



Global Mercury Project

Project EG/GLO/01/G34:
Removal of Barriers to Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies



SOCIO-ECONOMIC SAMPLE STUDY OF THE INGESSANA HILLS ARTISANAL GOLD MINING COMMUNITY, BLUE NILE STATE, SUDAN

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Executive Summary

- Since 1997 gold was discovered in the center of Ingassana Hills ~80 kilometers to southwest El Damazin town, the capital of the Blue Nile State. The discovery of gold around Gugub village has attracted massive population especially those displaced by civil war in the southern parts of the region. Now there are about 1000 multi-ethnic individuals practicing artisanal gold mining in Ingessana district. Both alluvial and primary types of artisanal gold mining are practiced excessively.
- The indigenous Ingessana tribesmen and the displaced Dawala group constitute the bulk of artisanal gold miners in Gugub sites in the center of Ingessana Hills.
- Each miner owns at least a pit but none has a legal title.
- Age range of active miners is 15-50 years. Few are older than 50 years.
- Women and children artisanal gold miners constitute ~50% of the total participants. Children make ~10%.
- About 90% of respondents are married. 38% of the male miners have two wives.
- 28% of male and 6% of female miners attended school. ~95% of these are from Dawala ethnic group. The majority of the Ingessana artisanal miners are illiterate (~95%).
- About 60% of the gold artisanal miners have an income around US\$80 per month. When compared to their monthly expenditure (~US\$50), most of them say that they make some saving.
- People argue that treatment from diseases is very costly for them since the nearest clinic is at Bau, ~10 km away. In serious cases of illness, they go to El Damazin hospital ~80 km away.
- The most common diseases reported in are Malaria, chest pain, dyspnea, eye problems, fatigue, irritability and depression especially among women. Daily injuries are common.
- Sorghum and maize porridge is the staple diet. 66% drink milk daily, 62% eat meat 2-3 times a week. ~95% eat vegetables, fruits and fish only occasionally.
- Water sources are springs and bore holes located ~2 km from the sites. Water is salty and contaminated by bacteria.
- Pitting on stream terraces/ quartz veins is the main method of artisanal gold mining. Gold extraction is through wooden plate panning (alluvium) or by both panning and amalgamation (primary).
- Amalgam is burned on frying pan at the miners homes or at the shops verandahs in Gugub.
- For every gram of gold produced, ~1.5 gram of mercury is lost to the environment.
- Awareness about environmental and health hazards associating mercury mishandling in gold processing is low.
- 70% of respondents agree to participate in artisanal gold mining within family framework but 84% refuse to participate in cooperative society.

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Introduction

This sociological sample survey targets artisanal gold mining community around



Gugub village in the Ingessana Hills, Blue Nile State (figure 1). The general aim of this study is to probe the community's habitat, behavior, characteristics, and activities. This will facilitate the implementation of the Global Mercury Project activities and provides the bases for the sustainable development of artisanal gold mining in the Ingessana Hills.

Terms of Reference

The terms of reference of this socio-economic study are as follow:

- 1- Collection of sufficient data and knowledge about the structure and demography of the people living in the selected site. Information is to be collected on infrastructure, type of occupations, estimate on gold output and trade, food composition and eating habits. Furthermore, description of the overall process of gold production will be given with focus on the use of mercury in gold amalgamation and its evaporation as well as the locations where burning of the amalgam is performed.
- 2- Collect information about health services and the prevalent diseases.
- 3- Investigate water resources: accessibility, quality, and availability.
- 4- Study attitudes and behavior pattern in the community, which may either encourage or hinder intervention, and willingness to learn the new technology.
- 5-

Objectives of the Study

The objectives of this socio-economic study are to collect sufficient data and knowledge about the artisanal mining practices in the Ingessana communities with respect to:

- Structure and demography of the community living around the selected mining sites.
- Types of human habitats and proximity to the pitting sites.
- Levels of education, health, and other services.
- Occupations.
- Detailed description of the overall processes of gold production, focusing on the use of mercury in gold amalgamation.
- Activities linked to artisanal gold production (mercury selling, gold trading, catering for miners ..etc.).
- Income levels.
- Food consumption patterns.
- Water sources, accessibility, and quality.
- Assessment of social behavior of the artisanal gold mining community.

Methodology Used

The study depended on two types of data: primary and subordinate secondary data. The information is synthesized in order to present a concise sociological overview of the chosen artisanal gold mining sites around Gugub village in the Ingessana Hills.

Primary data

The study utilized both qualitative and quantitative methods for data collection. As far as the quantitative methods are concerned, the study designed and conducted a detailed questionnaire covering demographic, economic, social and cultural information. Detailed information is collected on the number of people, sex, age, ethnic origin, religion, occupation activities, work shifts, and amount of mercury used. Qualitative methods like group discussions are also employed. The key informants were district chiefs and local government officials. About 67 questionnaires (49 men and 18 women miners), 7 interviews, and 6 group discussions were completed in the artisanal gold mining sites around Gugub and Taga villages.

Group discussions and interviews were held with each of male miners, female miners, and a mixed group of male and female miners. Gold traders/merchants were also interviewed. Topics discussed with women included problems faced by women when starting or improving their artisanal gold mining activities, interactions between men and women, gender balance in economic power and decision-making. Their awareness about both mercury uses and its impacts on human health were also discussed.

Secondary data

This includes information related to the history of the region, history of initiation of gold mining, civil services in the Ingessana Hills, government structure, and data on the geographic attributes.

Data analysis

Quantitative data was fed into computer utilizing the statistical SPSS 10.0 software. The results are presented as bar diagrams. Other valuable information was obtained from Bau deputy commissioner and other sources as well.

Ingessana Hills, Southern Blue Nile Region: an overview

Southern Blue Nile region, sometimes referred to as southern *Fung* region, is bounded by latitudes 10° 00' and 12° 00' North, and by longitude 33° 45' and Sudan–Ethiopia borders to the east. According to 1993 latest national census, the total population of the region was 413,694. Bau Locality where all the targeted artisanal gold mining communities live, has a population of ~100000.

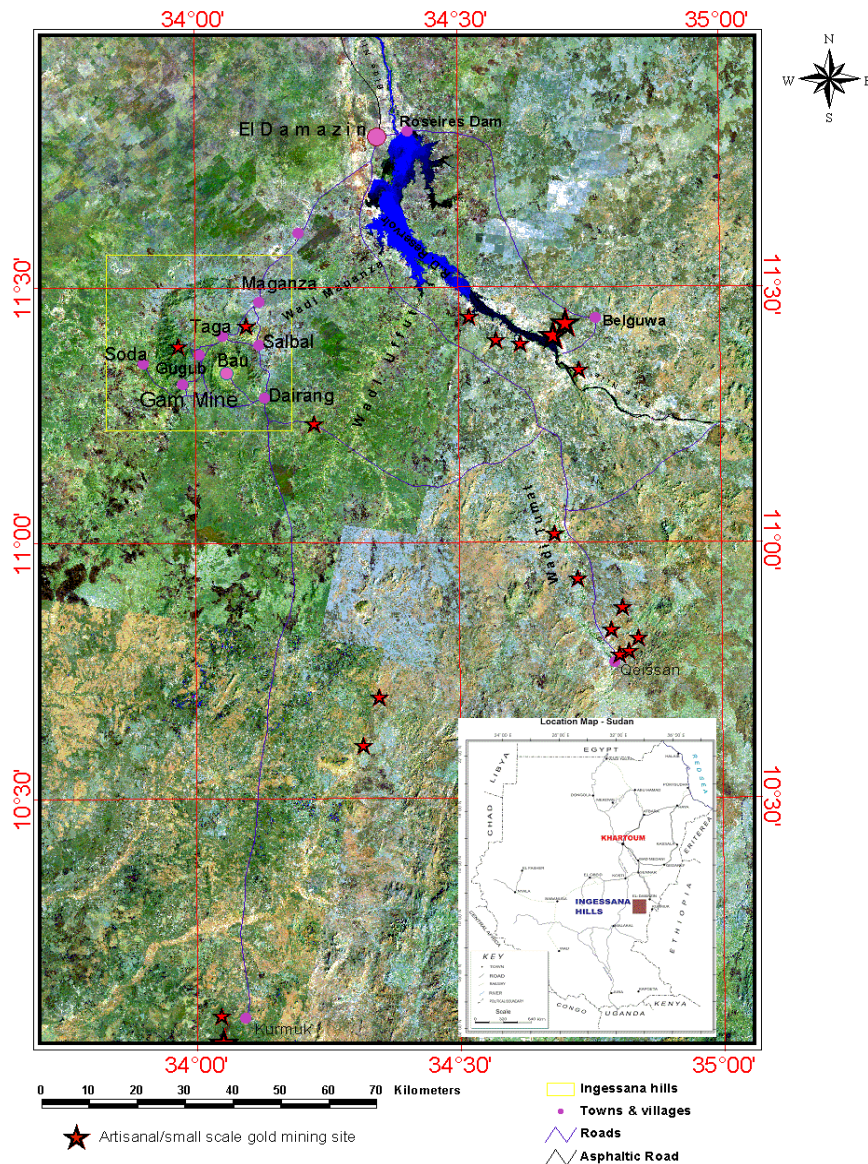
Topography

Southern Blue Nile region is characterized by both flat clay plains and a hilly topography in the south and the southwest, with gentle slopes towards the north and southeast. There are pediments that are gently sloping and with drainage flow connected to the Blue Nile River system. The average altitudes reach 1000 feet above sea level at the Ingessana Hills (figure 2).

Climate

The region lies within the Savannah Zone with annual precipitation ranges between 600 and 800mm. Dense bush and tall grass cover the hillside and the stream banks as well. Climatic seasons are defined by the hot dry summer (March-June), hot wet autumn (July- October), mild dry winter (November-February), and a very short spring (early March). Mean daily temperature ranges from 43°C in mid summer (April-May) to 20 °C in mid winter (December-January). Ingessana Hills rise 800 to 1000 feet above sea level.

Figure 2: Southern Blue Nile - Sudan



Economic activities

Agriculture is the main occupation of the sedentary population in the region; particularly around the Ingessana Hills. Other economic activities practiced in the region are animal husbandry and wood logging.

In 1970s, Government of Sudan, in line with development policy, had emphasized the increase and the expansion of mechanized farming in the region. This decision was motivated, among other things, by the availability of external financial and technical assistance funds from both the World Bank and oil-producing Arab countries. Despite

the fact that these mechanized farms have attracted both individuals and companies from all parts of Sudan as well as foreign investors, it has created grievances among parts of the indigenous inhabitants of the region. Such grievances manifested itself in the civil strife and many joined the rebels of southern Sudan. Ingessana Hills is now classified as one of 3 areas seeking special political status in the on-going peace negotiations between Government and Sudan peoples Liberation Movement (SPLM).

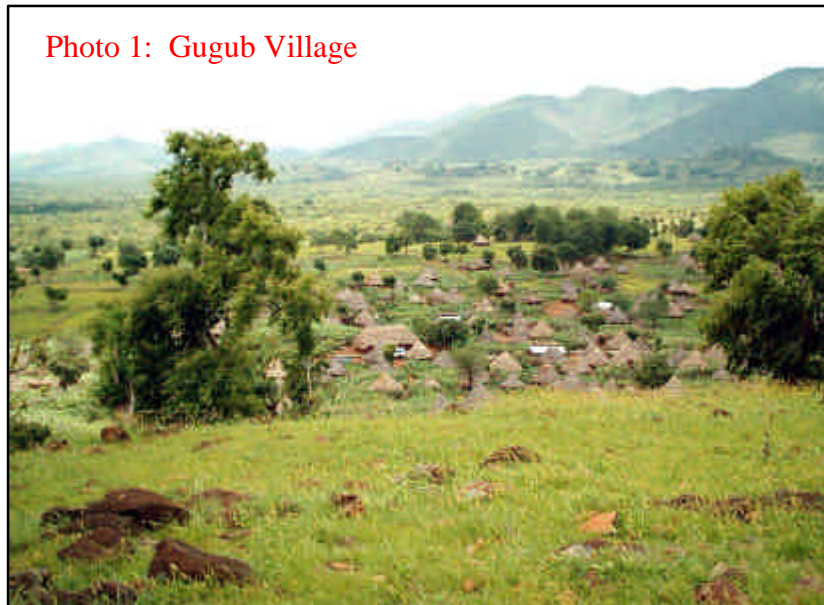
The region is full of economic and natural resources. Rain-fed macro and micro-scale farming, wood cutting, charcoal producing, artisanal gold mining, and commercial fishing are the major economic activities in the southern Blue Nile region. The region has more than one million Fedans of arable land and grazing area (1 Fedan=4200m²). Food crops grown include sorghum, maize, sesame, sunflower, vegetables, and fruits.

Many of the Ingessana Hills residents are now almost involved in artisanal gold mining activities. Gold extraction is a labor-intensive activity, drawing on all members of the community, including young children.

Administrative structure

Blue Nile State is administratively divided to four districts: El Damazin, Roseires, Kurmuk, and Bau. Each district is headed by a commissioner. The state government is headed by Walli (Governor) and 5-Minister cabinet. Bau and Roseires districts are the main areas where artisanal gold mining is now practiced. El Damazin is the capital of the State and serves as the administrative center for the region. There are the schools, a general hospital, Rosireis hydroelectric station, and it is connected to Khartoum by a 520 km asphalt road. The town is connected to Bau and other villages in the Ingessana Hills by an 80 kilometers dirt road, which becomes difficult to use in the rainy season.

Photo 1: Gugub Village



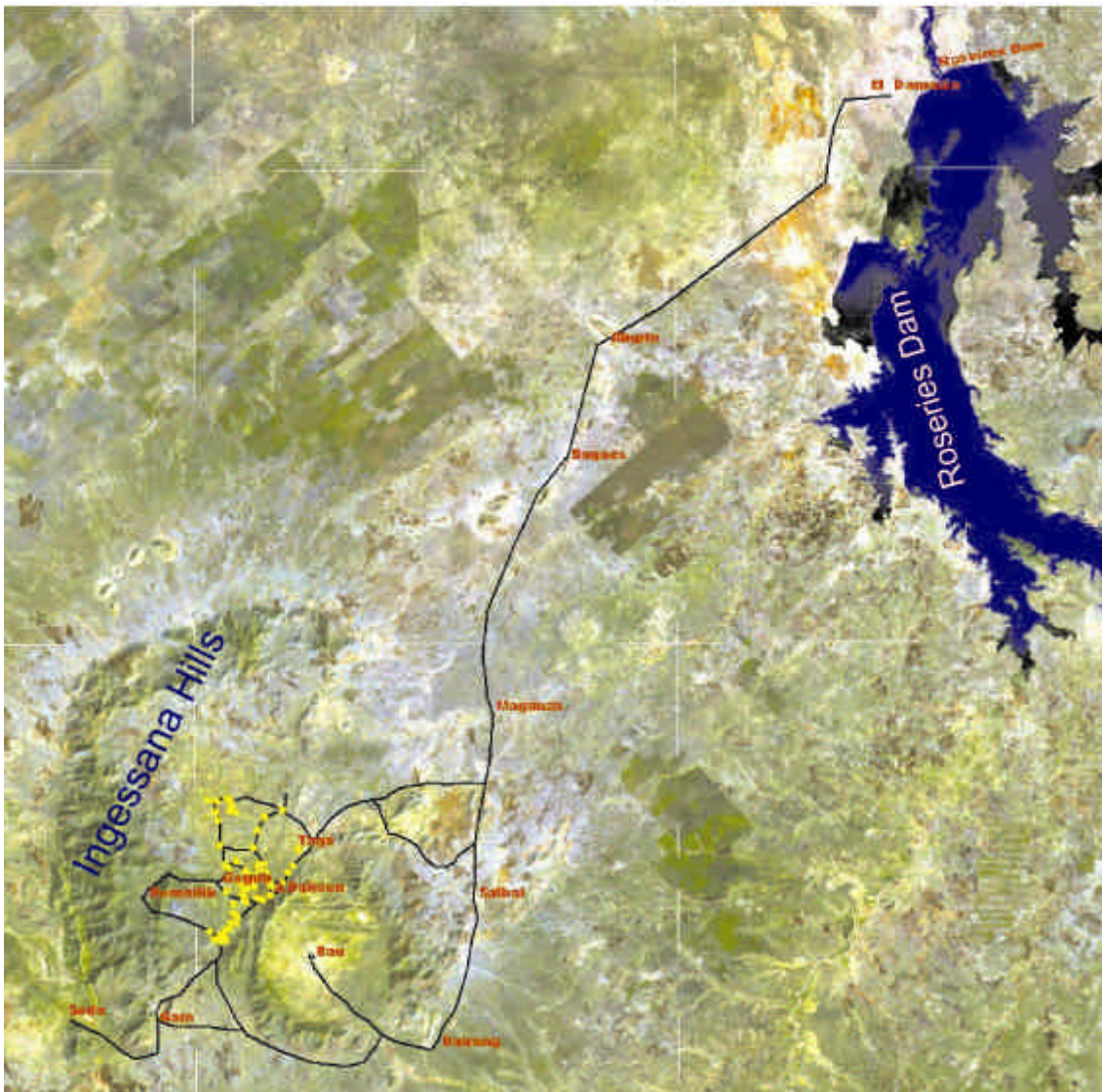
General Characteristics of the Ingassana Hills

Bau, the central town in Ingessana Hills district lies ~80 kilometers southwest of El Damazin, the capital of the Blue Nile State. Other smaller towns and villages scattered around the hills are Soda, Gabanit, Gam, Dairang, Taga, Kumrik, Fadamia, Salbal, and Gugub (figure 3; photos 1&2). Ingessana Hills district comprises major artisanal gold mining sites in Bau Locality. Ingessana district is characterized by a range of hills expanding in a semi-circular form from north to south with a diameter ~40

kilometers. Chromite, asbestos, magnesite (in 1960s) and later gold (in mid 1990s) are discovered in commercial quantities within these mountain ranges.

Fig. 3

Ingessana District Southern Blue Nile Region, Sudan

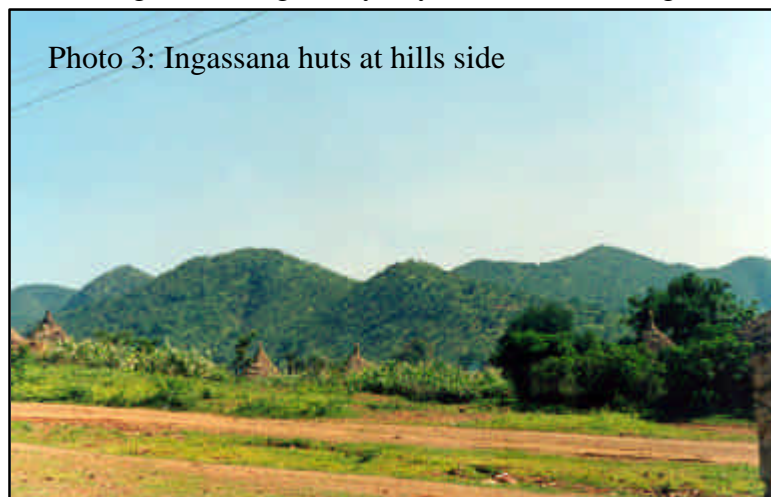




History of artisanal gold mining activities in the Ingessana Hills

Historically Ingassana depended on livestock and on minor shifting cultivation in the low lands beyond their mountains. That means that some Ingassana people used to spend some months away from their villages either in taking care of their livestock and/or cultivating subsistence crops (photo 3). Women used to stay at home in their villages taking care of their kids, and cultivating small land around their houses during the rainy

season. In these small lands, called *Jubraka*, they cultivate vegetables and staples for immediate household consumption. Many Ingessana tribesmen are now involved in artisanal gold mining. They say that since 1997 gold mining is the most important



activity they practice, and further claim that gold mining is profitable and so all members of the family participate in. Before 1996, Ingassana people know about neither gold nor practice artisanal gold mining. Their women do not value gold as jewelry. Now gold and artisanal gold mining is a business for

many and is the main source of cash.

Since 1997, Ingassana district attracted massive people looking for gold. The first to come and live with the Ingassana are Dawala people from Kurmuk ~100 km to the south. About 185 families built their huts in the Gugub village. The Ingassana are pleased to accept Dawala families in their homeland. Actually, the Ingassana confess

that the Dawala showed them the skills of artisanal gold prospecting and mining. Now it is estimated that more than 800 people in Ingassana district are practicing gold mining. The Dawala practice artisanal gold mining, some buy gold from Ingassana miners, and sell food stuffs (e.g. sugar, bread, flour, soap, tea, and coffee..etc) and mercury.

Demography

Number of people

As mentioned, the most recent census of Bau district (Locality) indicate a population of ~100000. The majority of the population is concentrated in bigger settlements like Bau, Dairang, Gam mine camp, Salbal, Maganza, as well as in smaller villages like Gugub, Taga, Gabanit and Soda (figure 3). There are also isolated Ingessana households scattered along hill slopes. Statistics on in and out migration in the Ingessana district is lacking.

Artisanal gold miners in the Ingessana Hills concentrate in Gugub, Taga, and Salbal villages. Gugub village of ~1000 inhabitants is the major center of activities. Artisanal gold miners are scattered in 3 sites at present. The biggest cluster of activities known as khor Gidad is located ~7 km (driving distance) north of Gugub village. There are ~800 individuals currently practise artisanal alluvial gold pitting mainly along stream terraces.

Among the artisanal mining community of Gugub, Dawala ethnic group make ~80% of the population (about 185 household). The rest of the community is represented by the Ingessana ethnic group. In contrast, about 70% of the 300 artisanal gold miners in Taga village located 5 km east of Gugub are from the Ingessana ethnic group. Salbal artisanal gold mining community around Turda site located ~10 km east of Taga Village is not considered in this study.

Ethnicity

Ingessana ethnic group makes 80-85% the district's total population. Visible sedentary ethnic minorities in the district are Dawala of Gugub and Dairang villages (~10%), and Ragarig of Maganza and Salbal villages (~2%) displaced groups. Arab (1-2%) and Folani (1%) nomadic groups are transient communities roaming southern Blue Nile with their cattle the year round. They settle in the Ingessana Hills temporarily during rainy season (June-October). Arabic language is spoken by all ethnic groups; however, each group has its vernacular.

Age distribution

As depicted in figure (4), the age bracket among Gugub artisanal gold mining community is between 15 and 50 years. The majority of male miners ages are in the 15-50 years range while most women miners and water providers at Khor Gidad site are in the 15-35 years old range. Few old men and women (>60 years) practise alluvial gold mining in shallow pits. Children at gold pitting sites are quite visible (10-15%). Girls in the 10 to 13 years age range constitute the majority of participating children.

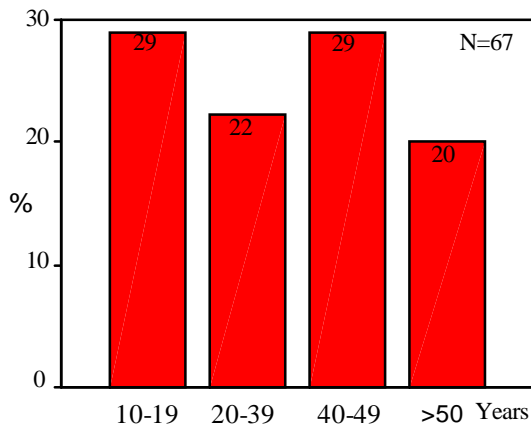


Figure 4: Age distribution of artisanal gold miners in Gugub

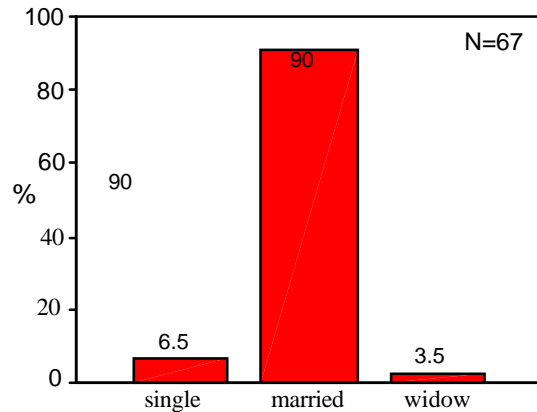


Figure 5: Marital status

Marital status

About 90% of the sample's respondents are married (figure 5). The 6.5% singles are male youth in the twenties who don't have enough money to make families. For women the average age of marriage is 18 years. Polygamy is prevalent; about 38% of the interviewed artisanal gold male miners are married to two wives living in the same houses with the husbands.

Number of children

Figure (6) below shows that the majority of the sample families have children in the few months to 15 years old. Some respondents (~5%) count their over 15 years youth living with them. It is clear that over 40% of families have five or more children.

Data on both fertility and mortality rates is lacking. A source mentioned that mortality rate among the infants is high due to lack of adequate health care. During our stay in Gugub, a UNICEF-sponsored paramedical team arrived from El Damazin for vaccination of the 1month to 4 years old children against a designated 6 types of pediatric deceases within the framework of a national campaign.

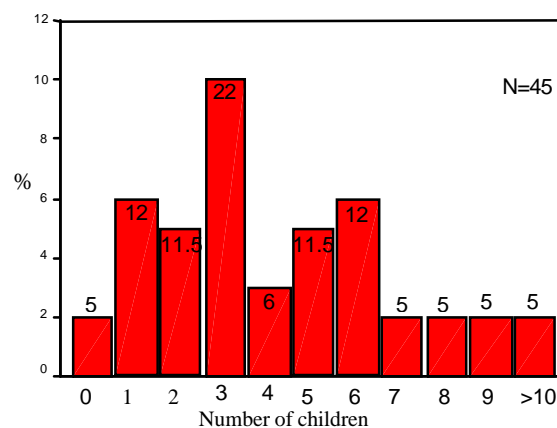


Figure 6: Number of children per family in Gugub

Community Characteristics

Ingassana are the indigenous Nilotic ethnic group who possibly inhabit the Ingassana hills since the 16th century. The second ethnic group is the Dawala who are war displaced. They migrated from Kurmuk district to Ingassana district in 1996 and soon after started practicing artisanal gold mining.

The Ingassana tribe has its own pagan beliefs and ritual practices. Now Islam is spreading among them. In 1997, the Dawala built a mosque and a primary school in Gugub village. These are important developments in the village. They have clearly created a substantial impact among the surrounding Ingessana community.

Community structure

Within the circle of Gugub artisanal gold mining community, Dawala account for ~80% of the ~185 households (~1000 heads). The rest are Ingessana group living at the fringes of the village or as isolated households at hill slopes. The bigger concentrations of sedentary Ingessana artisanal gold miners are found in Taga village ~5 km east of Gugub (~200) and Khor Gam–Rumailik ~7 km northwest of Gugub (~100).

An ethnic Ingessana woman (the wife of Bau commissioner) represents Bau district (Locality) in the National Assembly (Parliament). The district committee acts as both political and an administrative arm of the Blue Nile State in the district. Tribal chief (Omda), village chiefs (Shiehks), and village committees link the peasants with the district authorities and look into both the tribal affairs and services. The Ingessana tribe chief (Omda) lives in Taga village ~5 km east of Gugub. 6 school teachers in Gugub and another 4 in Taga village are the only civil servants within the artisanal gold mining sites in the Ingessana Hills.

Social stability

In terms of social stability within Gugub artisanal gold mining community, no history of conflicts has been reported. All Dawala men interviewed confess that since arrival to Ingessana Hills in 1996, they didn't advocate any case of hatred or discrimination against them. In fact, the Ingessana chiefs and individuals welcomed Dawala in their homeland, and allocated the Gugub area for them to build their dwellings. Because land ownership in the hills is open to the whole community, nobody has claimed a property possession on any piece of land for any type of use. Broadly, no competition on land property exists in the area. Promiscuity and drug/alcohol abuse are not reported among the artisanal mining community of Gugub.

Occupations

Sample data indicates 39% of men and 46% women miners consider artisanal gold mining is their only occupation. 62% of men and 38% of women admit that beside gold mining and extraction they practice some cultivation, cutting wood and related activities (figures 7 and 8). About 3 house wives indicate that they don't practice any economic activity.

Work hours

Most of the respondents (86%) spend 8-9 hours per day in artisanal gold mining and processing (figure 9). However, those who work more than ten hours usually work

overnight. Work usually start at 7-8 a.m. and continue up to 4-5 p.m. when they get back to residences.

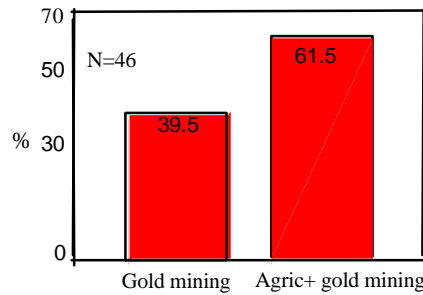


Figure 7: Father occupations

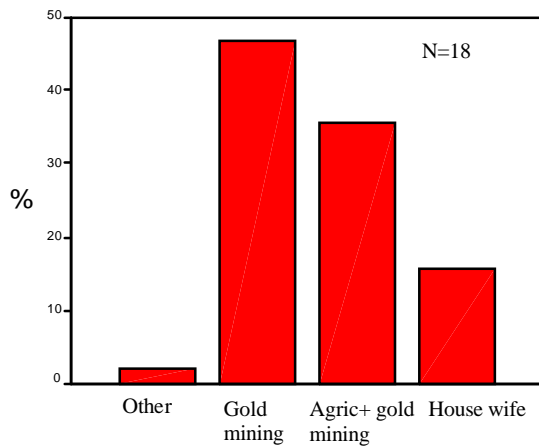


Figure 8: Mother occupations

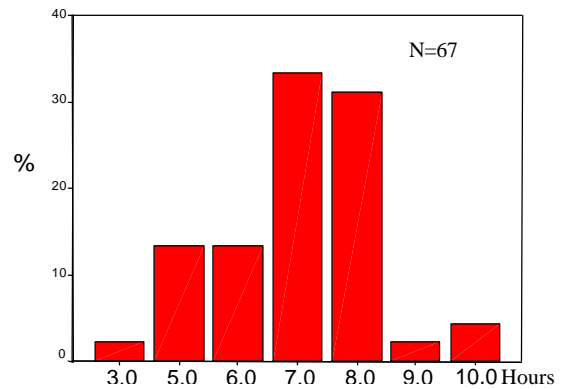


Figure 9: Daily work hours

Levels of income

Interaction between Ingessana tribesmen with the immigrant Dawala and other smaller ethnic groups has changed, to the better, the lifestyle of many Ingessana men and women by adding new culture and the skills of artisanal gold mining and extraction as well. More cash is earned from gold production, which entails more money to spend on the household needs and even make savings for investment. Today, each of the ~60% of artisanal gold miners in Gugub sites earns ~S.D.20000 (US\$ 80). It looks good as compared to the average monthly income of a traditional wood cutter/charcoal maker (~US\$30/month) or a monthly salary of local elementary school teacher (US\$40-50). Some Dawala artisanal gold miners earn more than S.D.40000 (>US\$160) a month (figure 10).

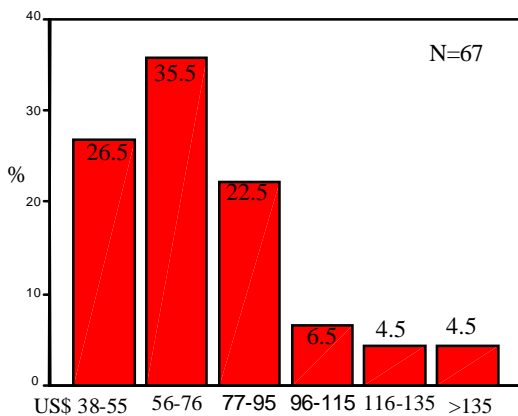


Figure 10: Ranges of monthly earnings from artisanal gold sales in Gugub

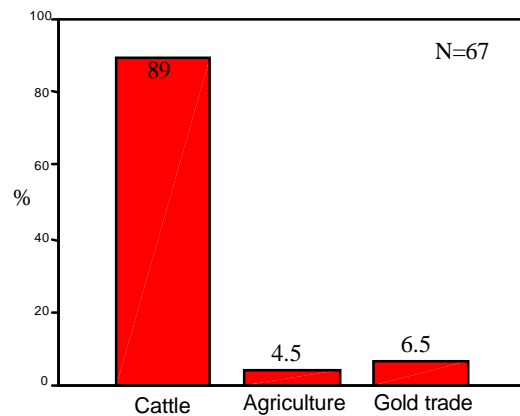


Figure 11: Investment

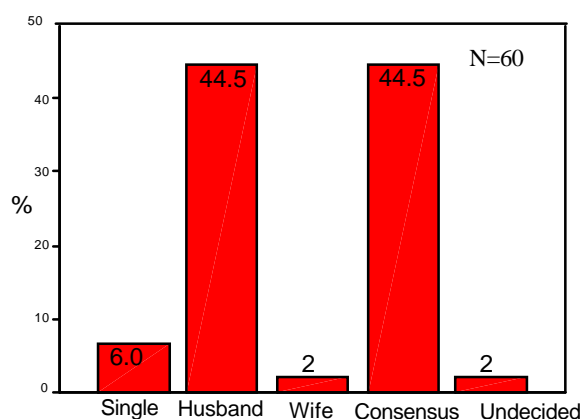


Figure 12: Decision-making in household affairs

Ingassana men argue that before practicing gold mining no such money was earned. About 89 % claim that they invest in cows from gold sales money (figure 11).

Decision-making on income and expenditure

The respondents were asked the question “who makes decisions in household affairs?” Almost 45% argue that men do (husbands and fathers); 45% say by consensus (figure 12).

In the focus group discussions especially with women’s group only, a substantial number of the participants reported that their husbands have the last say on how the money earned from gold mining is to be used.

There are many disadvantages associated with allowing the men to make total decisions for the household. When the men make decisions, the women are denied the opportunity to build up their confidence in the decision-making process. In addition, the women are denied the opportunity to advocate for their own interests, and when they are the ones actually doing the work, it might discourage them from improving the enterprise or excel in artisanal gold mining business.

Infrastructure and Living Conditions

Houses

Both Ingessana and Dawala families live in straw and thatch conical huts. Ingessana people build their huts either at the fringes of the mentioned villages or as isolated households on hillsides (photos1 and 3). Dawalla, on the other hand, live in groups. Excluding some of the shops, all dwellings, school class rooms, and mosque in Gugub are built of straw and wood even though some Dawalla men are affluent enough to build stone or brick bungalows. All respondents own their houses.

In the premises, there is no hut or place reserved for gold processing. The same house is used for sleeping, cooking food, rock ore grinding, and amalgam burning.

In last August, 53% of artisanal gold miners at Khor Gidad site live half a kilometer from the mining pits, 10% live three kilometers away, and 37% live in Gugub ~4 km (walking distance) to the pits.

Sanitation and hygiene

There is no housing plan in Gugub or in other villages of the Ingessana hills. The roads in Gugub are winding around the premises in a zigzagging manner. Garbage is dumped haphazardly along side roads. Both waters from springs and boreholes used in Gugub is contaminated by bacteria (e.g. *E. coli*); probably coming from animals dung.

During our visit, we saw only one latrine in Gugub School. The majority of artisanal gold miners both in Gugub and Khor Gidad mining site, ~7 km to the north, use the bush for bathing. Flies and mosquitoes are widespread in the area.

Education levels

Out of the 49 men and 18 women artisanal gold miners interviewed, only 28% of the men and ~6% of the women attended schools (figures 13 and 14). Among those attended schools, Dawala make ~95%. In this percentage, men miners constitute ~98%. The rate of literacy among the Ingessana artisanal gold miners is low (<5%). Almost all Ingessana women artisanal gold miners are illiterate. Until lately, education was not a priority for them. The ~5 % Ingessana male who attended school are below 15 years.

Education at the artisanal gold mining sites is introduced recently when a primary school is built in 1997 by the Dawala in Gugub village. Gugub and Taga mixed elementary schools are the only facilities where the kids (7-13 years old) of artisanal gold miners attend school. The principal reports that Gugub mixed school has ~150 pupils (1through 6 grades) and 6 teachers. Male: Female pupil ratio is 3. Similar ratio is found in Taga elementary school ~5 km east of Gugub. Among pupils, Dawala: Ingessana ethnic ratio is ~9 in Gugub school. Almost all of kids from both ethnic groups participate in the activities of artisanal gold mining and extraction. It is reported that, for several reasons, school dropout in the Ingessana Hills is high. A source says that school dropout is ~30% in Bau.

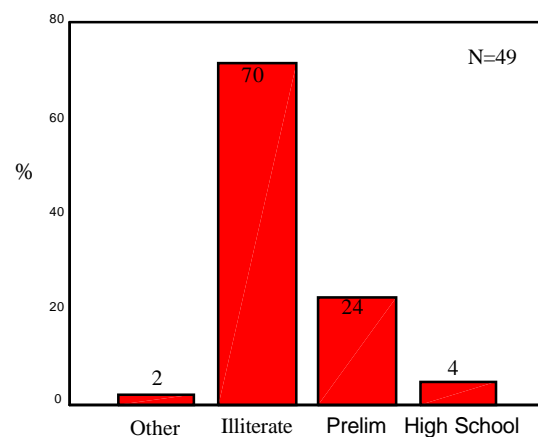


Figure 13: Father miners education in Gugub

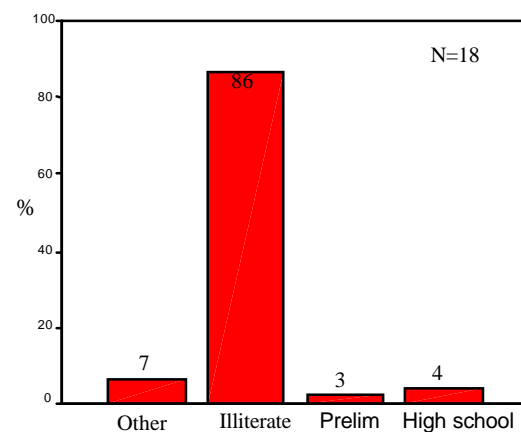


Figure 14: Mother miners education in Gugub

Health

Health care in the area is less than adequate. There is no clinic in Gugub or in Taga. The nearest hospital is located at Bau ~10 km away. In serious cases of illness, the artisanal gold miners go to El Damazin hospital and that is a difficult task during the rainy season. The most common diseases they mentioned are malaria, chest pain, dyspnea, cough, fatigue, urinary system problems irritability and depression especially among women. Daily injuries at pitting sites are common. Although they did not mention but we noticed many of the miners suffer from eye problems (red eyes, teary eyes, itching).

About 63% of respondents say that one or more of the family members suffer from a chronic disease for along time (figure 15). Only 38% admit that there could be health hazards associate with the use of mercury in amalgamation of artisanal gold produced (figure 16). So far, nobody in Gugub or Bau knows what are the symptoms of mercury poisoning.

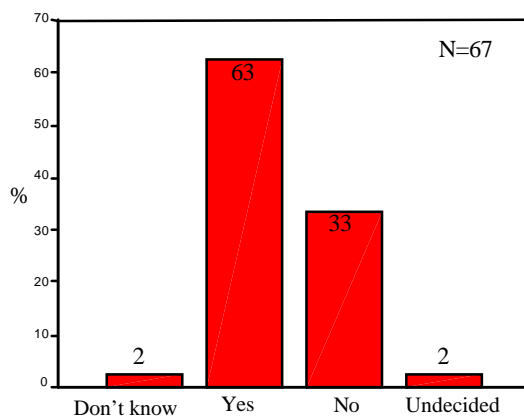


Figure 15: Are there cases of chronic deceases in the family?

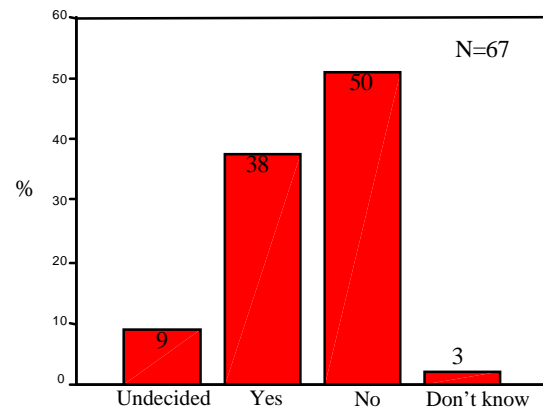


Figure 16: Do you think mercury used in amalgamation causes health problems?

Water supply and quality

Water for both domestic and artisanal gold panning use is obtained from springs, seasonal streams, and shallow boreholes around Gugub artisanal gold mining sites. Most of the respondents (85%) were of the view that the quality of water was good, but 15% mentioned that the water is hard. Almost 100% claim that they do not boil water for drinking. In the dry season, water tastes salty and most of boreholes become dry. M. Ibrahim reports that salt come from magnesite associating the rocks of Ingessana Hills. Water obtained from boreholes is mostly contaminated by bacteria e.g. *E.coli*. Some pits reach water table thus expose underground water to both heavy metals and bacterial contamination.

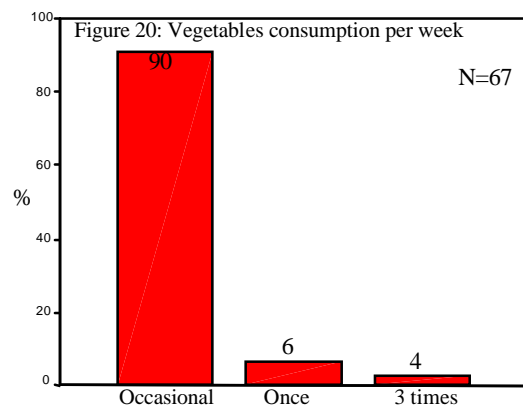
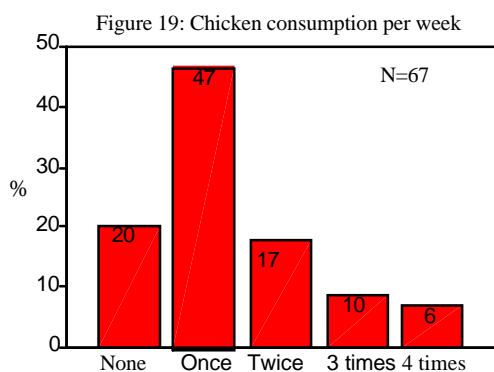
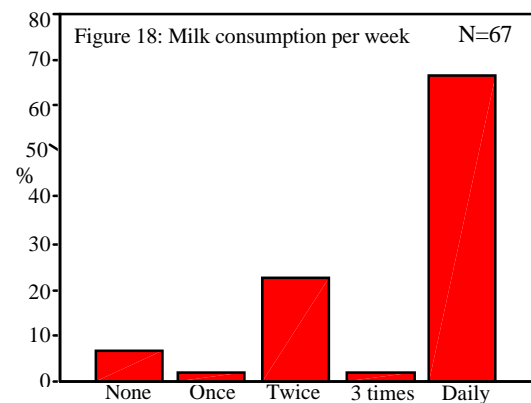
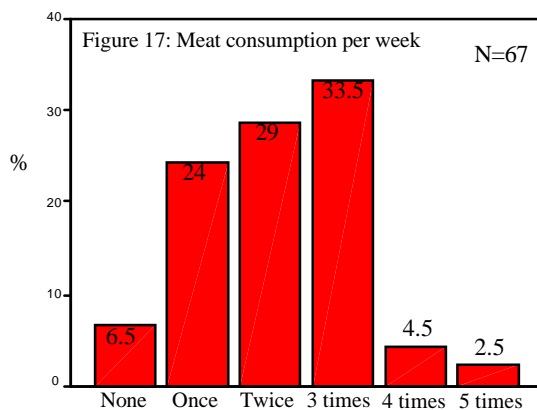
The traditional image of a woman as a mother and housewife underline a clear-cut division of labor between men and women. Hence, the role of fetching water as it has been revealed by the respondents (97%) is clearly the responsibility of women. However, men who do not have wives are buying water from carriers (8%). Ingessana women work as water fetching labor at Khor Gidad artisanal gold mining site located ~7 km (driving distance) north of Gugub. Each woman carries a pair of 4 gallons full

plastic containers on their shoulders ~2km from bore hole to the panning sites to be sold for ~US\$ 0.2 (photo 4).

Diet

Average family in Gugub area eats two meals a day. Sorghum and maize porridge/pan cakes is the main staple. Respondents are asked to determine how many times a week they eat the different types of food. As depicted in figures (17,18,19), 62% eats meat 2 to 3 times a week, 66.6% drink milk everyday, 25% eats chicken and 17% eats eggs once a week. Almost all eats vegetables, and fruits occasionally (figure 20). The nearest source of fresh food supply is about 20 km away. Being located ~50 km away from the Blue Nile western banks, the community of Gugub and the surroundings have no frequent access to fresh fish supply. In the survey, only 2% of the sample report eating fish occasionally. However, dry fish is available in Gugub market.

Photo 4: Ingessana women fetching water



Gold Mining and Extraction Cycle

Types of the extracted gold ore

Gugub and the surroundings comprise about 6 major artisanal gold mining sites. At present, Khor Gidad ~7 km (driving distance) north of Gugub and Khor Neiwi ~5 km northeast of Gugub are the main sites where ~800 artisanal gold miners produce artisanal gold from both alluvium and elluvium (photos 4 and 5). Minor primary gold is found in 3 sites; two of them are active with about 30 individuals practice mining and extraction.

The estimated average amount gold ore extracted from pit per a male miner per day is about 0.5 ton for alluvium, and 20-30 kilograms for rock (quartz).

Pit and tools ownership

All of the respondents have their own gold pits, but none has a mining licenses. They don not feel they need to have such licenses. In fact, the authorities have not asked them to obtain any type of mining licenses/titles. Now, after the discovery of gold and the increasing influx of people into the Ingessana Hills, we expect that pressure on land will increase tremendously and this will reflect on land relations. 99% of the respondents own hand-used rudimentary axes, picks shovels, rubble haulage containers, and wooden pans. All mining tools are locally made by a blacksmith that works beside the pits.

Provision of capital for gold mining and processing

Most of the respondents they obtained capital from their own resources (93%). Only 7% had borrowed money from relatives. There is no micro-finance scheme in the area. In the group discussion, they agree that family labor is basic in the artisanal gold mining activities. This often leads to increased workload for women who also have household duties.

Alluvial gold mining

Men and women artisanal gold miners of Gugub dig haphazard pits up to 20 meters deep. In digging down, they prepare helical steps for easy descend and ascend. Usually two or three persons work in one pit in some sort of a division of labor. Two or three individuals (usually family members) handle the operation. The one inside the pit mine alluvium/elluvium using axe, pick, and shovel. The person outside pulls the loaded bailer (plastic container) out of the pit using a robe. A third person empties the can into another plastic container or a wooden pan, then carry it to the panning spot. There he/she takes a small amount of the rubble into a wooden plate and wash in water. Every now and then, he/she stops shaking and throws away part of the mixture and add more rubble. This process of shaking and throwing part of the mixture continues until fine heavy fraction, expected to contain gold grains/particles, remains at the bottom of the pan. Depending on visual check, the appearing small pieces of gold are picked by a wet piece of cloth. By the end of the day all gold pieces are gathered and sold, without farther treatment, to the gold trader who actually moves around the site all day buying the produced gold. Usually the gold trader pays in cash or in kind, i.e. trade them what they need from foodstuff and other products. During our stay in the area, a gram of alluvial gold sells for S.D. 2400-2500 (US\$ 9-9.5).

Primary gold mining

In primary artisanal gold mining, people search for signs of gold in the rocks. When the miner sees such signs, they start digging and breaking the rocks selectively into small pieces with a locally made sledge hammer and pick (photo 6 and7). At home, women grind these rock pieces using grinding stone until the ore becomes very fine. After initial panning in water to reduce waste, mercury is added to the remaining rock powder.

The amalgam is then transferred into an open frying pan or tin plate then put on wood fire. Mercury evaporates leaving behind gold. Of course, all family members stay around the evaporating pan watching the magic of mercury disappearance leaving behind gold as an informant told us.

In the process, members of the family cannot avoid inhalation of smoke coming from the frying pan. They don't know the risk of such process. 84% of miners interviewed denied any risk (figure 21). The amalgamated gold has less value in the local market (S.D. 1500=US\$ 6/gram). M. Ibrahim indicated that primary gold could contain natural alloyed silver and copper up to 20% by weight.

Photo 4: Ingessana and Dawala miners at work in Khor Gidad site



Photo 5: Alluvial gold panning



Photo 6: Artisanal gold miner at a pit

Photo7: A pioneer Ingassana artisansal primary gold miner



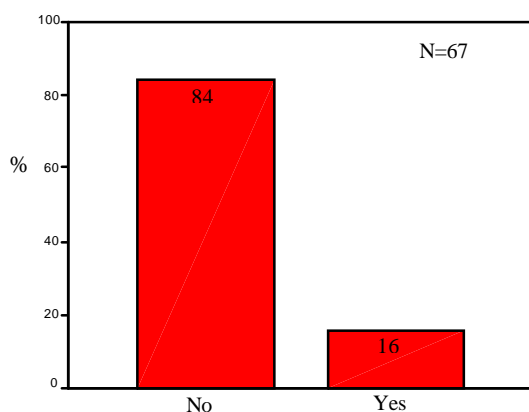


Figure 21: Awareness about risks in using mercury

Artisanal gold processing

Panning of alluvium/rock powder as well as rock grinding in Gugub artisanal gold production sites is mainly women's job. It is reported that efficiency of panning using the traditional wooden pan is ~50%. Apparently, all fine gold goes down with the tailings. Alluvial/elluvial gold produced through panning is sold without undergoing further purification.

After selection of mineralized rock pieces in primary artisanal gold mining, size reduction is performed by mortars and /or grinding stones (photo 8). Mechanical mills are prohibited since inception of activities in 1997 by the local authorities. The semi-fine quartz+gold powder (200-500 microns) is panned carefully by women at homes.

In Gugub artisanal gold mining site, mercury is used frequently in extraction of fine gold practices from the panned concentrate. The way of handling mercury in gold amalgamation is careless. Hg is poured onto the concentrate and mixed with bare fingers to make the amalgam. After thorough mixing, the amalgam is squeezed in a piece of cloth to expel excess Hg. After that, the separated amalgam is transferred to an open plate or frying pan then burned. Amalgamation and amalgam burning processes are also performed in the house, sometimes inside the huts. Amalgamation's tailings are disposed of in the house yard or at pit site.

The amount of mercury used to extract 1 gram of gold in Gugub amounts to about 3 grams (figure 22). Though not all Hg poured into the gold-bearing concentrate goes into amalgam. Based on estimates reported by M. Ibrahim, About half (~1.5 grams) are squeezed off as an excess Hg and collected into a container to be used again. Thus, the ratio of Au_{produced}: Hg_{lost} is 1:1.5 i.e. for every gram of gold won, 1.5 grams of mercury is emitted as mercury vapor. An ounce of mercury in Gugub costs (US\$0.8). Accordingly, the cost of 1.5 gm Hg lost per 1 gm Au produced is US\$0.045.

About 70% of the artisanal gold miners in Gugub say that mercury is bought from local merchants/dealers and 27% obtain mercury from Gugub merchants only (figure 23). Some miners claim that merchants supply them with free mercury in return of selling their gold to the merchant. Goldsmiths of El Damazin are said to be the major mercury suppliers because they have access to big gold markets in Khartoum and Omdurman. Gugub merchants buy mercury from goldsmiths/dealers at ~US\$29/kg.

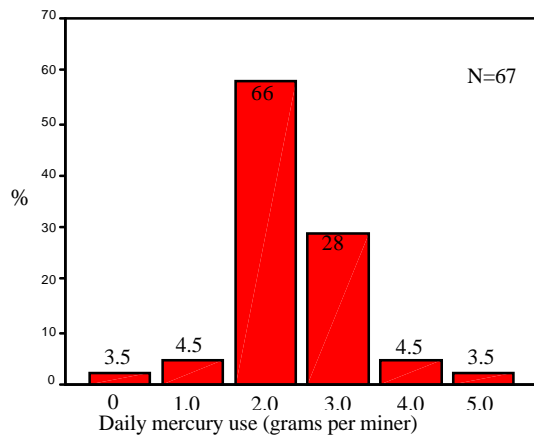


Figure 22: Daily mercury usage in artisanal gold extraction-Gugub AGM

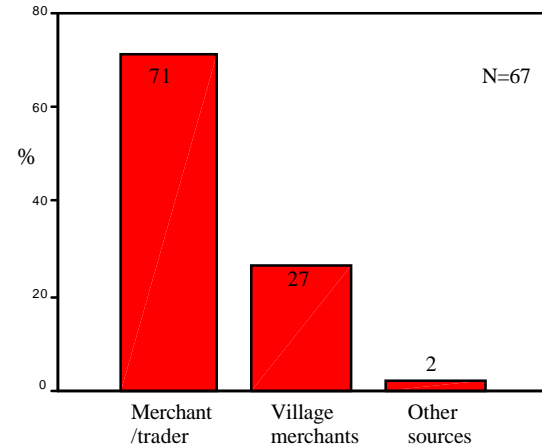


Figure 23: Suppliers of mercury used in artisanal gold extraction-Gugub AGM sites

Awareness about environmental or health hazards caused by the use of mercury

Over 80% of the respondents do not see health risks resulting from using of mercury in gold amalgamation. During focus group discussions, both men and women were less informed about the effects of mercury on both human health and the environment. When we told them about mercury dangers they said that they have been mining for so long and nothing is seen of such hazards. Any awareness campaign to be carried out on mercury hazards should put in mind that the majority of the miners at Gugub artisanal gold mining sites illiterate, and so acquiring new skills depends either on visual, aural, or experimental learning.

Willingness to participate in the project activities

Almost all respondents agree to be trained on how to use the introduced new gold mining and processing equipment. However, about 15% of them admit that they rather use the traditional procedures (figure 24). When asked whether they prefer to work in group or alone, 70% agree to participate in artisanal gold mining as group (figure 25) but 84% refuse participating in any cooperative society (figure 26). This reflects the family practicing artisanal gold mining and processing in Gugub.

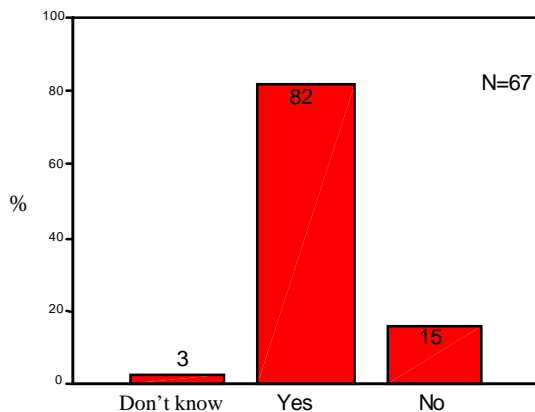


Figure 24: If new equipment is supplied would you accept using it in AGM?

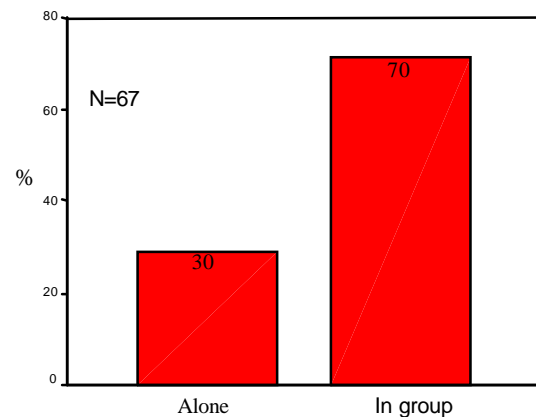


Figure 25: Do you prefer to work in group or alone?

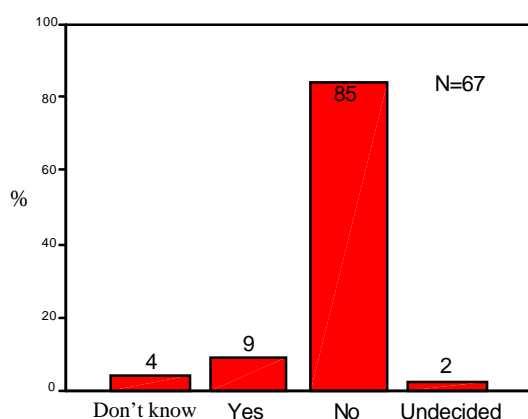


Figure 26: Do you mind to participate in artisanal gold mining cooperative society?

Conclusion and Recommendations

- After we came back from Ingassana Hills in last August, reliable news came that in Khor Gidad gold mining site, Gugub miners discovered a gold-bearing vein that returned more than 56 kilograms of gold. We expect that more gold miners will rush into the Ingassana district. Therefore, what we suggest and recommend now are really important and urgent.
- Environmental and Health investigation team should immediately start surveys in the district. Data and information must be gathered about the E&HA situation in the district, which are essential for future comparisons and the information will furnish a database for future assessment.
- Knowledge about health hazards caused by mercury should be disseminated as early as possible. This could be done through different media e.g. videos, posters, T-shirts, caps, banners etc. Since the majority of the people are illiterate, audio-visuals, photos, and public discussion methods should be used. Local authorities and leaders like Sheikh (chief), Omda (big chief) should play important roles in such campaigns.
- Alternative gold extraction technology that minimizes the health and environmental hazards of mercury should immediately be introduced. All miners agree to accept the new affordable technology if it could be demonstrated for them and prove efficiency.
- The problem of water (hardness, scarcity during summer, remoteness from mining site and households) should be addressed.
- Women should be given special consideration. They need to be exposed to adult education. They also need to have special programs for them, i.e. giving them the new equipment in reduced prices, and help them organize themselves in sort of co-operative societies etc.
- The latest news that gold is found in great quantities in Ingassana district, and the subsequent rush of gold miners to the district will result in land ownership conflicts. We suggest that authorities should start an immediate land registration and give priority to the Ingassana people. Also urgently needed is a police station or some arrangement for security measures. Up to now, Ingessana chiefs are keeping law and order in the district, because they are

respected in the tribe. But with the expected rush, diversified and heterogeneous ethnic groupings may lead to competition that may end up in the development of clashes and conflicts in the absence of security measures.

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Appendix 1: Volunteers for the Health Survey

#	Volunteer's name	Age	Sex	Address
1	Ali Basha	45	M	Gugub
2	Abdullah EL Haj Basheer	34	M	"
3	Eisa Tiya Salim	35	M	"
4	Dahia Abdalla	30	F	"
5	Mohamed Alamin	55	M	"
6	Um El Hassan M.Alamin	25	F	"
7	Um El Hassain M. Alamin	25	F	"
8	Ibrahim M. Alamin	16	M	"
9	Mahir M. Alamin	14	M	"
10	Bakeita M.Alamin	13	F	"
11	Mohamed Salih Mamoun	38	M	"
12	Zu Lkifle Yahia	28	M	"
13	Ali AL Rayeh Ali	36	M	"
14	EL Haj Elyas	25	M	"
15	Rawda Mohamed Ali	22	F	"
16	Musa Mohamed El Naeme	45	M	"
17	EL Zaki Badawi El Zaki	55	M	"
18	Nazar Badawi El Zaki	24	M	K Gidad/Gugub
19	KhamisTiya Salim	45	M	"
20	Farid Tiya Salim	17	M	"
21	Awad Balla Tegian	27	M	"
22	Isam Awad Balla	15	M	"
23	Balla Awad Balla	13	M	"
24	Khadiga Mohamed	25	F	"
2	Awatif Mohamed Elhaj	27	F	"
26	Hassan Daffalla	29	M	"
27	Aisha Omer	26	F	"
28	Sabir Hassan Daffallah	12	M	"
29	Abdul Hadi Ahmed	47	M	Gugub
30	Halima Ramadan	40	F	"
31	Marriam Elhaj Basheer	35	F	"
32	EL Rasheed Abdelrahman Hamd	25	M	"
33	Abujal Misik Garmos	39	M	"
34	Hamid Ahmad Moala	47	M	"
35	Eitidal Salih Mohamed	24	F	K.Gidad/Gubub
36	Ramadan Tiya	45	M	"
37	Toma bakheit	40	F	"
38	Musa Hassan El Shafee	24	M	"
39	Fatima Saad El Shafee	20	F	"
40	Suliman Ambali	42	M	"
41	Makkia Amken	35	F	"
42	Mohamed Nour Suliman	16	M	"
43	Toma Osul Abdelgader	23	F	"
44	Abdella Musa	36	M	"
45	EL Sora Fedellalmoula	39	F	"
46	Isam Abdella	23	M	Gugub

47	Musa Abdella	21	M	“
48	Taha Abdella	19	M	“
49	Mohamed Abdella	17	M	“
50	Beladin Abdella	16	M	“
51	Salfa Jakati	57	M	“
52	Dirweesh Kulfa	58	M	Taga
53	Ibrahim Ahmed	37	M	Khor Gam
54	Saad El Shafee	55	F	Gugub
55	Mardia Ambali Saadella	49	F	“
56	Adam Biraig wolfa	45	M	“
57	Sayma Adam	37	F	“
58	Mohamed Afodi siraj	65	M	“
59	Abuk Dawka Kore	39	M	“
60	Alamin Mohamed El Fadil	45	M	Taga
61	EL Seir Hajar Baggar	35	M	Gugub
62	Saadia Mohamed Jaadain	25	F	Khor Gidad
63	Hassan Jinka Hamed	45	M	“
64	Absoni Merik	36	M	Ferri
65	Farah Boot Idris	35	M	Absoni
66	Abdu Marhom Gisso	49	M	Merik
67	Bashir Abdella Abilo	55	M	Dairang