining activities in CNP started in 2006 soon after the discovery of alluvial gold in Chimanimani area. It was evident that artisanal gold panners constituted the majority of arrests between 2006 and 2009 compared to wildlife poachers. The number of artisanal gold panners however, decreased towards 2009 as a result of increased law enforcement in CNP.

Table 2. Law enforcement statistics for arrested wildlife poachers and artisanal gold panners in Chimanimani National Park between 2006 and 2009

Year	Wildlife poachers arrested	Artisanal gold panners arrested
2006	11	> 10,000
2007	46	1,040
2008	3	533
2009	7	324

Source: Chimanimani National Park law enforcement records

DISCUSSION

Our results show that artisanal gold mining emerged as a key activity in Chimanimani area in mid-2000 and declined towards 2010. We attribute the increased artisanal gold mining to the country's poor economic performance for the period between 2000 and 2008 (Matsa, 2011; Spiegel, 2009). In an environment with economic challenges such as hyper-inflation, and also drought, artisanal gold mining activities became a booming illegal activity in the Chimanimani area. Earlier studies have reported that some of the typical environmental impacts caused by artisanal mining activities include diversion of rivers, water siltation, landscape degradation, deforestation, destruction of aquatic life habitat, and widespread mercury pollution (Betancourt, Narváez, & Roulet, 2005; Kitula, 2006; Mutakyahwa, Ikingura, & Mtui, 2009; Tom-Dery, Dagben, & Cobbina, 2012). However, the extent of damage depends largely on the mining and processing methods being used.

In this present study we also recorded negative impacts of illegal gold mining such as land degradation, vegetation loss, wildlife habitat degradation and pollution of rivers among others. Accordingly, environmental problems from both the formal and informal sections of the mining sector in Zimbabwe have been generally classified into two broad categories: i) physical effects, i.e. vegetation destruction, wastage of resources, and river siltation, and ii) chemical effects mainly pollution from mercury (Maponga & Ngorima, 2003). Furthermore, social impacts of small-scale mining, results in increase in human population leading to possible increased poaching (Zwane, Love, Hoko, & Shoko, 2006). It was however, not possible to tease out whether artisanal gold panners were also involved in the poaching of wildlife in CNP.

Despite its negative effects, artisanal mining is an essential activity in many developing countries as it provides an important source of livelihood, particularly in regions where economic alternatives are critically limited (Hinton, et al., 2003). People engage in mining for a variety of reasons. They are unable to find other work, other jobs pay insufficiently and their low educational status limits access to better paying jobs (Amankwah & Anim-Sackey, 2003; Prasetyo, et al., 2010). In rural communities where mining takes place, the activity has reduced rural exodus, promoted local economic development and contributed towards poverty reduction (Amankwah & Anim-Sackey, 2003), as gold rush miners may be lured by prospects of striking it rich (Heemskerk, 2005). Environmental, economic and social development has been highlighted as the three pillars of sustainable development and their integration is therefore encouraged (Azapagic, 2004; World Commission on Environment and Development, 1987).

Artisanal gold mining can also contribute to sustainable development and livelihoods sustainability of rural communities by using approaches similar to those adopted by many large-scale, formal mining companies, which primarily consists of support for auxiliary enterprises such as jewellery production and agricultural development (Hinton, et al., 2003). Moreover, artisanal gold mining sector occupies an important niche in mineral production through the exploitation of small economic deposits and providing alternative sources of livelihood for impoverished masses mostly in rural areas. Overall, small scale mining increases economic power to rural communities, and in that way, contributes positively to social development. In addition, during periods of drought, artisanal mining provides an alternative source of livelihood (Maponga & Ngorima, 2003). Therefore, with proper support and planning, artisanal mining could occupy the gap between small and large-scale mining and contribute to the development of resilient, sustainable communities (Hinton, et al., 2003).

CONCLUSION

Although mining plays an important role in the sustainable development and livelihood sustainability of rural communities in developing countries, our study, however, shows that when artisanal gold mining is conducted in areas designated for wildlife conservation, environmental degradation may be witnessed. Therefore, our findings suggest that mining activities within CNP are incompatible with the purposes of the protected area which are in tandem with the International Union for Conservation of Nature (IUCN) Protected Area Management Categories I to IV (International Union for Conservation of Nature, 1994). The environmental problems of artisanal gold mining in CNP could be overcome through enhanced law enforcement and continuous awareness programmes about biodiversity conservation in protected areas. Moreover, extraction of mineral resources, and associated infrastructure near protected area should be subjected to environmental impact assessments (EIA). These EIAs should consider, *inter alia*, the immediate and cumulative effects of mining activities on protected areas, recommend operating and after use conditions, and ensure that the values of protected areas are safeguarded so as to promote sustainable biodiversity conservation and rural development.

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