

Socioeconomic and Environmental Implications of Traditional Gold Mining in Sudan: The case of Barber Locality, River Nile State

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Abstract

This paper seeks to examine the socioeconomic and environmental implications of traditional gold mining in Sudan with special reference to Berber locality, River Nile State. The investigation is based on fieldwork conducted in April 2013.

The main findings of the research are that, 93.4% of the miners covered by the survey are male (20-40 years) of employable age seeking to pull out of unemployment and poverty. All the main regions of Sudan constitute a large reservoir of unemployed young people who are willing to migrate to the gold mining areas in spite of the harsh living conditions, and the low earning of between 2-4 USD per day. As the mining areas are remote and located away from the population centers food supplies as well as deficiencies in basic services which adds to the implications. The fact that, traditional gold mining depends on the use of mercury and cyanide in the process of purification make the miners vulnerable to infectious respiratory diseases including cancer.

The paper suggests an action plan to promote traditional gold mining to make it more contributive to Sudan's economy and to the environment by reducing health hazards.

Key words: gold mining, migration, impoverished workers, mercury, ecological degradation, infectious diseases.

INTRODUCTION

Since ancient times gold was one of the main reason behind migration. In the late nineteenth century the gold rush reached its highest level worldwide (Raymond, 1999). Sudan's fame with gold dates back to prehistory as well as archeological artifacts recovered from ancient tombs. Also gold was one of the reasons of Turko-Egyptian invasion in 1820, as the country was known for its rich gold mines. Geologically, gold associate with basement complex rocks of igneous, metamorphic, and sedimentary origin (Whiteman 1971). The lower mantle of igneous rocks of Donite and Harzburgite contain chromium and platinum in Ingassana and Red Sea Hills, and the Nuba Mountains. Copper, Nickel, Platinum of Kambalda type associate with Gabbro, Peridotite, and Harzburgite rocks of Ingassana, Wadi Amir in Darfur and Onib area in Red Sea Hills. Also, gold associates with acid volcanic rocks of Ariab area of Red Sea Hills, the eastern parts of Ingassana Hills, the Nuba Mountains, Hofrat Al Nahas in Darfur, and eastern Wadi Halfa, and Gabgaba Wadi in northern Sudan (Embassy of the Sudan in South Africa, 2006). "Geologic studies have indicated the variability of mineral resources of Sudan, though the deposits that have been discovered so far correlates with deposits in adjacent countries renowned for great mineral wealth" (Abdelgadir, 2012).

The first gold amalgamation activities in Sudan were done by British small-scale mining companies in Red Sea Hills and Northern Sudan, when they were intermittently operating during 1904–50s (Ibrahim, 2003). Recently, gold mining is found in 14 states of Sudan (Figure 1). Operations was carried out by 91 big companies and 590 small ones prospecting for gold in 106 sites (Khartoum Journal, 2013). Work in gold mines involves the use of simple manual tools of shovels, pickaxes, hammers, chisels and pans in both surface and underground environments (Aryee et al. 2003). As a result of secession of South Sudan in 2011 and loss of petroleum money which contributed 50% of the GPD, the contribution of gold to national economy has come at the right time to save the economy from collapse. By 2014, traditional gold mining contributed about 90% of the gold mining industry in the country (Sudan now, 2014; African Mining Brief, 2014). However, regardless of such an economic gain, traditional gold mining has negative impacts on the health of miners, local, and a miner levels. The purpose of this paper is to investigate the socioeconomic and environmental ramifications of traditional gold mining in Abedia area, the River Nile State, and to suggest a plan of action to mitigate the negative impacts.

THE STUDY AREA AND FIELD METHODS

The study area is located in River Nile State, Northern Sudan (Fig.1), covering an area of 122,123 km² and a population size of 1,000,000 estimates for 2006. The most prominent geomorphic feature in the State is the fifth cataract of the River Nile (Stern et.al. 1997). Hudi deposits which appear east of the Nile between Khartoum and Berber which represent a type of lacustrine deposition during Oligocene. It is covered by Nubian gravel, which is covered by basalt resulting from more recent volcanic activity. The study area is spotted with rocky desert hills with reaching more than 1000 m in elevation, crossed by Atmour valley which is considered as part of Red Sea Hills, (GRAS, 1995). However, Bayouda desert is an area of rocky sandy desert composed of basement rocks and lava fields associated with Cenozoic and cinder cone complexes dating back to Devonian age. The majority of the remaining of Bayouda desert is a rocky sandy desert with scarps and plateaux of sedimentary rocks dating to the Mesozoic separated by open sandy plains known as Qoz. Bayouda formation includes Abisol, Kurmuk, Rahaba, and Abuharig series. Auharig series was distinguished by Vail (1979) belonging to the grey Gneisses group, while the first three belong to meta-sedimentary group. The formation of the River Atbara, to the south of the study area, is believed to have occurred during the Mesozoic. All these geologic formations have witnessed gold excavations. Temperatures in this arid area rise up to 50° C during the hot summer falling to as low as 5° C in in the winter season.



METHODOLOGY

The fieldwork was conducted in April 2013 in Alebedia area, Berber Locality in the River Nile State (Fig. 1). Two groups of gold workers were investigated. The first group deals with excavation, collection of stones and gold pieces, as well as stone crushing and packaging (Photograph 1). The second group deals with stone grinding, washing, and amalgamation of gold (Photograph 2). The number of interviewed in the first group was 35 individuals, and in the second group was 25 giving a total of 60 individuals. The authors believe that due to lack of official data of traditional gold workers in these remote areas the sample is likely to give important indicators as to conditions of gold miners who were interviewed. They were interviewed according to their accessibility during the time of the fieldwork (nonprobability sampling procedure). The questionnaire included socioeconomic characteristics of individuals including medical and water services, work environment, together with views towards solving the current problems.

Photograph.1. Gold Excavation**By: Wadi and Alredaisy (2013)****Photograph. 2: Gold crushing****By: Wadi and Alredaisy (2013)****RESULTS AND DISCUSSION****MINERS' SOCIOECONOMIC CHARACTERISTICS**

There are two types of workers, those who work individually and those who work under the umbrella of an investor, group of investors, or companies. Those in the age group more than 60 formed a 3.4%, while those less than 20 years and more than 60 years were 6.6%. The fact that 66.7% of the workers in the age group 20-30 is indicative of widespread of unemployment among the youth (Table 1), and (Photograph 3). Nearly half of the miners (47%) were involved in mining activities for less than 3 years, ¼ for 3- 6 years, and another ¼ for more than 6 years (Table 1). The total number of jobs in the mining areas is put at 100,000 of which 95% are in traditional gold mining sector, in addition to 150,000 jobs have been indirectly created as a result of increasing mining activity (Abdelgadir, 2012). Traditional gold mining in Sudan absorbs about 5 million miners and other workers of accompanying jobs, while those affected by this activity are estimated at 11 million people (Sudanow, 2014). This is similar to what is happening in many

countries, where there are more than 15 million people including some three million women and children who are involved in small-scale gold mining in 70 countries around the world (United Nations Environment Program).

Photograph 3: The traditional gold miners in the study area



By: Wadi and Alredaisy (2013)

Table 1: Miners' socioeconomic characteristics

Characteristic	Groups	Frequency	Percentage
Age groups	< 20 Years	2	3.3
	20-30 Years	40	66.7
	30-60 Years	16	26.7
	> 60 years	2	3.3
Involvement	< 3 years	24	45
	3-6 years	17	28.3
	> 6 years	16	26.7
Monthly Income (ADG)	250-500 SDG	12	20
	500-1000 SDG	26	43.3
	> 1000 SDG	22	36.7
Previous Work	Idle	1	1.7
	Student	24	40
	Worker	31	51.7
	Trader	4	6.7
Place of Origin	Khartoum State	37	61.7
	Central State	11	18.3
	Western State	10	16.7
	Northern State	2	3.3
Educational characteristics	Illiterate	5	8.3
	Basic	23	38.3
	Secondary	14	28.3
	University	18	30
Marital Status	Single	39	65
	Married	21	35

Source: Field work (2013).

Monthly income of the majority of gold miners (43.3%) ranges between 500-1000 SDG (Table 1), which equals 60-120 USD or 2-4 USD/ day, while 20% of them earn 2-1 USD/day which means over 60% are under the poverty line. However, although (36.7%) of the miners earn more than 4 USD /day, they are not far away from the poverty line (Photograph 4). The financial situation of the gold miners are similar to those of a large proportion of Sudanese (46.5%) or 14.4 million who live below the poverty line according to

national family survey in 2009 (Ministry of Federal Education, 2014). The same report clarified 75% rural people are poor, while urban poor stood at 26.7%. In addition, it is indicated that in Sudan there are more than 60,000 impoverished miners, who work in a hard desert where the basic services is lacking (Reuters, Khartoum May 2013). Gold miners in Ghana stated that “their work is dirty and difficult and they will not do it if other viable alternatives are available for them” (Samuel, 2012). A similar situation is reported in India indicating low earning of small-scale operations (Joe, 2014). Regardless of the low income of traditional gold mining areas, gold miners are able to support their families (Heemskerk et al. 2003). Some of individuals in the gold mining industry are well-educated including university graduates who failed to secure decent job after graduation (Table 1).

Photograph 4: Poor and impoverished miners in the study area



By: Wadi and Alredaisy, (2013)

At the local level, money generated from traditional mining has activated business and basic services in mining areas by 41% as documented by Anja (2014), (Hordofa, et al., 2014), (Photograph 5). In addition, gold mining activities have a negative impact on traditional farming and animal husbandry which came to be abandoned by young people (Vivian et al. 2011).

Although traditional gold miners are considered as impoverished workers, Sudan gained much from the industry by increasing activities. Production of gold from 34 tons in 2013 reached 64 tons in 2014 (African Mining Brief, 2014). Sudan witnessed an increase in mining exports from 140 million USD in 2009 to 200 million USD in 2010 (Abdelgadir, 2012), a situation might be similar to that in Botswana, where mining constitutes around 60 percent of GDP in 2005 (Isaksen et al., 2004; Lange et al. 2005), and Mali where mining's proportion of GDP increased steadily from six percent in 1998 to 14 percent in 2002, and to the Amazon Basin where deep mining has become increasingly prevalent as a source of income and employment (Project Amazonia, 2006). The gold rush in Sudan has also resulted in massive migrations which triggered conflict over the land ownership in the recipient areas (Vivian, et al. 2011). As a consequence, conflicts between communities and mining operators over land use rights are common in many regions worldwide, where for example surface mining in Ghana had resulted in deforestation and substantial loss of farmland within mining concessions (Vivian, et al. 2011).

Photograph 5: Accompanying services to traditional gold mining in the study area



By: Wadi and Alredaisy, 2013

Although Darfur and Kordofan States are geographically remote from the study area, nearly half or one third of the workers came from there (Fig.1). This is an indication that the western states suffer from widespread unemployment. However, although the study area is within the Northern State, migration to mining areas is limited. This is so, because traditionally people of the Northern State migrate to Gulf Arab Counties rather than migrate locally.

Nearly 1/3 of the miners are university graduates or those who have completed secondary education, indicating lack of jobs for young people. Also gold workers include those who have completed basic education, or other school leavers (ten than 20 years of age) who may be classified as child labor and aged less than 20 years could be considered as school leavers and /or child labor. About 18% of traditional gold miners in Sudan could be considered as school dropout (Ahdath Newsletter, 2012). According to the Education Office of Abu-Hamad Locality, River Nile state, some students left their schools seeking jobs in the gold mining areas to help their relatives financially (Tahani, 2011). Poor families do not have the financial means to pay for the education of their children.

The light concentration of the young males in gold mining areas for long period make the workers vulnerable to homosexuality, HIV infection, and increase of criminal acts (Hordofa, et al. 2014).

In general, HIV infection or excessive alcohol and tobacco consumption tended to exacerbate existing health problems of gold miners in Australia, North America, South America, and Africa (Eisler, 2003).

MINERS' ENVIRONMENTAL HEALTH CONDITIONS

Table 2 depicts that, workers consume unsafe water which is insufficient in amount and expensive, giving rise to multiple health problems. This is particularly true in Sudan, where only 67% of the population have access to safe drinking water (Nation Master, 2010). However, even those served by clean water do not get 40-50 liters per day per person as stipulated by WHO (WHO, 1983). These deficiencies in quantity and quality of water in the mining areas make the workers exposed to water washed and water borne diseases such as diarrhea, dysentery, typhoid, and cholera. Since gold miners do not have access to piped water and are therefore served by water vendors, the risk of contamination become extremely high (Photograph 6, 7, and 8), and (Alredaisy, 1993).

Photograph 6. Traditional gold mining in Darfur



By: Wadi and Alredaisy, 2013

Photograph 7: Water distribution using containers in the study area



By: Wadi and Alredaisy, 2013

Photograph 8: Contaminated water due to Mining processes in the study area

By: Wadi and Alredaisy, 2013.

Table 2: Miners' environmental health conditions

Service	Characteristics	Frequency	Percentage
Water services	Unsafe	12	20
	Expensive	34	46
	Insufficient	14	23
Food services	Unreliable	15	25
	Expensive	31	35
	Insufficient	24	40
Medical services	Clinic	7	11.7
	Dressing point	5	8.3
	Shop	35	59.4
	Urban areas	13	21.7
Common Diseases	Respiratory	10	16.7
	Gastrointestinal Dis.	1	1.7
	Malaria	6	10.0
	Fever	1	1.7
	Insect bites	1	1.7

Source: Fieldwork, 2014

Moreover, food unreliability, unaffordability, and unavailability, with reflections of susceptibility to food deficiency diseases, infectious diseases, and morbidity are wide spread in the mining areas (Table 2). Deficiency to micro nutrients might subject miners in the study area to hidden hunger, which represents the most prevailing form of nutrition deficiency diseases in the world (UNICEF, 2008). On the other hand, nutrition insecurity of miners might expose them to protein – energy malnutrition. In addition, good nutrition requires healthy environment which is not available, because mining areas lacking to adequate water services, food supplies, and basic medical services, and suffer from poor living conditions (Photograph 9), (Table 2). These conditions put gold miners under hazards of infectious and communicable diseases, such as respiratory and gastrointestinal diseases, fever, and malaria Table (2).

In fact, health problems among miners are worldwide phenomena spread in Australia, North America, South America, and Africa. Including frequency of cancer of the trachea, bronchus, lung, stomach, and liver, increased frequency of pulmonary tuberculosis (PTB), silicosis, and pleural diseases, increased frequency of insect-borne diseases, such as malaria and dengue fever, noise-induced hearing loss, diseases of the blood, skin, and musculoskeletal system. All these health complications decrease life expectancy of the gold miners (Eisler, 2003). The outbreak of yellow fever in Sudan October 2012 in general, and in Darfur in particular, was found that 18% of the recorded cases working in traditional gold mining areas (Elhassan, et al., 2012).

Health records of Abu Hamad's Central Hospital, which is one of the main hospitals close to the study area, received 107 cases of undiagnosed fever from gold mining areas, in addition to some cases of cancer and respiratory diseases (Abu Hamad Central Hospital, March 2011). Cancer that was diagnosed in the hospital is due to the use of mercury and cyanide for gold extraction by these gold miners (Mohammed, 2003). Mercury goes into the human body through inhalation or by eating polluted food or water, and it was found that 48% of miners blood affected by mercury compounds (Ashri, 2012). Mercury cause health problems, which may appear for years later which include brain damage, kidney failure, skin and eye problems; and dysfunctional neurological development in infants and children (Wilopo1, et al., 2013).

In fact, the quick and dirty production process of gold amalgamation emits mercury into the atmosphere in the study area. It was found that, the small-scale gold mining is responsible for 37 percent of global mercury emissions and is the largest source of air and water mercury pollution (United Nations Environment Program, 2011). Such emissions might also seeped into soil, water bodies and agricultural fields, similar to the Amazon Basin where the release of large concentrations of mercury through mining inhibited plant growth and animal immunity, resulting in the death of flora and fauna (Project Amazonia, 2006).

Photograph 9: Huts use traditional building materials in the study area



By: Wadi and Alredaisy (2013)

The serious problem is that, there are no restrictions or awareness in the process of using of mercury and cyanide (Photograph 10). Furthermore, the fieldwork investigation revealed that, the amounts of mercury used exceed the permitted levels of one part per million (p.p.m.) put by World Health Organization, or two p.p.m. put by the United States Food and Drug Administration (Vivian, et al., 2011).

Photograph10: Gold amalgamation using Mercury in the study area



By: Wadi and Alredaisy (2013)

Dust resulting from gold mining affects neighboring communities and soil erosion around mines (Vivian et al. 2011). Crushing and grinding from traditional mining areas has a direct impact on the environment (Nur Rafidah, et. al. 2012). The exposure of traditional gold miners to the dust might explain the resistance of these exposed to drugs in the study area (Photograph 11), (Reddy, 2005).

Photograph11: Dust pollution caused by rock crushing in the study area



By: Wadi and Alredaisy (2013)

Such dust resulting from mining activities increases the risk of TB infections. In addition, the desert conditions of the study area, there is a risk of Sun Stroke when temperature exceeds 50⁰ C during summer, and even more when digging takes place at a depth of 40 meters below the earth surface.

CONCLUSIONS AND RECOMMENDATIONS

The main findings of this research are as follow:

- 1- At the personal level the worker at the traditional gold mining areas is impoverished since his income is low, and is subjected to all sorts of hazards and insecurity.
- 2- At the national level, traditional gold mining has generated income and contributed to the GPD, but led to public health hazards; increased school dropout and child labor; as well as other social ills and environmental degradation.
- 3- If the conditions in the gold mining areas are to continue unabated, serious socio-economic and environmental problems will persist unless an action plan is formulated to control the negative impacts.

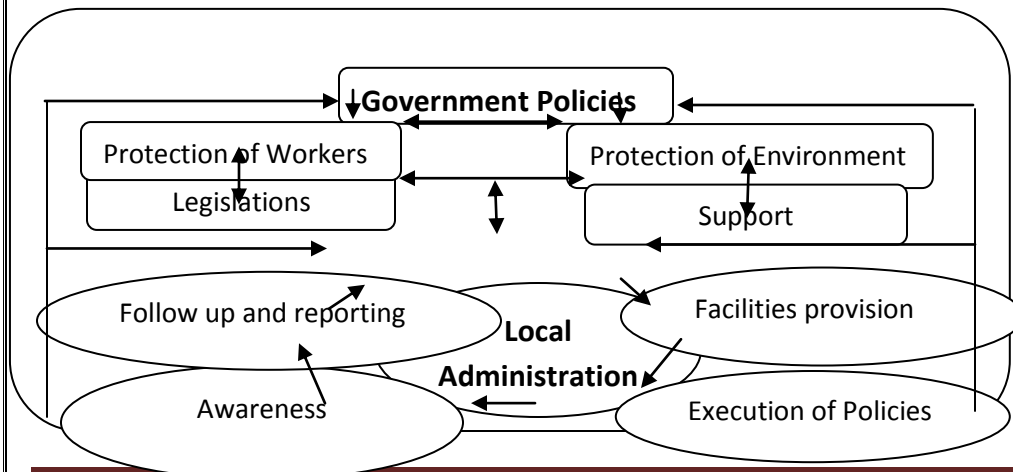
TOWARDS AN ACTION PLAN TO PROMOTE TRADITIONAL GOLD MINING IN SUDAN

Based on the main findings of this research, it is clear that the action plan should basically work to achieve the workers’ rights to obtain basic services as well as protecting the, and protection to work environment through legislations (Fig.2). Promotion of traditional gold mining will be the outcome of the interaction between these different integrated efforts so that mining activities will be more contributive to Sudan’s economy and less harmful to the workers and environment.

National Government Policies

National policies should focus on protection of mining environment and workers through legislations and support through adequate financial budgets. Since there are two types of workers, those who work individually and those who work under the umbrella of an investor, group of investors, or companies, such national policies should support those who work individually through micro financing, enhancement of local authorities to provide basic services, and public awareness of dangers of working individually(Fig.2).

Figure 2: A Proposed action plan to promote traditional gold mining



Source: The Authors.

For those who work under the umbrella of an investor, group of investors, or companies, achievement of the workers' rights could be through legal contracts between partners to avoid a worker's rights violation; guarantee the wages and health insurance; protection against work accidents; and compensation in case of death or handicap. In addition, the government could enter as a partner to support small companies or well-off investors, by opening Gold Bourse in central mining areas to buy gold directly from individual workers and investors in current world prices.

National policies should work ultimately to protect the environment against any harmful practice such as use and disposal of mercury and cyanide, unauthorized excavating, and removal of natural flora, threatening thereby wild life. This could be achieved through legislation and provision of an investment maps of gold in Sudan similar to those of gas and oil. Concession areas of gold should be distributed to individuals, cooperative societies and companies. Provision of basic services and protection of environment should include also provisioning of adequate water supply and medical services; security services; housing; workers' camps; waste disposal and other related sanitary services. This should be accompanied by public awareness of dangers of unprotected use of toxics; collapse of mines; and all other expected natural threats and hazards, by using both social and mass media.

Furthermore, experiences of other countries in sustainable management of gold mining activities should be put in mind to avoid negative impacts.

Enhancement of roles of local authority

Local authority or administration shielded by these national policies should be in the field, to secure both workers and the environment. Local authority should be the immediate body to all stakeholders in gold mining areas, to execute those national policies. Awareness of workers about their rights and how to conserve the environment, and at the national level follow up and reporting of situation in gold mining areas are also extremely necessary.

Guarantee for the achievement of the proposed plan

The plan underlines cooperation and collective work of all those involved in traditional gold mining, including the Government, local authorities, companies, investors, and individual workers. The plan also advocates and commitment of by the authorities to protect the environment of gold mining areas as well as having easy access of workers to health facilities.

To sum up one can say that, the government should be more concerned with promotion of the work environment and provision of services, protection of natural environment rather than collection of taxes.

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