Environmental Impacts of Gold Mining in the Zaamar Goldfield, Tov province, Mongolia

1. Introduction

1.1. Background of the Study

Mining is the key to Mongolia's economic development and growth, with the sector contributing 36% to Mongolia's gross domestic product (GDP) and comprising 70 percent of its exports. In Mongolia, mining industry is considered as one of the important source of economic development of the nation, like many other developing countries including Ghana, Indonesia, China and Tibet. As cited by Naranhuu (2010), the reports of Metals Economics Groups stated that Mongolia is one of the top 10 destinations for the mineral exploration due to the exploration expenditures in years 2004 and 2006.

Currently, there are more than 2,150 legal entities registered to explore or extract minerals in Mongolia and 31 percent of the country is licensed for exploration. More than 6000 deposits of eighty different minerals have been discovered in Mongolia. The boom of foreign investment in exploration has resulted in the discovery of several large deposits, including Tavan tolgoi (coal), Oyu tolgoi (copper and gold),Tsagaan Suvarga (copper and molibdenum), Gatsuurt (gold), Tumurtei (iron) and Ulaan (lead and zinc). Additionally, the rapid expansion of placer gold mining has occurred the Government launched the 'Gold Project' which opened up to local and foreign investors since 1992.

The mine revenue from the placer gold deposits in Zaamar are of vital importance to the national economy of Mongolia. For the last two decades, gold have been extracted a massive amount in Zaamar mining area. According to official statistics, in 1997: gold reserves in Mongolia amounted to 2000 tons, exploration of gold was occurring in 140 gold mines, annual gold production was 10-12 tons, and there were more than 40 gold mining companies working in the Zaamar area where approximately 9000 hectares of fertile land is suffering from the impacts of gold mining activities. As of today more than 60 tons of gold is exploited in this area and paid to the State bank and Treasury fund.

According to the local officials there are 1762 hectares land of water reservoir in whole territory of Zaamar soum and 6795 hectares land of forest reservoir occupy the 0.63% of the total area in this area. There are more than 40 surface-water, including rivers, streams, springs, breakwater, lakes and ponds in this area and hence about 20 of them dried up completely, some of them have flow depletion and levels of groundwater are down. It deems reasonably to be depended on climate change, global warming and mining industries. In 2010, water use for Zaamar mining industries, 5637,4 thous.m^3/year according to annual mining work plan of mining entities based on 'Conclusion on water use' by the Water Authority, Government Implementing Agency of Mongolia.

Currently, a conflict of interest exists between the development of industry and the development of animal husbandry because pasturelands, previously used by herdsmen, are now occupied by gold mining sites. In the case of Zaamar, informal gold mining is creating environmental destruction, consequently making life difficult for the local people, especially herders, who must compete for pastureland and water resources.

The water supplies are becoming increasingly polluted while the land is being negatively affected by gold mining activities. The increase in mining activity along with the utilization of outdated techniques for extraction and processing of ore has resulted in the long term damage to natural resources. These impacts include large increase in sedimentation, nutrient loading and alteration to the river hydrology. In the Tuul river's Zaamar gold mining zone, the water used for washing the mine is not completely cleaned before being drained into the river. This causes negative externalities not only in the lives of locals, but also in the river's biological life and the growth of the river fish.

Given the reasons above, it is important to study the environmental impacts of gold mining in Zaamar area, Mongolia, as well as its negative impact to the river water quality and land degradation in order to make a clear situation of water quality at Tuul River needs of local people and herders livelihood implication of mining-related land cover change.

1.2. Research Question and Hypothesis

My hypothesis is that environmental impacts arising from the mines along the Tuul river in area of Zaamar district that continue to negatively impact on the local herding

economy as well as on the ecology of Tuul river.
With the aim of understanding environmental impacts of mining, i posed the following questions to answers throughout my research:

1. Is heavy metal pollution of sediments as one of the indicator of water pollution in downstream of Tuul river, Zaamar Goldfield?
2. How does the pollution of water systems affect humans and the natural environment for the last few years?
3. Has land cover change due to surface gold mining affect the Zaamar Goldfield between 2001 and 2010?
4. What are the environmental consequences of these land cover changes?
5. What are the consequences of gold surface mining-related land cover changes for local livelihoods in Zaamar District?
6. What are the challenges of the government and local government in addressing negative impacts of mining?

1.3. Research Objectives

The research aims to identify the negative impacts of mining to the environment, by determining the precedent indicators:

1. Determine extent of land cover change between 2001 and 2011.
2. Investigate the main factor of water quality deterioration caused by the placer gold mining activities.
3. Make recommendations on how to minimize deforestation and water pollution and its resources in the Zaamar area.

1.4. Significance of Research

The main purpose of the research is to provide identification of the present status of water quality for surface water and land cover changes around Zaamar Goldfield. It is hoped that research will hopefully provide sufficient information about the protecting lands and improve the surface water quality that are key for local government`s regional development plan.

1.5. Methodologies.

In order to answer research questions and validate my hypothesis I have chosen a concurrent mixed method that combines both qualitative and quantitative methods that from data analysis, data collection and generating questions.

Qualitative research methodology features in-depth interview, focus group discussion, field observation and semi-structured questionnaire. A questionnaire was developed to assist the in-depth interview including open-ended questions.

A focus group discussion and in-depth interview was conducted at the governor's office of Zaamar soum to initiate lively talk and exchange of ideas, process of rehabilitation, information around informal mining, problems related to illegal mining, local people knowledge and skill as regards to environmental impacts, what was currently being done in this area that carried out restoration works, monitor the process of it, and challenges facing local government.

Quantitative method was conducted in order to gain secondary data (water quality data, land use and land cover map) as well as in the form of questionnaires distributed to local people as regard to their opinions and activities relating to mining impacts.

Both statistical and geographic information system analyses were adopted in this study. GIS is a powerful data integration and spatial analysis tool.

Table 1. Data Requirement and Methodologies used in the Research

No.	Objective	Data	Method	
			Data collection	Analysis
1	Determine extent of land cover change between 2001 and 2011.	-Satellite image data -Ground-truth- data in Research Site	Getting the data from Aster, secondary data	Quantitative description
2	Investigate the main factor of water quality deterioration caused by the placer gold mining activities.	-Collect water samples -In-depth interview	Field observation, in-depth interview	Qualitative description, quantitative description
3	Make recommendations on how to minimize deforestation and water pollution and its resources in the Zaamar area.	-Negative impact of water pollution to livelihood -Negative impact of land degradation to the livelihood	Field observation -In-depth interview -Questionnaire	Qualitative description, quantitative description

		-People perception on environment/nature		

1.6. Research Site.

The Zaamar Goldfield is situated along the east side bank of Tuul river valley floodplain and surrounded by terraces and hills. Its length is over 50 km and width ranging from 10 to 20 km. The Zaamar Goldfield is about 230 km away from northwest of Ulan bator, Mongolia's capital city (Fig 1a). The Tuul river is the fifth longest river (784 km) in Mongolia. The distance from the Zaamar Goldfield to Zaamar soum is approximately 30 km and located southwest of Oil Zaamar range. Various stages of exploration program found that gold placer reserves along the river Tuul continues almost 50 km and each valley (Upper Zaamar, Bumbat, Toson, Ar Naimgan, Khailaast, Ar khundii) hosts significant amount of gold (Fig 1b). The area is agriculture area with nomadic animal husbandry and lies within the semi-arid climate zone. Meteorological data from a weather station of Lun, Altanbulag shows a mean annual precipitation of 227.3 mm and annual air temperature in winter -19^0C-24^0C, whereas summer is relatively warm and dry, with temperatures between 18^0C-25^0C. 80% of the rain fall between June and August. At the weather station of Zaamar also indicate that heavy rain fall (67.6 mm) occurred in June, 2008 because of the summer rainy period. The placer gold mining is fully dependent on surface water from the Tuul river, which is used for the separation of gold from sediment. The Tuul river water in the Zaamar area was toxic seepage water originating the poorly managed tailings previously used as local drinking water. Nowadays, groundwater from wells is the main drinking water resource for people in Zaamar goldfield (662 household). In the long run, this groundwater can be at risk due to contamination by toxic seepage water originating from the poorly managed tailings and gangue piles, as well as from contaminated river sediment.

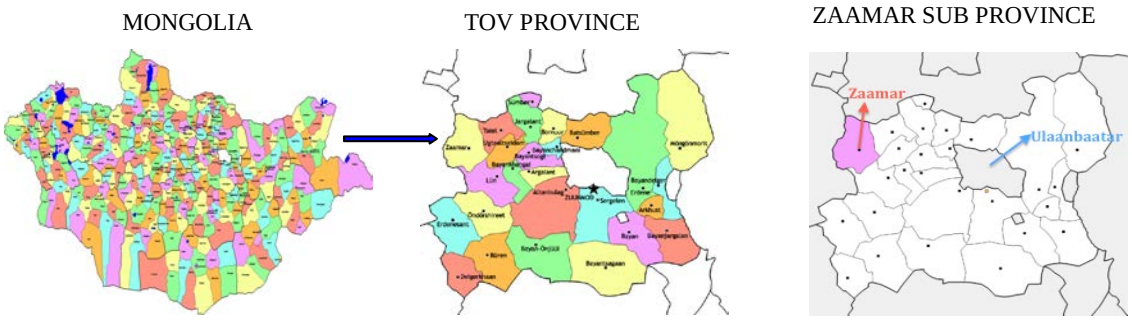

Figure 1. Study Area

1.7. Expected Outputs

The expected output of this research is set of policy recommendations for government in implementing mining policy, which will be vital for effective implementation of the relevant laws and regulations.

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