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Negative Impacts of Traditional Gold Picking on Soil and Water Quality in Mandiana in the Republic of Guinea

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ABSTRACT

This present study analyzes the negative impacts of traditional gold mining on the quality of soil and water in the Prefecture of Mandiana in the Republic of Guinea. The action of artisanal miners in the production process in a context of extensive and not very productive agriculture is the source of degradation of natural resources (land, water, animals and plants) and modification of lifestyles and social relations. . In view of the practices that are now in progress in the final gold recovery process, namely the use of chemicals (mercury, cyanide, zinc, etc.) whose impacts are little or not perceived by rural stakeholders , it is now necessary to take an interest in this new facet of gold panning. It is therefore to understand these environmental impacts of gold mining that this article was produced. The study method consisted of: investigating close to the actors and taking soil and water samples from the mining sites selected for this study, in order to carry out laboratory analyzes. The results of the study reveal that gold panning has negative impacts on the environment in the Prefecture of Mandiana, 87.50% of respondents are aware of the negative impacts of artisanal gold panning on soil and water against 12 , 50% who underline the contrary.

KEYWORDS: negative impact, traditional gold mining, Mandiana.

1. INTRODUCTION

Artisanal gold mining, commonly known as gold panning, is an informal type of activity, exploiting this resource in an unplanned manner which certainly contributes to reducing poverty in rural areas by injecting monetary income, but generates many environmental problems. Without being exhaustive, this activity causes deforestation, deforestation, soil degradation, air, soil and water pollution, loss of biodiversity and the shaping of the landscape [1-6]. It is generally accompanied by the opening of trenches, wells, scraping and turning of the soil, with the corollary of the weakening of the soil and the gradual destruction of Arab lands. Gold panning contributes to the destruction of plant cover and predisposes the soil to

often intense erosion processes [7]. In addition, the use of chemicals (mercury, cyanide, acids) and other non-biodegradable solid wastes can reduce soil fertility. As the soil is an important support for ecosystems, in particular terrestrial ecosystems, a degradation of its physical, chemical and biological properties induces a subsidiarity in the consequences generated in this case on agrosilvopastoral activities [8]. According to some researchers, the anarchic exploitation of gold in several prefectures of eastern Guinea has negative effects on the environment and on the living environment of the populations, because the use of chemicals pollutes the soil, rivers and causes them to dry up. In Mandiana, where the topographical base of the locality is based on gold deposits recognized for a long time, gold is mined in an artisanal and semi-artisanal way by many populations from all over Guinea and the sub-region (Republics of Mali, Burkina Faso, Côte d'Ivoire, Senegal, Liberia, Sierra Leone, etc.). Since 2011, Mandiana Prefecture has seen the introduction of the first Australian branded metal detector "Minelabe". It is thanks to the use of this instrument, that the populations understood that there are quantities of gold on the surface of the earth and it is this discovery which caused a significant influx of populations towards Mandiana which you could call it 'the gold rush'. Currently, Mandiana is experiencing a real rush of populations especially economic assets for the traditional exploitation of gold which is detrimental to the development of agricultural activities, by negatively affecting arable land and other natural resources (water, animals and plants) [9].

2. Materials and Methods

2.1.Materials

Within the framework of the present study, the materials used are of two types: a-Populations of 4 mining villages of Mandiana constitute the target public targeted by this study to carry out surveys relating to their opinion on the impact of the chemical substances used in the extraction of gold from soils and rivers; b- and four gold washing sites were selected: Siguifily (CU of Mandiana), Nafadjilén and Missiman (CR of Morodou) and Kourouni (CR of Kantoumanina) for the taking of soil and water samples for their analysis at the Laboratory for:

- determine through the soil, the current rate of chemical substances (cyanide and mercury or zinc) used by gold miners in the treatment of ores;
- carry out the physicochemical characterization of the water (pH, conductivity, nitrates, nitrites and phosphates) of the mining sites selected, in order to assess their possible impacts.

2.2. Methods

The documentary analysis phase led to having a true picture of certain elements that constitute the object of the study, which required a moment of contemplative prospecting in order to obtain objective representativeness in order to provide its characteristics well.

-Sampling

Data collection operations covered 4 mining villages in Mandiana Prefecture. They targeted a population considered as a target estimated at 48 households located in the cities mentioned, or 12 households per mining village.

This sampling frame is made up of 324 households. Thus the sampling rate will be 1/27 which means that for each group of 27 households, one will be retained. Note that as we do not have specific demographic data for the 4 sites selected for this study, we have relied on the data from the 2014 general population and housing census (RGPH) to the extent that it was not of a homogeneous and continuous universe.

- Taking soil and water samples

Soil samples were taken from the four mining sites at horizon A (30cm) and placed in special bags labeled for this purpose, while water samples were taken from the four mining sites in bottles previously sterilized and packaged. All the samples collected were transported the same day to the Lab (April 30, 2020) where the preparatory work began on May 2, 2020.

3. Results and Discussion

3.1. Survey results: Impacts on soils

The results of these surveys are reported in the table below.

Table 1: Perceptions of the impacts of artisanal gold mining on soils

Sites / Modalities	Nafadjilén	Kourouni	Siguifily	Missiman	Total	%
Yes	11	11	11	9	42	87,50
No	1	1	1	3	6	12,50
Total	**12**	**12**	**12**	**12**	**48**	**100**

The results in Table 1 show that the populations are aware of the negative impacts of artisanal gold mining on the soils of their land: 87.50% state that gold mining degrades the soil against 12.50% who point out the opposite.

The first impact cited by respondents is the delay in the agricultural calendar. As long as the mines provide gold, many farmers are slow to reach the fields and thus fall far behind the agricultural calendar. If in the past gold mining was a seasonal activity that ended as soon as the agricultural season was announced with the arrival of the first rains, today it has almost become a full-time activity.

The second negative impact revealed during the interviews is the migration of a large segment of the agricultural workforce towards gold mining. Many farm households have simply seen their active members migrate to gold work or petty trading. This flight of agricultural assets results in a decrease in agricultural labor and an increase in mining labor which contributes every day to destroying the soils, plants, rivers, natural habitats of animals thus contributing to global warming.

The third negative impact revealed by the respondents is that gold panning degrades the soil by the opening of numerous holes, the erosion of the topsoil, deforestation, the destruction of forest galleries which result in the scarcity of the rains which affect agricultural yields.

3.2. Results obtained in the Laboratory

The analysis of heavy metals was carried out with the MP-AES 4210 Metallizer which is an automatic, self-programmabledevice operating with plasma. These results are shown in Table 2.

Table 2: Results of the analysis of soil samples taken in the Prefecture of Mandiana

ND	Sampling sites	Parameters	
		CN-	Zn
		mg/l	mg/l
1	NAFADJILEN (Rural Municipality of MORODOU)	<0,01	1,2
2	MISSIMA (Rural Municipality of MORODOU)	<0,01	0,5
3	SIGUIFILY (Urban Municipality of MANDIANA CENTER)	<0,01	0,84
4	KOUROUNI ((Rural Municipality of KANTOUMANINA)	0,15	2,1
WHO STANDARDS		**0,07**	**0,5**

Analysis of soil samples from selected mining sites, Kourouni (Kantoumanina CR) shows a high value of cyanide (0.15 mg/l) and a very high value of zinc (2.1 mg/l) compared to WHO standards which are 0.07mg/l and 0.5mg/l respectively.

The sites of Nafadjilén (CR of Morodou), Missima (CR of Morodou) and Siguifily (CU of Mandiana) have low cyanide values (<0.01 mg/l) which are lower than the WHO Standard (0.07 mg/l), while at the same time the zinc value in Nafadjilén and Siguifily (1.2mg/l and 0.84mg/l respectively) is higher than the WHO Standard (0.5mg/l). As for Missiman, the value of the zinc present (0.5 mg/l) is identical to the WHO Standard (0.5 mg/l).

From the above, one could conclude that:

-The Kourouni mining site (Kantoumanina CR) is the one which, by virtue of its soil analysis results, presents high values of cyanide and zinc, followed by the Nafadjilén and Siguifily mining sites whose revealed zinc contents are superior to the WHO Standard.

3.3. Impacts on water

The negative impacts of gold mining on rivers are essentially the retreat of their banks, the silting up of their beds and their pollution, which is also another threat to the rivers. During surveys, gold miners and non-miners have recognized gold panning as one of the causes of water turbidity in rivers. Oil leaks from construction machinery used in artisanal gold mining are a major factor in the contamination of water in rivers by the runoff process.

Table 3: Negative impacts of artisanal gold mining on river

Sites / Modalities	Nafadjilén	Kourouni	Siguifily	Missiman	Total	%
Yes	12	11	10	9	42	87,50
No	0	1	2	3	6	12,50
Total	**12**	**12**	**12**	**12**	**48**	**100**

From the results of the surveys in Table 3, we note that gold mining has:

• negatively altered the quality of the waterways (color of the water) which once served as a watering hole for humans and animals;

• resulted in the destruction of the forest galleries that cover the rivers and this situation is damaging to biodiversity, which is deteriorating day by day;

• caused the silting up and the destruction of the banks by the creation of an ore washing device. The sludge that is dumped is drained into the rivers.

Water is involved in the performance of almost all activities of artisanal gold mining. During the sinking, the artisanal miners reach the water table which is on average 14-15 m deep. They use motor pumps to evacuate impressive amounts of water. These motor pumps on the site each evacuate several liters of water per day, thus helping to reduce the level of the groundwater table. Also, leaving used batteries inside wells can pollute groundwater resources. The mills that grind the ore use water to cool the engine. Even if the water consumption is not significant at this level, it should be noted the discharge of used oils and hydrocarbons which can reach the water resources.

In addition to all these activities, the daily life of the artisanal miners requires a daily need for water (nutrition, laundry, shower, etc.). The production of solid and liquid waste also pollutes water resources by leaching or infiltration. This water is pumped outside and flows into the river, which can be a source of intoxication for residents.

In short, the negative impacts on water are the depletion of water resources (massive use of water, water discharges during sinking), pollution of surface and / or underground water, destruction of the bed of streams.

To obtain the analysis results of the water samples, we used the phmeter and conductivity meter (Multi 3420 SET G) for the physical parameters (pH and Conductivity) and the direct reading spectrometer (DR or Direct Reading) to determine nutrients (NO3, NO2 and PO4).

Table 4: Results of the analysis of water samples taken in the Prefecture of Mandiana

ND	**SAMPLING SITES**	**PARAMETERS**				
		PH	**CONDUCTIVITY**	**NO3**	**NO2**	**PO4**
			µs/cm	mg/l	mg/l	mg/l
1	NAFADJILEN (Rural Municipality MORODOU)	7,7	72,9	2,02	0,34	0,3
2	MISSIMA (Rural Municipality MORODOU)	7,54	67,4	1,66	0,27	0,04
3	SIGUIFILY (MANDIANA CENTER)	7,25	60,3	1,7	0,06	0,07
4	KOUROUNI (Rural Municipality KANTOUMANINA)	7,08	22,9	1,5	0,06	0,06
WHO STANDARDS		**6,5 - 9,5**	**1000**	**50**	**0,5**	**0,2**

In view of the results of Table 4, it appears that the values obtained for the physical parameters (pH and conductivity) of all 4 sites are normal since they are within the intervals recommended by WHO.

As for the chemical parameters (Nitrates, Nitrites and phosphates), it is only at the level of the mining site of Nafadjilén (CR of Morodou) where the value of phosphates is slightly higher (0.3 mg / l) than the WHO Standard (0, 2mg / l). The values of all these chemical parameters observed at the other three sites are within those recommended by WHO. Despite this slight increase in the phosphate value observed in Nafadjilén, its nitrate and nitrite values are also within those recommended by the WHO.

Thus, with regard to the results of water analyzes on the Mandiana mining sites which were the subject of this study, it could be said that the water found in Missiman, Siguifily and Kourouni is not polluted and does not represent any danger for living beings (humans, animals and plants).

In Nafadjilén where the value of phosphates is slightly higher than the WHO Standard, for the moment there is no concern to qualify the water as polluted or at the beginning of pollution. Indeed, the chemical parameters analyzed are part of the nutrients.

3.4. Discussion

According to some researchers, if the gold mining activity and its social consequences in West Africa have been relatively well studied for twenty years [9-14], the documentation on its environmental consequences is more fragmented [15, 16]. Even if research work on the use of chemicals for gold extraction has been carried out, the literature does not allude to laboratory analysis results concerning said substances at soil and soil level. water. Thus, from the above, and not having data from a study similar or close to ours, the discussion of our results will be limited to its comparison with WHO Standards.

The Kourouni mining site is the one which, due to its soil analysis results, presents high values of cyanide (0.5 mg/l> 0.07 mg/l, WHO standard) and zinc (2.1 mg/l> 0.5 mg/l, WHO Standard), followed by the mining sites of Nafadjilén and Siguifily whose revealed zinc contents (1.2 mg/l and 0.8 mg/l) are higher than the Standard WHO (0.5 mg/l). For the three other mining sites Nafadjilén, Missima and Siguifily, the cyanide result obtained (0.01 mg/l) is lower than the WHO Standard (0.07 mg/l); while, the zinc result obtained at Missiman is identical (0.5 mg/l) to the WHO Standard. The heavy metals (zinc and cyanide) analyzed in this study are within the accepted standards.

Regarding the physicochemical elements analyzed, the results obtained compared to WHO Standards do not indicate levels in the water that could lead to proven pollution. The values of pH and conductivity revealed are within the accepted standards. However, the discharge of residues from mineral processing into rivers is responsible for the change in the color of the water as well as its high turbidity.

Our study revealed that traditional gold mining has led to changes in the natural resources of the mining sites explored in Mandiana. Gold panning has negatively affected agricultural production, reduced the area of cultivable land, affected water resources, flora and fauna. A similar result had already been found by [17-19].

According to [20], all of the gold miners and non-miners surveyed in Kéméni and Kpaza are unanimous on the fact that gold mining weakens the soil. Gold panning sites, even those that are abandoned, are no longer the subject of agricultural development.

From this perspective, 60% of the artisanal and non-artisanal artisanal miners interviewed affirmed that they do not cultivate on gold mining sites abandoned because of the holes and degradation of the soil. The holes left by the various mining methods also expose gold mining sites to erosion and landslides. Leaks of motor oil and hydrocarbons from semi-artisanal mining are a major cause of soil pollution at the site in question.

4. Conclusions and Suggestions

Thus, the conclusion that can be drawn from these results in the first place is that, on the one hand, the use of chemicals in the treatment of minerals extracted from the gold mining sites of Mandiana is confirmed; on the other hand, the results obtained call out to the urgent need to alert all stakeholders in the traditional gold panning process (government officials, local authorities, local elected officials, community leaders as well as direct actors, etc. .) in:

- explaining the global health hazard resulting from the use of these substances through the pollution of soil, water and cultivated plants, all resulting in contamination of the food chain (living animals and plants);

- raising awareness among stakeholders on the effects of these substances on rivers and their ecosystem.

This study can serve as a basis for better understanding the problem of the use of chemical substances (heavy metals and physicochemical parameters) in artisanal gold mining in Mandiana or elsewhere in the Republic of Guinea. While there is still time, the State at the highest level through its deconcentrated structures should take up the issue to prevent our populations, mostly illiterate, from the pollution of its natural resources which are: the land, water, vegetation as well as the contamination of humans and animals (domestic or not) of this land as a result of the use of these substances.

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