



Artisanal and small scale mining baseline survey report

Prepared for Ministry of Energy and Minerals,
United Republic of Tanzania

Contract ME/008/SMMRP/C/26

Prepared by Godwin Protace, ASM Project Manager
Pact Institute
74 Uporoto Street, Ursino South, Victoria
P.O.Box 6348, Dar-es-salaam, Tanzania
Tel.: +255-22 276 1933
Fax: +255- 22 276 1938
gprotace@pactworld.org

Executive Summary

The Ministry of Energy and Minerals (MEM) of Tanzania signed a contract with Pact Institute for Preparation of an Operational Manual and Coordination of Small-scale Grants Scheme Phase II for Artisanal and Small-scale Miners (ASM). Pact was required to conduct a baseline survey in three mining blocks of Tanzania namely Chunya, Geita and Tarime focusing on current production statistics, average individual and household incomes of miners, and valuation of mining assets.

This baseline survey employed mixed methods in its design incorporating both qualitative as well as quantitative methods using questionnaires for mining households, miners, mine operators and owners and focus groups discussions with miners. The study identified a control group of non-mining households living around the mining sites in order to establish a comparison point for evaluation purpose.

The random sampling of the mining sites for the survey was done from two lists of mining sites. The first list comprised of mining sites that were seen by MEM as active sites with many mining groups and the second list comprised of mining sites that MEM felt were small and with few mining groups. This was in line with the requirement of the MEM in order to ensure that the baseline survey did not leave out the small and emerging mining sites. A stratified, random sampling approach was used to select respondents for this survey. In this approach to sampling, strata (divisions) were predetermined and then the respondents within the predetermined strata were randomly selected to participate in the study.

The questionnaires were administered using the mobile phones and survey software on existing cellular networks to provide an electronic platform for data collection and enable immediate data entry. The mobile phones used for the data collection exercise were GPS enabled and thus allowed the data collectors to take GPS coordinates for households and mining sites visited in areas where there was network coverage. GPS coordinates for social services infrastructures were also collected in all places with network reach.

The baseline survey highlighted that mine workers have low levels of education with women having lower mean level of education than men. The majority of miners reported being taught mining by their peers within the mining site, indicating a system of informal apprenticeship and training in artisanal and small scale mining that can be explored and improved for skills building in the artisanal mining sector. Mining was the sole source of livelihood for 50% of miners where 24.4% of all miners have been mining in the same mining site for 5–10 years indicating some stability in the area contrary to the migratory mining phenomenon seen during a ‘gold rush’. 1.8% of miners were children (below 18 years) though this is related to the sampling process which specifically identified adult respondents. The clandestine nature of child labor under the Tanzania Employment and Labor relations Act (2004) which prohibits employment of children in hazardous work means that a rigorous/quantitative analysis of child labor in mining is extremely difficult to do.

Basic needs expenditure analysis and a review of how the income from mining is spent were used as a proxy for average individual and household income and the results show that miners spend an average of 50,000 Tshs (approximately 31.3 USD) per week on food. Statistically, with equal variance not assumed, there is no significant difference observed in food security between mining households and non-mining households. This means that on average mining households do experience same level of food shortage/ struggle to get food for the family as does the non-mining households. 19% mining households spent up to TZS 50,000/- (31.5 USD) on medical expenses in comparison to their counterpart non-mining households where 8.9% spent the same amount of money for medical expenses. Communication and transport consumed an average of 20,000/- Tshs (12.5 USD) per

week. Artisanal and small scale miners' income is irregular and dependent on striking a productive ore body thus they can be months or a whole year without income. In terms of burden of care, the results show that women have a statistically higher average number of dependents than men with 76% of women having up to six dependents as compared to 57% of men. Supporting these families without regular income is a challenge and many miners live on credit and 23% of income from mining is used to pay debts. 33% of income is used for running costs related to mining activity, mineral processing, and transport or trading.

In terms of production once a gold bearing ore is reached, 13.0% of mine owners are producing up to 20 kg of gold-bearing ore per day, 17.4% of owners reported 20 – 40 kg of ore per day, 10.9% of owners reported more than 40 kg of ore. The majority of respondents (58.7%) reported measuring production in other terms. 65.2% of mine owners reported to produce an average of 1 – 5 grams of gold out of whom 13.3% reported to produce 1-5 grams of gold from 20 kg ore, 16.7% reported 1 – 5 grams from 20 – 40 kg ore, and 10% reported 1 – 5 grams of gold from over 40 kg of ore. Majority of mine owners (60%) reported other measures.

28.3% of miners work more than 13 hours a day while 49.5% of miners work in excess of three night shifts per week. 11.8% of miners are too sick to work every week representing a considerable loss of productivity for the mines and income for the miners. Poor processing methods lead to loss of valuable minerals which can be avoided through more efficient technologies. A shortage of skilled workers in the mining sites, such as certified blasters and geologists among other skills, also negatively affects production.

In terms of alternative livelihoods, miners expressed a preference for trading businesses and considered that this would potentially provide much a higher income than mining. Other alternatives identified were agriculture including farming and animal husbandry. The miners' interest in these alternative livelihoods was also confirmed by data showing reinvestment of income gained from mining into mining equipment/ tools, agriculture, and small business activities.

The baseline survey recommends the following to the Ministry of Energy and Minerals:

- a) Support artisanal and small scale miners with in-kind assistance in terms of geological surveys to determine the location, extent, quality and quantity of mineral deposits in the areas so as to maximize time and resources invested by artisanal and small scale miners in mineral extraction and to avoid wastage, inefficiencies and debt.
- b) Through the regional and zonal mining offices, identify active and functioning, legal mines to be the beneficiaries of Government support in improving productivity.
- c) Support artisanal and small-scale miners with tools/equipment for mining. The equipment and tools should be placed under the regional mining office with equal access to all legal miners. Reasonable fees should be charged for paying the operators and maintenance of the equipment/ tools.
- d) Address the low literacy levels of miners through adult literacy programs and train miners on basic business skills, coupled with savings programs to support self-generation of capital.
- e) Conduct a study on the health and well-being of miners, their access to health services, and local health systems strengthening.
- f) A nationwide geological survey to determine mineral deposits in areas where artisanal and small scale mining is conducted so that the Government will have better estimates of production and thus better prospects for royalties estimation.

Abbreviations

ASM	Artisanal and Small scale Mining
CITI	Collaborative Institutional Training Initiative
COSTECH	Commission for Science and Technology
DIT	Dar-es-Salaam Institute of Technology
GPS	Global Positioning System
HIV/AIDS	Human Immuno Virus/ Acquired Immunity Deficiency Syndrome
IGA	Income Generation Activity
LSM	Large Scale Mining
M	Mean
MEM	Ministry of Energy and Minerals
NGOs	Non-Governmental Organizations
PML	Primary Mining License
SD	Standard Deviation
SMMRP	Sustainable Management of Mineral Resources Project
SMS	Short Message Service
SPSS	Statistical Package for Social Sciences

Table of Contents

Executive Summary.....	ii
Abbreviations.....	iv
List of Tables	vii
List of Figures	vii
1. Introduction	1
1.1 ASM challenges for financiers.....	1
1.2 Women in mining.....	2
1.3 Best practices in small grants mechanisms.....	2
1.4 Pact’s Assignment	4
1.5 Objectives of the project.....	4
2 Methodology.....	5
2.1 Overview of the survey design and implementation.....	5
2.1.1 Study Population and Selection Criteria	5
2.1.2 Sampling Procedure	5
2.1.3 Data Collection Methods	6
2.1.4 Data Management	7
2.1.5 Methods of Data Analysis	7
2.2 Ethical considerations	8
2.3 Baseline survey limitations	9
3 Results.....	10
3.1 Demographic characteristics.....	10
3.2 Average individual and household incomes of miners in mining areas	12
3.2.1 Household economic profile	12
3.3 Production statistics in targeted mining areas	20
3.4 Valuation of mining assets: mining/ minerals processing equipment and tools.....	26
3.5 Health and safety in mining	30

4	Discussion of results.....	35
4.1	Situation of Artisanal and small scale mining in Tanzania	35
4.1.1	Miners’ levels of education and skills	35
4.1.2	Mining practice, technology and accessibility of mines	35
4.2	Opportunities within artisanal and small scale mining.....	36
4.2.1	Mining as a means of earning livelihoods.....	36
4.2.2	Skills building through apprenticeship.....	37
5	Conclusion.....	38
	Appendices.....	39

List of Tables

Table 3.1.1: Number (%) of respondents by age, sex and mining block.....	10
Table 3.2.1: Household respondents by source of income, respondent type and mining block	13
Table 3.2.2: Household assets ownership by type of respondents and mining block.....	15
Table 3.2.3: Average number of dependents per head of household interviewed.....	16
Table 3.2.4: Average weekly savings from mining income	17
Table 3.2.5: Alternative income generation activities	19
Table 3.3.1: Distance and accessibility of the mines from the district capital	21
Table 3.3.2: Miners and pit owners by type of work they do in the mines	22
Table 3.3.3: Skilled Miners and the type of skill	23
Table 3.3.4: Amount of gold bearing ore extracted per day	23
Table 3.3.5: Amount of gold produced per specific measurement of gold bearing ore	24
Table 3.3.6: Average price of gold (per gram) and selling points	24
Table 3.3.7: Presence of Government officials in the mining sites.....	25
Table 3.4.1: Equipment and tools used in artisanal and small scale mining	27
Table 3.4.2: Equipment and tools needed to improve mining	28
Table 3.5.1: Recurrent illness and mining accidents	31
Table 3.5.2: Symptoms of mining related illnesses as reported by household respondents.....	33

List of Figures

Figure 3.1.1: Percentage of respondents by level of education	11
Figure 3.1.2: Proportion of miners and pit owners by level of education and gender	11
Figure 3.1.3: Household respondents by type of respondents	12
Figure 3.2.1: Average weekly expenditure on basic needs.....	17
Figure 3.2.2: Average monthly savings by gender	18
Figure 3.2.3: Reinvestment of mining income into mining activities	19

Figure 3.2.4: comparison of size of mining income and other income generation activities.....	20
Picture 3.3.1: Extracted gold ore	
Figure 3.3.1: Legal status of mining sites as reported by mine owners.....	21
Figure 3.3.2: Ownership of minerals produced in a mining site	25
Picture 3.3.2: Underground mining shaft	
Figure 3.4.1: Consumables used to run the equipment/tools used in mining sites	28
Figure 3.4.2: Hazardous materials used in artisanal and small scale mining.....	29
Figure 3.4.3: Effluents from the mines	30
Figure 3.4.4: Availability of electricity in the mining sites	30
Figure 3.5.1: Physical wellbeing as reported by miners and pit owners	32
Figure 3.5.2: Respondent’s self- reported HIV status.....	34

1. Introduction

Artisanal and Small-scale Mining (ASM) is characterized by the use of rudimentary tools and techniques, with high levels of manual labor, to extract, transport, process and trade minerals. It is often carried out under poor working conditions and precarious security causing negative social and environmental impacts. Lack of technical resources and knowledge often result in a poor capture rate for benefits and low levels of production efficiency. However, despite these challenges, it is also an important livelihood for millions of men and women providing either a primary, supplementary, seasonal or emergency income source which may be much higher than that gained from other occupations and, importantly, is an immediate source of cash compared to other longer-term income-generating activities. ASM was the major producer of minerals in Tanzania between 1987 and 1997 and, despite the increase in industrial Large-Scale Mining (LSM), the artisanal sector continues to provide an important livelihood for some 680,000 people. ASM occurs throughout Tanzania, producing gold, diamonds, gemstones, tin, salt, limestone, dimension stone, gypsum, sand and gravel.

One of the primary constraints blocking the enhanced efficiency, increased mineral recovery, and improved safety standards of ASM is lack of access to finance. The Government of Tanzania's Sustainable Management of Mineral Resources Project (SMMRP) plans to respond to this need by providing small-scale grants and an equipment leasing scheme for ASM operators. The activities will involve the development of Small-Scale Grants Operational Manual for management of small grants financed through the SMMRP, along with supporting resources such as a database and training plan, to support the efficient and effective disbursements of small-scale grants by the SMMRP.

1.1 ASM challenges for financiers

The ASM sector presents an array of challenges which have negatively impacted on the credit-worthiness of miners and mine operators and which have resulted in a dearth of funding mechanisms. These challenges include:

- Artisanal miners often lack geological skills and resources. Mines may be located by chance, by using abandoned geological workings, by following professional prospection teams, or other methods. The miners may have very limited knowledge of the scale and potential life of their deposit hence the potential return on investment in the mine is unknown;
- Depending on the legislative framework governing the mining sector, artisanal miners may have limited rights to own or control the resources they find or exploit. This leads to a precarious position vis-à-vis their site tenure and the value of their deposit as collateral on a loan;
- Due to lack of equipment and appropriate exploitation and processing techniques, the ore body may be exploited in an inefficient manner resulting in 'high-grading' which removes the most accessible, highest grade ore but wastes the lower grade material which is still valuable. Poor recovery techniques may also contribute to lower productivity than is possible. This results in sub-optimal profitability of the operation;
- Poor mine management techniques can result in significant environmental damage which may result in liabilities, fines, suspension of operations, or other disruptions to income and debt repayment. The same may apply to failure to observe health and safety regulations which, again, may result in suspension of activities;
- Artisanal miners are often migratory and if they have little personal investment or ties to an area, they may easily and rapidly leave a site to move to another which is reported to have

found a rich strike or may be producing a mineral with a higher market price. Thus a mine owner may literally find him/herself with a dramatic reduction in labor overnight with resulting depressed production;

- ASM is subject to the same price fluctuations as LSM depending on international mineral markets. ASM operators will typically have limited resources to act as a buffer against market fluctuations and will rarely have a business plan in place which demonstrates how they anticipate managing such risks;
- Artisanal miners and mine managers often have not had the opportunity to develop their business skills, may have limited financial management acumen, and may have existing debts to service from previous operations.

Faced with such a daunting array of potential pitfalls and negative factors, it can be understood why ASM has traditionally been excluded from many small business funding mechanisms, especially those where the finance comes in the form of a loan with terms of repayment. Even when the finance mechanism is a non-repayable grant, the challenges exist and potentially compromise the effectiveness of the grant therefore they are of equal concern to a grantor as a lender. However recognition of these limitations is already the first step towards building a viable and effective funding mechanism which is appropriate for the ASM sector.

1.2 Women in mining

Women constitute a significant proportion of the ASM workforce and may be involved in a wide range of activities including mining, transporting, processing, trading, and mine ownership or management. Women often face particular challenges that create barriers to accessing mineral resources and rights, as well as generating equitable benefits from ASM. These challenges may be legal, cultural, traditional and practical. Added to this, women may also have experienced exclusion and discrimination in terms of education opportunities which may limit their ability to work in some aspects of ASM such as business development. Women may be poorly represented in structures such as mining cooperatives. The Small-Grants Program component of the SMMRP will recognize and respond to their particular needs and potential vulnerabilities of women in ASM and the granting process will be designed to specifically ensure the inclusion of women grantees.

1.3 Best practices in small grants mechanisms

Pact manages sub-grants to indigenous NGOs across the globe, from nascent to well-developed organizations, with individual grants from \$1,000 to \$5,000,000. Pact has a strong reputation as a trusted grants manager for USAID and other donors, allowing donors to grant money and provide capacity development support to small organizations that do not have the ability to maintain compliance with rules and regulations on their own. Grants management is one of Pact's primary focus areas with approximately 70% of Pact's annual turn-over in the form of sub-grants. In 2011 alone, Pact administered \$40.5 million through 500 grants and strengthened the capacity of local partners in 23 countries. This robust expertise has provided a library of best practices to be used in the development of the Grants Manual. Below are a set of key lessons from past experience.

In order for small grants to be effective, there are important preliminary steps which need to be taken to identify and prepare the prospective grantees, as well as a process to accompany the effective implementation and management of the grant to ensure and measure successful outcomes and impacts. As noted above, the business and operating environment has to be well understood with an emphasis on the often challenging economic structures and constraints of ASM mineral market. The business acumen of the applicant (whether an individual or a consortium such as a

cooperative) must be understood and reinforced. If the applicant is the latter, the terms and statutes governing the consortium must be clear and legally recognized.

There are also many factors that affect the successful establishment of local and community level procurement opportunities and systems. These go beyond the business considerations and also touch on issues such as traditional structures, cultural constraints and expectations, as well as relationships within the community. Procurement (in this case, selection of grantees) is a process which is potentially fraught with challenges and compromises and is often subject to local complaint or misinterpretation if it creates disparities, preferential opportunities, or jealousies.

Community sensitization is a key part of a successful small-grants program which will be a key component of the needs assessment field work. Clear communication of these parameters will help in the management of expectations and the procurement/disbursement process. Protection of the integrity of the system, and assurance of ease of operation by the Client, is achieved through transparent processes which are clearly communicated and have in-built, simple, effective audit mechanisms.

People become involved in ASM for a wide range of reasons. Some are driven by need and lack of alternatives, some are opportunistic and see this as the most lucrative choice available at the time, some become trapped in the sector but would rather be working in a different profession, and some are trained and/or committed miners who have an interest, aptitude and future in mining. Whilst all can benefit from support, it is the latter group which has the potential to use grants for the longest term and largest scale benefit. Identifying genuine entrepreneurs who have the ability to create jobs or economic opportunities for others has a significant multiplier effect. Building this profiling into the application screening process is important.

Applicants are also likely to need support to access and complete the grant application process. Lack of capacity at this stage should not be a barrier to application for a grant, therefore the process of training and capacity building starts even before the grants are made. Once grants have been dispersed, the recipients need to have clear terms, simple tools, direct support, and an appropriate degree of flexibility to manage them effectively. Skills development and business planning are integral to the management process. Disbursement of the grant may be done on an incremental basis against agreed milestones and success indicators to maintain a high level of participation in the process, generate feedback, and to facilitate benchmarking of progress.

A robust monitoring and evaluation mechanism is a cornerstone of a sound grants program, and it allows for continuous improvement in the selection and support of grantees. The SMMRP has already established an ASM baseline database and this report constitutes an update to that baseline. Indicators will be integrated into the SMMRP M&E Framework.

As noted previously, many artisanal miners are indebted due to the precarious and unpredictable nature of their work as well as lack of formal and professional resources. Whilst it is sensitive information, it is important to know the level of indebtedness that an applicant for a grant may have in order to avoid the benefits of the grant being used solely to service the debt. Repayments can be legitimately incorporated into a business plan but must not become the object of the grant.

Finally, the tools provided for the grants mechanism must be accessible, user-friendly, and use appropriate language. These principles will be applied to the Small-Scale Grants Manual which is a key deliverable of this Project. Pact has an internal Grants Manual which sets standards and provides tools for staff and grantees, which will be used as one source of guidance for the development of the tailored Manual for this Project.

1.4 Pact's Assignment

On 1st August, 2013, the Ministry of Energy and Minerals of Tanzania signed contract No. ME/008/SMMRP/C/26 with Pact Institute in respect of Preparation of Operational Manual and Coordination of Small-scale Grants Scheme Phase II for Artisanal and Small-scale Miners (ASM). This contract was based on the proposal that Pact Institute submitted in response to the Request for Proposals (RFP ME/008/SMMRP/C/26) and subsequent negotiations.

Pact developed the Inception Report based on the results of a team workshop and meetings with the SMMRP team in Dar es Salaam from 13-16 August, 2013. The Inception Report provided a detailed, finalized review of the project work plan, methodology, tools, logistics, and implementation calendar. The report incorporates clarifications, direction, and materials provided by the SMMRP. The Inception Report builds on and supersedes the proposal and is fully aligned with the contract. Hence it formed the base working document for the project going forward. Based on the inception report, Pact was tasked to complete a number of key activities under this contract.

1.5 Objectives of the project

The objective of the project is to develop a Small-Scale Grants Operational Manual, along with a Baseline Database, a Needs Assessment and a Training Plan, to support the efficient and effective disbursements of Phase II ASM Small-scale Grants by the SMMRP.

To achieve this, the following activities will be undertaken:

- 1) An ASM Baseline Study in three blocks (Geita, Tarime, and Chunya) focusing on: (a) ASM production; (b) individual and household incomes; (c) community social interventions; and (d) ASM mining assets and equipment;
- 2) A Needs Assessment in all Mining Zones to gather data on: (a) alternative livelihoods; (b) community social interventions; and (c) constraints to ASM efficiency;
- 3) Desk research into other ASM Grants Schemes;
- 4) Integration with other SMMRP activities, notably the Scoping Study on Establishment of demonstration Centres for ASM and research into potential linkages with other SMMRP projects.

Chapter two of this report provides the details of the methodology used for the baseline survey as well as the study limitations.

2 Methodology

Pact was tasked with updating the ASM baseline survey in Geita, Tarime, and Chunya blocks. Specific tools were designed for this activity, which are shown in Annex of this report and received approval from the MEM in advance of the start of the survey.. The data obtained from the baseline survey are to be used to update the current ASM baseline database at the Ministry of Energy and Minerals.

A team of 21 mining graduate students from the Dar es Salaam Institute of Technology (DIT) was contracted for data collection utilizing the mobile phone technology under the supervision of Pact's M&E Officers.

Pact is required to conduct a desk research with SMMRP to obtain relevant materials and to study the ASM legal framework, completed ASM grant programs in other countries as well as existing and completed tool leasing programs from other countries. Pact will also conduct a needs assessment and scoping study in all eight mining zones, focusing on alternative livelihoods, community infrastructure, ASM efficiency, and synergies with SMMRP activities.

2.1 Overview of the survey design and implementation

The baseline survey used mixed methods design incorporating both qualitative as well as quantitative methods. The study provides a general overview of the situation of artisanal and small scale miners in three mining blocks of Tanzania. The mining blocks are Chunya, Geita, and Tarime.

2.1.1 Study Population and Selection Criteria

The study included a variety of people working within the mining sites in the selected mining blocks as well as a control group of non-mining households living around the mining sites in order to establish a comparison point for evaluation purposes. The non-mining households were selected based on similar socio-economic status to that of mining households and matched by location. The study interviewed mining households, miners/ pit operators and mine owners/ mine operators at the mining site to gain an understanding of artisanal and small scale mining in the selected blocks.

Study respondents selection criteria were:

- 1) Adults members of a household involved in artisanal and small scale mining activities;
- 2) Adults members of a household not involved in mining activities (control group);
- 3) Mining site owners;
- 4) Mining site operators;
- 5) Miners (including people involved in mine extraction and those performing supporting functions within the mine such as transport, processing etc.).

Criteria for exclusion in the study were:

- 1) Disability that prevented the respondent's ability to willingly participate in the survey;
- 2) Selected respondent's informed choice not to participate in the survey.

2.1.2 Sampling Procedure

A stratified, random sampling approach was used for this survey. Stratified sampling is division of the population elements into mutually exclusive groups and then selection of a random sample from each group (Christensen et.al, 2011). In this approach to sampling, strata (divisions) were predetermined and then the respondents within the predetermined strata were randomly selected to participate in the study and analysis was done based on these respondents. The predetermined

strata in the case of the study were the mining blocks Chunya, Geita and Tarime. Stratified sampling was selected for this purpose because MEM had provided the mining blocks to be included in the baseline survey, thus defining the strata for the survey. The mining sites to be included in the survey were done randomly using two lists of mining sites from the MEM. The first list comprised of mining sites that were seen by MEM as active sites with many mining groups and the second list comprised of mining sites that MEM felt were small and with few mining groups. This was in line with the requirement of the MEM in order to ensure that the baseline survey did not leave out the small and emerging mining sites. The random selections from the two categories were combined to have a single sample representing both categories. This was agreed with the SMMRP¹ before the survey commenced.

Sampling of respondents in the field was initially designed to be a simple random sampling based on the list of registered miners. The prevailing situation in the mining sites was, however, different from the initial plan where there were no lists of registered miners in almost all mines visited. To address the sampling issue in this case, the data collection team used a systematic sampling.

Once in the field, the team:

- 1) Held meetings with mine owners (as many as could be identified) to understand the situation of the mines they own. This included a number of miners who were active and available at the sites;
- 2) Determined how many miners they could interview in each mining site based on the sample size;
- 3) Divided the sample by available population to get the Nth number for interviewing e.g. if $n=3$ then it meant the team would be interviewing every third person they met in the field.

The sample size was calculated using the formula: $s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P)$. Where:

- s = required sample size;
- X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841);
- N = the population size;
- P = the population proportion (assumed to be 0.5 since this would provide the maximum sample size);
- d = the degree of accuracy expressed as a proportion (0.05).

2.1.3 Data Collection Methods

The baseline survey employed questionnaires with mining and non-mining households for collecting data on individual miners or households' incomes. Production statistics as well as mining assets valuation data was collected through questionnaires with miners/ pit operators, mine owners/ mine operator. The study also used focus group discussions for collecting data on alternative livelihoods for miners as well as efficiency of artisanal and small scale mining. A survey of social infrastructure was also conducted to collect data on available social services around the mining sites.

The questionnaires were administered using mobile phones through the use of mobile survey software and existing cellular networks to provide an electronic platform for data collection and allow for immediate data entry. This technology has also been used before in Tanzania for social marketing research and orphan and vulnerable children research. In this technology, the

¹ Meeting, 6th September 2013

questionnaire was uploaded into the mobile phone using software developed by Mobenzi (www.mobenzi.com). A web-based system was established that allowed electronic surveys or questionnaires to be designed (on a word processor), sent to, and conducted on standard, entry-level mobile phones. As surveys were completed, they were automatically uploaded to the host server. In cases where there was no mobile network coverage, surveys were conducted offline and completed surveys were automatically stored securely on the phones (entry level mobile phones store up to 50 completed surveys – depending on the length of the survey). When the phone was back within network coverage, the completed surveys were automatically uploaded into the server.

The mobile phones used for the data collection exercise were GPS enabled and thus allowed the data collectors to take GPS coordinates for all households and mining sites visited in areas where there was network coverage. Key infrastructures GPS coordinates were also collected in all places with network reach. Interactive maps are generated from the GPS information collected in order to support the numerical data collected. Pictures were also taken for key issues that need to be reinforced by images in the report.

2.1.4 Data Management

Data collected from the field was securely kept on the server of the host computer. All data collectors were assigned unique identifier codes for easy tracking and correction of data errors. All data was checked daily by Field Supervisors and the Data Manager. Regular reports including daily data collection status by mine block was generated to monitor the progress of the data collection exercise. The data management system allowed the Data Manager to open the submitted complete survey from the central computer and review for data quality issues. The Data Manager was able to send instant SMS directly to the field data collector's mobile phone from the computer while data collection continues so as to alert the data collector on some data quality issues that are emerging from the submitted data. All survey data was encrypted maintaining the confidentiality of responses and data security. Access to the web-interface was protected by passwords and firewall. Furthermore, the completed questionnaire could not be accessed or retrieved on the phone. This was a feature that allowed for data security in case a phone was stolen during or after data collection.

2.1.5 Methods of Data Analysis

The quantitative data collected was exported from the server into excel for final data clean-up. The data clean-up at this stage ensured that there were no pilot test data in the final dataset for analysis. The data was then imported into SPSS V.20 where further clean-up was conducted to ensure that all coding is in line with SPSS coding and thus final dataset for analysis. Merging of relevant datasets was also done at the data clean-up stage to ensure that data was analyzed as a single dataset. The analysis syntax was kept with clear procedures on how data manipulation and computing was done for future reference of data analysis procedures if needed. The data is presented in this report in tables and charts.

The qualitative data was transcribed into electronic versions and translated from Swahili (language of interview) into English. The data was manually coded and categorized. The data analysis team read through the interviews and highlighted key points / issues of interest that come up through the interviews, impression of depth, credibility and usefulness of information. The team selected the most descriptive words of the text to form codes. The raw data was then organized into codes of related topics/ themes. The themes were then categorized based on the interview guide questions.

2.2 Ethical considerations

Ethical clearance

Ethics is a crucial issue when conducting research with human subjects primarily in order to ensure that no harm is done to the study respondents. Ethics are also essential in ensuring that a survey adheres to scientific methods of inquiry and thus captures data that is accurate, valid, empirical and replicable. The baseline tools and protocol were first submitted to the MEM for review and approval. The tools were also submitted to Tanzania Commission for Science and Technology (COSTECH) which is an ethical clearance board for review and approval of research protocols. In further ensuring ethical practice, all the data collectors in this baseline were required to participate in online research ethics training for human and behavioral sciences from CITI (Collaborative Institutional Training Initiative, www.citiprogram.org), at the University of Miami, of which Pact Inc. is an affiliate member. The training provides reading materials and requires completion of tests for each module. The trainees become certified upon satisfying the requirements of CITI with a pass rate of 80%, which was set by Pact.

Informed Consent

The baseline survey team provided information to the participants about the baseline survey and clarified the expected role of the participants prior to beginning the data collection. Upon clear understanding, the written consent of participants was sought. In the case of a child respondent, the consent for participation was first sought from the parents/ legal guardians. In the absence of legal guardians, a Government official responsible for the community where the child lives was requested as proxy consent for a child to participate. The children were also asked for a written assent after information was provided to them about the baseline. Contact details for the research team were left with respondents in case they needed to follow-up with questions or need any clarifications after the data collection.

Confidentiality of study participants

Participants were assured that all information collected will be kept securely and used for the sole purpose of the baseline survey. Further assurance was given that in case of a direct quote made from the data collected, no name will be mentioned in relation to the quote. Participants were assured that the data collected from the phones cannot be retrieved from the phone and that participants' information will be secure in the server in the event the phone get stolen; lastly, participants were assured that access to the data in the server is limited to authorized persons only.

Non coercion

The research team ensured that no participant was coerced into participating in the survey. Participants were informed that participation is completely voluntary, that they had a right not to participate in the survey and that their choice not to participate would have no consequence on their part or for their families. Participants were also informed that they had the right to stop the interview at any time if they felt uncomfortable about it. They could also choose not to answer part or an entire question if they felt uncomfortable about it.

Benefit to the study group

The research team understands that SMMRP under the MEM intends to work with all artisanal and small scale miners involved in this baseline survey in order to improve the socio-economic impacts of mining sector in Tanzania. The research team acknowledges the dilemma of using control groups in social science research. To ensure that participation is of benefit for all respondents (including the

control group) and based on the findings of the survey, the baseline survey results includes recommendations for social infrastructure improvements within and around mining sites which have potential to benefit not only mining communities but all people around the mining sites.

2.3 Baseline survey limitations

Although Tanzania has eight mining zones and many mining blocks, the baseline survey was limited to three blocks of Chunya, Geita and Tarime. This was in accordance with the Consultant's terms of reference given by the client, the MEM. The baseline survey only selected a few mining sites within the mining blocks as agreed with the MEM and did not cover all the mining sites within the block.

Attaining the maximum sample size was limited by the prevailing situation in the mining sites. In Tarime and Chunya particularly, the data collection teams found that in most mines, the active and available miners were less than the required sample size. In some instances, the teams were compelled to interview all miners in the mining site in order to attain a statistically significant sample. Despite the limitations, the overall data collected represent 99% confidence interval. The confidence interval is reduced when data is analyzed at the mining block level.

Existing conflicts and tensions within some mining sites prevented the teams from accessing the mines for data collection. This happened in Tarime where the team was specifically advised by mine owners and Government officials to not attempt visiting some mining sites for security reasons.

3 Results

The results presented in this chapter are organized according to the baseline survey key indicators of data collection, i.e. average incomes of individual miners and households, production statistics as well as assets valuation. Additional information presented is the demography of baseline survey respondents and observations on health and safety in mining.

3.1 Demographic characteristics

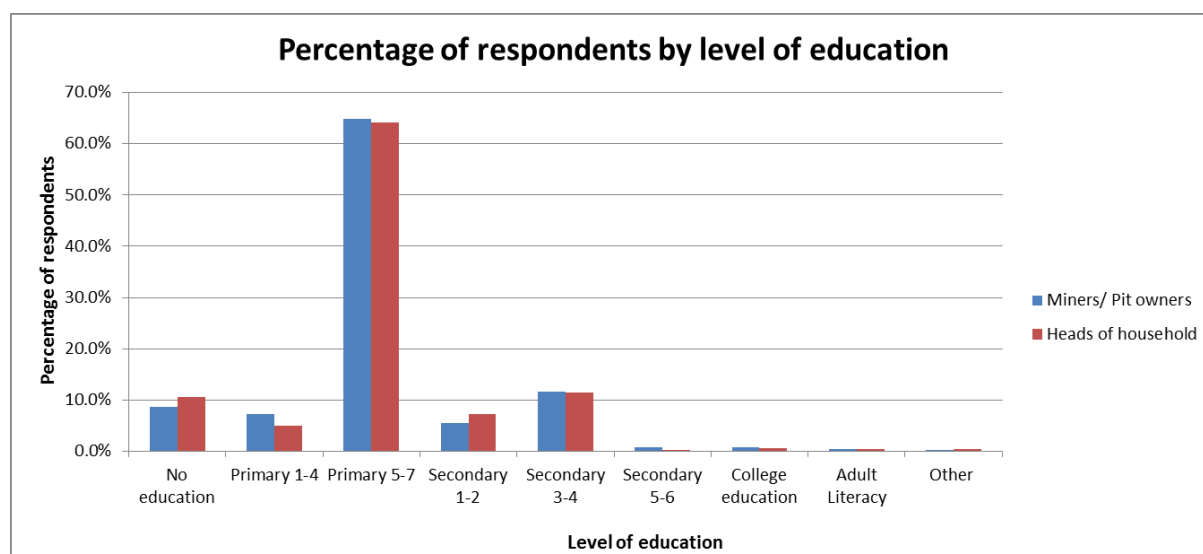
The baseline survey data was collected from 849 miners /pit owners (233 from Chunya, 351 from Geita and 265 from Tarime). Other respondents were 46 mine owners and 647 heads of households. The table below provides the breakdown of respondents by mining block, age and sex.

Table 3.1.1: Number (%) of respondents by age, sex and mining block

Variable			Chunya		Geita		Tarime		Overall Total
			Male	Female	Male	Female	Male	Female	
Miners/ pit owners	Age of the respondents	Below 18 years	6 (2.7)	0 (0.0)	4 (1.3)	1 (3.0)	3 (1.3)	1 (2.9)	15 (1.8)
		18-35 years	157 (71.4)	13 (100)	236 (74.2)	21 (63.6)	124 (53.9)	12 (34.3)	563 (66.3)
		36-60 years	56 (25.5)	0 (0.0)	76 (23.9)	10 (30.3)	101 (43.9)	22 (62.9)	265 (31.2)
		Above 60	1 (0.5)	0 (0.0)	2 (0.6)	1 (3.0)	2 (0.9)	0 (0.0)	6 (0.7)
		Sub-total	220 (100)	13 (100)	318 (100)	33 (100)	230 (100)	35 (100)	849 (100)
Mine Owners/ operators	Age of the respondents	18 - 35 years	5 (18.5)	0 (0.0)	2 (28.6)	0 (0.0)	2 (22.2)	0 (0.0)	9 (19.6)
		36 - 60 years	19 (70.4)	0 (0.0)	4 (57.1)	0 (0.0)	6 (66.7)	2 (66.7)	31 (67.4)
		Above 60 years	3 (11.1)	0 (0.0)	1 (14.3)	0 (0.0)	1 (11.1)	1 (33.3)	6 (13.0)
		Sub-total	27 (100)	0 (0.0)	7 (100)	0 (0.0)	9 (100)	3 (100)	46 (100)
Household respondents	Age of the respondent	Below 18 years	0 (0.0)	1 (2.4)	2 (0.8)	0 (0.0)	0 (0.0)	2 (3.8)	5 (0.8)
		18 - 35 years	71 (82.6)	37 (88.1)	120 (46.0)	44 (57.1)	67 (52.3)	26 (49.1)	365 (56.4)
		36 - 60 years	15 (17.4)	4 (9.5)	135 (57.7)	31 (40.3)	59 (46.1)	24 (45.3)	268 (41.4)
		Over 60 years	0 (0.0)	0 (0.0)	4 (1.5)	2 (2.6)	2 (1.6)	1 (1.9)	9 (1.4)
		Sub-total	86 (100)	42 (100)	261 (100)	77 (100)	128 (100)	53 (100)	647 (100)

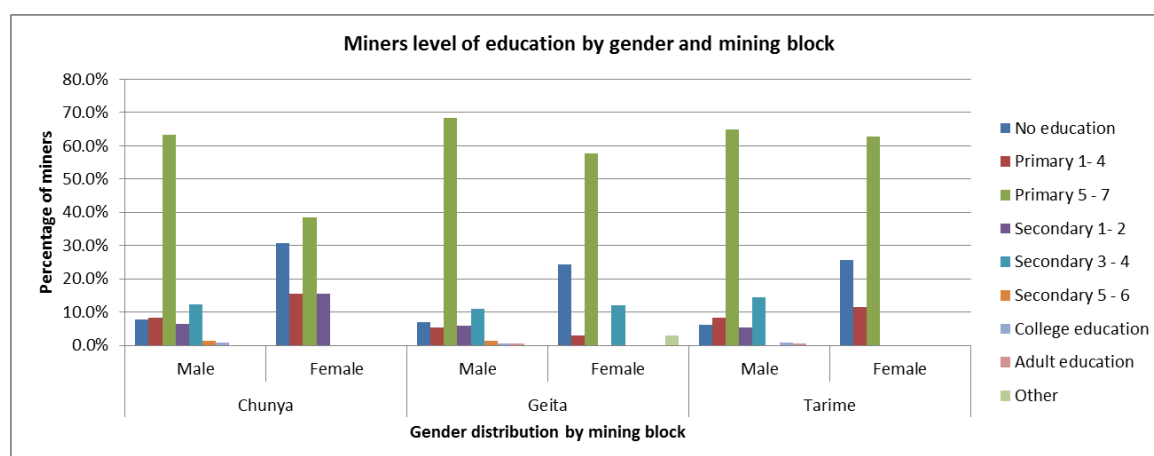
From the table above, it is noted that children below 18 years old represented 1.8% of the interviewees. The Tanzania employment and labour relations Act (2004) prohibits children employment in hazardous work which includes mining. Furthermore 0.8% of heads of households interviewed were children below 18 years old indicating the presence of some child headed households within the mining sites. The baseline survey looked at respondents' education as part of the demographic profiling. The data shows that the majority of artisanal and small scale miners (64.9%) in the three mining blocks have completed primary education. 11.7% of miners and 11.2% of household respondents have completed lower secondary school, while 8.7% of miners and 10.5% of household respondents have no education. Only 0.7% of miners and 0.6% of household respondents had attained college education. Data on education of mine owners were not collected.

Figure 3.1.1: Percentage of respondents by level of education



The data from the chart below shows that women in each mining block are less likely to be educated than their men counterparts. In all the mining blocks, a significantly large number of women with no education were observed. In Chunya the percentage of women with no education is 30.8% as compared to 7.7% of men. In Geita the percentage is 24.2% as compared to 6.9%, whereas in Tarime the percentage is 25.7% as compared to 6.1%.

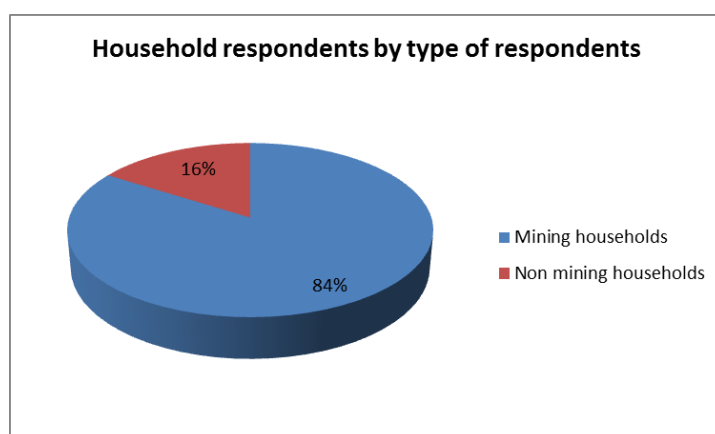
Figure 3.1.2: Proportion of miners and pit owners by level of education and gender



A t-test with no equal variance assumed shows that there is significant difference in the mean level of education between men (M= 3.18, SD 1.08) and women (M= 2.59, SD = 1.28), $t(92.5) = 3.95$, $p = 0.00$. This means that the observed differences between men and women are not due to chance.

The survey also looked at the number of mines that miners had worked in and the length of time that the miners have worked in the present mining site. The questions were aimed at establishing whether artisanal and small scale mining in Tanzania is migratory in nature which tends to reduce the incentive for miners to invest in the area. The data shows that 6.5% of miners interviewed have worked in more than 10 mines, while 8.5% miners have worked in 5 – 10 mines. The majority (64.5%) of miners however, have worked in 1 – 3 mines. In terms of the length of time that the miners have worked at the present mine, 36.6% of miners have worked for 6 – 12 months. 28.4% have worked for 1 – 3 years while 24.4% have worked at the present mine for more than 5 years.

Figure 3.1.3: Household respondents by type of respondents



A total of 647 respondents were interviewed at household level. This included 475 male and 172 female respondents. Out of these respondents 82.1% were married, 11.9% were single, 2.5% were divorced and 3.6% were widow/ers. Table 3.2.2 shows respondents distribution by sex and marital status

Table 3.2.2 Respondents Marital Status by Gender

Gender	Marital Status	Mining Block			Total
		Chunya	Geita	Tarime	
Male	Married	67(77.9)	225(86.2)	111(86.7)	403(84.8)
	Divorced	2(2.3)	5(1.9)	1(0.8)	8(1.7)
	Single	17(19.8)	27(10.3)	13(10.2)	57(12.0)
	Widow (er)	0(0.0)	4(1.5)	3(2.3)	7(1.5)
Female	Married	26(61.9)	53(68.8)	49(92.5)	128(74.4)
	Divorced	3(7.1)	4(5.2)	1(1.9)	8(4.7)
	Single	10(23.8)	10(13.0)	0(0.0)	20(11.6)
	Widow (er)	3(7.1)	10(13.0)	3(5.7)	16(9.3)

The above findings indicates that majority of males respondents (84.8%) were married. There is a slight different to female respondents who 74.4% reported being married. There is insignificant percentage of female reported being widow (9.3%) with a slight high number (13.0%) being reported in Geita mining block.

3.2 Average individual and household incomes of miners in mining areas

To address the objective of establishing average individual and household income of miners, data was collected on household sources of income, assets owned by household members, household expenditures and savings. Other data collected included financial decision making at household level, food security, potential alternative livelihoods as well as HIV/AIDS situation at household level.

3.2.1 Household economic profile

Out of the 647 household respondents interviewed, 63.1% are earning their income as miners, 7.4% are earning income in mineral processing, and 8.8% are small traders. In terms of non-mining activities, 8.5% respondents are farmers while 1.4% of household respondents are formally

employed. 0.6% of respondents have no sources of income. The table below provides a detailed account of respondents by sources of income and mining block.

Table 3.2.1: Household respondents by source of income, respondent type and mining block

Respondents' sources of income	Chunya		Geita		Tarime		Overall Total
	Mining household	Non Mining Household	Mining household	Non Mining Household	Mining household	Non Mining Household	
Employment	0 (0.0)	0 (0.0)	3 (1.1)	4 (7.1)	2 (1.1)	0 (0.0)	9 (1.4)
Mining	69 (82.1)	2 (4.5)	220 (78.0)	7 (12.5)	110 (62.1)	0 (0.0)	408 (63.1)
Mineral trading	1 (1.2)	0 (0.0)	8 (2.8)	2 (3.6)	5 (2.8)	1 (25.0)	17 (2.6)
Mineral processing	2 (2.4)	0 (0.0)	31 (11.0)	0 (0.0)	15 (8.5)	0 (0.0)	48 (7.4)
Farming	3 (3.6)	10 (22.7)	10 (3.5)	20 (35.7)	11 (6.2)	1 (25.0)	55 (8.5)
No income source	0 (0.0)	1 (2.3)	0 (0.0)	1 (1.8)	2 (1.1)	0 (0.0)	4 (0.6)
Causal labour	0 (0.0)	1 (2.3)	1 (0.4)	0 (0.0)	7 (4.0)	0 (0.0)	9 (1.4)
Small business /trader	2 (2.4)	25 (56.8)	4 (1.4)	15 (26.8)	11 (6.2)	0 (0.0)	57 (8.8)
Other	7 (8.3)	5 (11.4)	5 (1.8)	7 (12.5)	14 (7.9)	2 (50.0)	40 (6.2)
Total	84 (100)	44 (100)	282 (100)	56 (100)	177 (100)	4 (100)	647 (100)

Table 3.2.2 provides an overview of individual main source of income. Overall, mining still remains to be the leading source of income especially for male where about 70.7% of all male depends on mining as their main source of income

Table 3.2.2 Individual Source of Income by Gender

Gender		Mining Block			Total
		Chunya	Geita	Tarime	
Male	Employment	0	2(0.8)	2(1.6)	4(0.8)
	Mining	53(61.6)	192(73.6)	91(27.1)	336(70.7)
	Mineral trading	1(1.2)	7(2.7)	4(3.1)	12(2.5)
	Mineral processing	1(1.2)	26(10.0)	6(4.7)	33(6.9)
	Farming	8(9.3)	18(6.9)	5(3.9)	31(6.5)
	No income source	1(1.2)	1(0.4)	1(0.8)	3(0.6)
	Causal labour	1(1.2)	1(0.4)	5(3.9)	7(1.5)
	Small business/trader	10(11.6)	7(2.7)	4(3.1)	21(4.4)
	Other	11(12.8)	7(2.7)	10(7.8)	28(5.9)
Female	Employment	0(0.0)	5(6.5)	0(0.0)	5(2.9)
	Mining	18(42.9)	35(45.5)	19(35.8)	72(41.9)
	Mineral trading	0(0.0)	3(3.9)	2(3.8)	5(2.9)
	Mineral processing	1(2.4)	5(6.5)	9(17.0)	15(8.7)
	Farming	5(11.9)	12(15.6)	7(13.2)	24(14.0)
	No income source	0(0.0)	0(0.0)	1(1.9)	1(0.6)
	Causal labour	0(0.0)	0(0.0)	2(3.8)	2(1.2)
	Small business/trader	17(40.5)	12(15.6)	7(13.2)	36(20.9)
	Other	1(2.4)	5(6.5)	6(11.3)	12(7.0)

Findings to miners households further indicates that a large proportion of male are depending on mining with Tarime mining block recording the highest number of male depending on mining as their main source of income. Despite percentage of male depending on mining being high compared to women, a significant percentage of female depends on mining as their main source of income compared to other source like farming and small business. Unlike Tarime where high number of women (35.8%) depends on mining, in Chunya mining block, female tend to focus in both, mining (42.9%) and small business (40.5%) as their source of income

Assets ownership

The baseline survey also looked at the assets ownership within the study population. The results show that 37.6% of respondents owned a house made of concrete, roofed with iron sheets and with a latrine. 25.3% owned a house made of mud and thatched roof and with a latrine. 1.2% respondents did not own any assets. 1.1% respondents from mining households (three from Chunya and four from Tarime) owned mining equipment and only one respondent from Tarime owned mining tools. It was also interesting to note that only one respondent reported to own a mobile phone, nine respondents own a radio and only three respondents own a television. In this era of information technology, this means majority of interviewed households do not have / have limited access to information.

Table 3.2.2 Household Asset Ownership by Gender

Mining Block	Gender	Radio	Television	Mining tools	Mining equipments	Mineral processing equipment	Mobile phone	Refrigerator	Agricultural land	Motorcycle	House (concrete blocks with iron sheets and a latrine)	House (mud with a thatched roof and a latrine)	House (mud with a thatched roof without a latrine)	Mining site	Car/vehicle
Chunya	Male	71(17.5)	27(6.7)	44(10.9)	50(12.3)	5(1.2)	72(17.8)	6(1.5)	43(10.6)	18(4.4)	44(10.9)	12(3.0)	1(0.2)	4(1.0%)	2(0.5)
	Female	31(21.5)	9(6.3)	6(4.2)	9(6.3)	0(0.0)	31(21.5)	1(0.1)	24(16.7)	2(1.4)	21(14.6)	7(4.9)	1(0.7)	0(0.0)	0(0.0)
	Total	102(18.9)	36(6.6)	50(9.1)	59(10.7)	5(0.9)	103(18.8)	7(1.3)	67(12.2)	20(3.6)	65(11.8)	19(3.5)	2(0.4)	4(0.7)	2(0.4)
Geita	Male	247(21.1)	46(3.9)	122(10.4)	94(8.0)	65(5.5)	232(19.8)	7(0.7)	106(9.0)	39(3.3)	114(9.7)	73(6.2)	7(0.6)	3(0.3)	2(0.2)
	Female	58(21.6)	11(4.1)	21(7.8)	10(3.7)	6(2.2)	60(22.3)	6(2.2)	36(13.4)	2(0.2)	35(13.0)	15(5.6)	3(1.1)	1(0.4)	1(0.4)
	Total	305(21.2)	57(4.0)	143(9.9)	104(7.2)	71(4.9)	292(20.2)	13(0.9)	142(9.8)	41(2.8)	149(10.3)	88(6.1)	10(0.7)	4(0.3)	3(0.2)
Tarime	Male	116(18.4)	25(4.0)	52(8.2)	62(9.8)	20(3.2)	91(14.4)	2(0.3)	105(16.6)	13(2.1)	53(8.4)	55(8.7)	7(1.1)	14(2.2)	2(0.3)
	Female	41(18.3)	10(4.5)	15(6.7)	14(6.3)	13(5.8)	28(12.5)	1(0.4)	40(17.9)	5(2.2)	18(8.0)	24(10.7)	5(2.2)	7(3.1)	0(0.0)
	Total	57(18.4)	35(4.1)	67(7.8)	76(8.9)	33(3.9)	119(13.9)	3(0.4)	145(17.0)	18(2.1)	71(8.3)	79(9.2)	12(1.4)	21(2.5)	2(0.2)

Overall, radio takes up the biggest portion of assets ownership in the regions across gender, with females in Geita being the highest 21.6%. Following it was mobile phone ownership of 20.2% in Geita, 18.8% in Chunya and 13.9% in Tarime. Besides radio, female tends to own more agricultural land than their counterparts across all the regions whilst more men were mine owners and had cars. No women in Chunya owned either mines or mineral processing equipment, while 3.1% of female were mine owners and 5.8% had mineral processing equipment. Except for Tarime (8.0%), more female respondents owned concrete houses compared to the other two regions. Men outnumber women in mining tools, mining equipment and motorcycle ownership in all regions.

An independent t-test failed to reveal a statistically significant difference between mean assets that mining households owns (M= 9.23, SD = 2.41) and assets that non mining household owns (M 9.13, SD = 2.43), conditions; $t(645) = 0.41, p = 0.69$. This means that the data doesn't show significant difference in assets ownership between mining and non- mining households and thus any observed difference a merely due to chance. The table below provides detailed results of household assets ownership by the type of respondent.

Table 3.2.2: Household assets ownership by type of respondents and mining block

Assets owned at household level	Chunya		Geita		Tarime		Overall Total
	Mining Household	Non Mining Household	Mining Household	Non Mining Household	Mining Household	Non Mining Household	
Radio	1 (1.2)	0 (0.0)	4 (1.4)	2 (3.6)	2 (1.1)	0 (0.0)	9(1.4)
Television	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.7)	0 (0.0)	3 (0.5)
Mining tools	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	0 (0.0)	1 (0.2)
Mining equipment	3 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.3)	0 (0.0)	7 (1.1)
Mobile phone	1 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)
Refrigerator	10 (11.9)	7(15.9)	47 (16.7)	6 (10.7)	8 (4.5)	0 (0.0)	78 (12.1)
Motorcycle	10 (11.9)	5 (11.4)	16 (5.7)	6 (10.7)	9 (5.1)	0 (0.0)	46 (7.1)
House (concrete with iron sheets and latrine)	37 (44.0)	22 (50.0)	112 (39.7)	23 (41.1)	47 (26.6)	2 (50.0)	243 (37.6)
House (mud with thatched roof and a latrine)	11 (13.1)	6 (13.6)	75 (26.6)	12 (21.4)	59 (33.3)	1 (25.0)	164 (25.3)
House (mud with thatched roof and no latrine)	2 (2.4)	0 (0.0)	8 (2.8)	2 (3.6)	9 (5.1)	0 (0.0)	21 (3.2)
Mining site	3 (3.6)	0 (0.0)	2 (0.7)	0 (0.0)	17 (9.6)	0 (0.0)	22 (3.4)
Car/ Vehicle	2 (2.4)	0 (0.0)	3 (1.1)	0 (0.0)	2 (1.1)	0 (0.0)	7 (1.1)
I don't own any asset	2 (2.4)	2 (4.5)	0 (0.0)	1 (1.8)	3 (1.7)	0 (0.0)	8 (1.2)
Other	2 (2.4)	2 (4.5)	15 (5.3)	4 (7.1)	13 (7.3)	1 (25.0)	37 (5.7)
Total by mining block	84 (100)	44 (100)	282 (100)	56 (100)	177 (100)	4 (100)	647 (100)

Average household/ individuals' income

In determining the average incomes of individuals, the baseline survey looked at average household expenditures on basic needs per week for mining and non-mining households. The data on family size and other income earners in the household was also collected so as to assess the burden of care for household respondents. The survey also collected data on the proportion of household income that comes from the mining sector.

The results from mining households showed that 49.5% of respondents earn all their income from the mining sector, 30.8% earn more than half of income from mining while 12.3% households earn half of their income from mining. The results from the non-mining households show that 73.1% of households earn very little or no income from mining sector while on the other hand 9.6% reported earning all of their income from mining. In terms of other income earners in the household; respondents were asked to provide a number of income earners in the households. The results show that 33.0% mining households and 23.1% non-mining households didn't have other income earners. The majority of households (73.3% mining households and 59.6% non-mining households) had other income earners. It should be noted that 4.8% of non-mining households reported having two boys below 18 years old as other income earners in the household in comparison to 1.3% mining households. Moreover 9.6% mining households and 5.8% non-mining households have one boy and

one girl as other income earner in the household. In the mining households 4.4% reported one boy and 2.8% reported one girl as other income earner.

Burden of care

The data on burden of care reveals that 28.3% of respondents have between 1 – 3 adult dependents. 18.1% have between 4 – 6 children dependents. Once again the independent t-test failed to show statistically significant difference between the mean number of dependents for mining households (M= 2.3, SD = 1.42), and non-mining households (M=2.2, SD = 1.35), conditions; $t(645) = 0.69$, $p = 0.49$. This means that the burden of care for mining households and non-mining households does not differ.

The data on burden of care was also analyzed by gender to establish disparities between men and women. An independent t-test with no equal variance assumed was carried out and the results showed statistically reliable difference in the mean number of dependents for men (M= 2.45, SD = 1.45) and mean number of dependents for women (M= 1.91, SD = 1.20), $t(362) = 4.76$, $p = 0.000$. This means that women had a higher mean number of dependents than men and that the observed differences are not by chance.

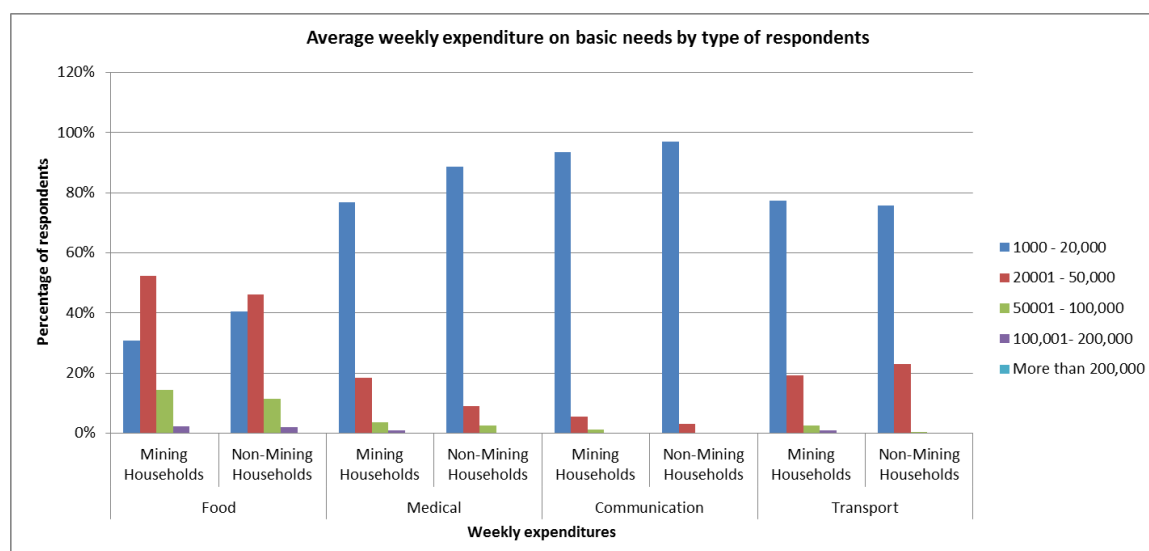
Table 3.2.3: Average number of dependents per head of household interviewed

Number of dependents per head of household	Chunya		Geita		Tarime		Total Male	Total Female
	Male	Female	Male	Female	Male	Female		
1 - 3 children dependents	44 (51.2)	21 (50.0)	123 (47.1)	53 (68.8)	27 (21.1)	18 (34.0)	194 (40.8)	92 (53.5)
4 - 6 children dependents	9 (10.5)	9 (21.4)	47 (18.0)	15 (19.5)	22 (17.2)	15 (28.3)	78 (16.4)	39 (22.7)
More than 6 children dependents	2 (2.3)	1 (2.4)	14 (5.4)	0 (0.0)	12 (9.4)	7 (13.2)	28 (5.9)	8 (4.7)
1 - 3 adults dependents	28 (32.6)	10 (23.8)	67 (25.7)	9 (11.7)	57 (44.5)	12 (22.6)	152 (32.0)	31 (18.0)
4 - 6 adults dependents	2 (2.3)	0 (0.0)	6 (2.3)	0 (0.0)	7 (5.5)	1 (1.9)	15 (3.2)	1 (0.6)
More than 6 adults dependents	1 (1.2)	1 (2.4)	4 (1.5)	0 (0.0)	3 (2.3)	0 (0.0)	8 (1.7)	1 (0.6)
Total by mining block	86 (100)	42 (100)	261 (100)	77 (100)	128 (100)	53 (100)	475 (100)	172 (100)

Average income expenditure

An average weekly expenditure on basic needs revealed that food was the highest average expenditure where 52% mining households and 46% non-mining household spent up to TZS 50,000 per week equivalent to 31.5 USD. Moreover, 15% of mining households and 12% of non-mining households spent up to TZS 100,000/- (62.5 USD) per week on food. 19% mining households spent up to TZS 50,000/- (31.5 USD) on medical expenses in comparison to their counterpart non-mining households where 8.9% spent the same amount of money for medical expenses. This is of particular interest in indicating the financial burden incurred by mining households in relation to health problems.

Figure 3.2.1: Average weekly expenditure on basic needs



Statistically, with equal variance not assumed, there is no significant difference observed in terms of food security between mining households ($M = 1.83$, $SD = 0.375$) and non-mining households ($M = 1.89$, $SD = 0.309$), conditions; $t(167) = -1.86$, $p = 0.65$. This means that on average mining households do experience same level of food shortage/ struggle to get food for the family as does the non-mining households. Any observed difference from the data in this case is only by chance. From the survey findings, 15.9% mining households reported to have slept hungry in the last 30 days preceding the survey in comparison to 10.6% non-mining households.

Savings and reinvestments

72% of non-mining households save up to TZS 50,000/- per week as compared to 68.3% of mining households who reported the same. An independent t-test shows that there is no statistically observed difference in saving habit between the two groups. The difference seen is therefore by chance. The data shows Mining households ($M = 80,997$, $SD = 198,668$) and non-mining households ($M = 59,721$, $SD = 107,641$) conditions, $t(645) = 1.062$, $p = 0.289$.

Respondents were asked about their savings and investments of income from mining. The response on this indicator was only from 68.9% mine owners out of 46 who participated in the survey. The results below indicate that over half the respondents save over TZS 50,000 (31.25 USD). The majority saves over TZS 100,000 (62.5 USD) and this is highest in Geita, where all those who responded to this indicator reported to be saving over TZS 100,000 from mining per week.

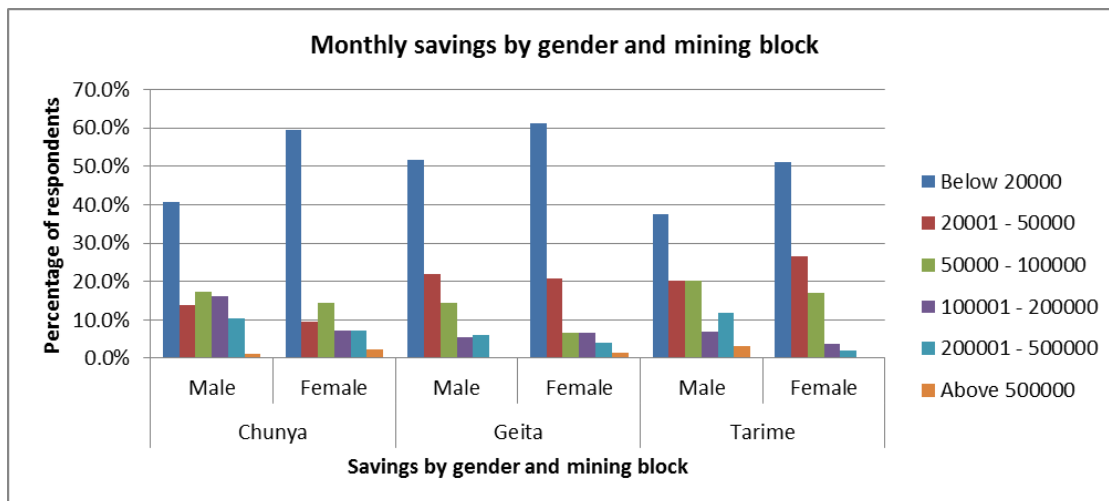
Table 3.2.4: Average weekly savings from mining income

		Chunya	Geita	Tarime	Total
Average savings that mine owners make from mining per week(TZS)	TZS. 1000 - 10,000	5(31.3)	0 (0.0)	1(14.3)	6(21.4)
	TZS. 10,000 - 50,000	4(25.0)	0 (0.0)	2(28.6)	6(21.4)
	TZS. 50,000 - 100,000	4(25.1)	0 (0.0)	1(14.3)	5(17.9)
	Over TZS. 100,000	3(18.87)	5(100)	3(42.9)	11(39.3)
Total		16(100)	5(100)	7(100)	28(100)

The baseline survey data on monthly savings at the household level was compared by gender to determine variations in savings habit between men and women. The data shows that across all mining blocks, women are more likely to make monthly savings than men. The data shows that 57.6% of women make a monthly savings of up to TZS 20,000 equivalent to 12.5 USD as compared to 45.9% of men making the same amount of savings. At a savings of 50,000 – 100,000 equivalents to 31.25 to 62.5 USD, there is 16.6% of men and 11.6% of women who reported to make such amounts of savings per month.

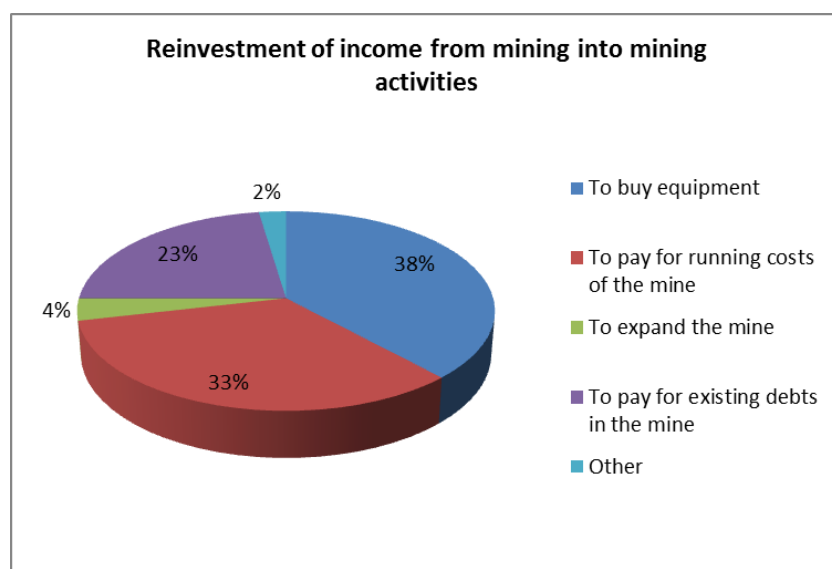
An independent t-test with no equal variance assumed, showed that there is statistically reliable difference between the mean number of men (M= 2.16, SD = 1.37) and mean number of women who are making monthly savings (M= 1.83, SD = 1.21), $t(341) = 3.06, p = 0.002$. This means that the differences that are observed are not by chance. The chart below illustrates the percentage of men and women who reported making monthly savings, by the amount of savings they make and by location/ mining block.

Figure 3.2.2: Average monthly savings by gender



With regards to investment of income gained from mining in improving mining activities, a large proportion of respondents use the financial gains from mining to buy equipment (38%) and to pay for the running costs of the mine (33%). Money is also used to pay for the existing debts of the mine (23%) and relatively few use the financial gains to expand the mine (4%). The data in this regard shows that less than 45% of income from mining is reinvested in improving the mining activities where the larger part of income is going into recurrent running costs and payment of debts. This means that most mine owners are not able to break even on the returns of their investments in mining. The figure below shows the proportion of mining income use.

Figure 3.2.3: Reinvestment of mining income into mining activities



The reinvestment of mining income into other economic activities were also explored where results showed that 78.3% reinvested their income in agriculture while 43.5% reinvested in small business and trading. 13.0% reinvested their income in other minerals. Only three women in Tarime reported to reinvest their savings. No women reported reinvestment of income from mining in Geita or Chunya.

Alternative Income Generation Activity

The household respondents were asked on what they could consider as an alternative for Income Generating Activities (IGA). The respondents were also asked to give reasons why they have not pursued the alternative IGA being provided and also to give a comparison from their understanding on the current income gained and that from the alternative IGA. The results of alternative income generation activities are summarized in the table below.

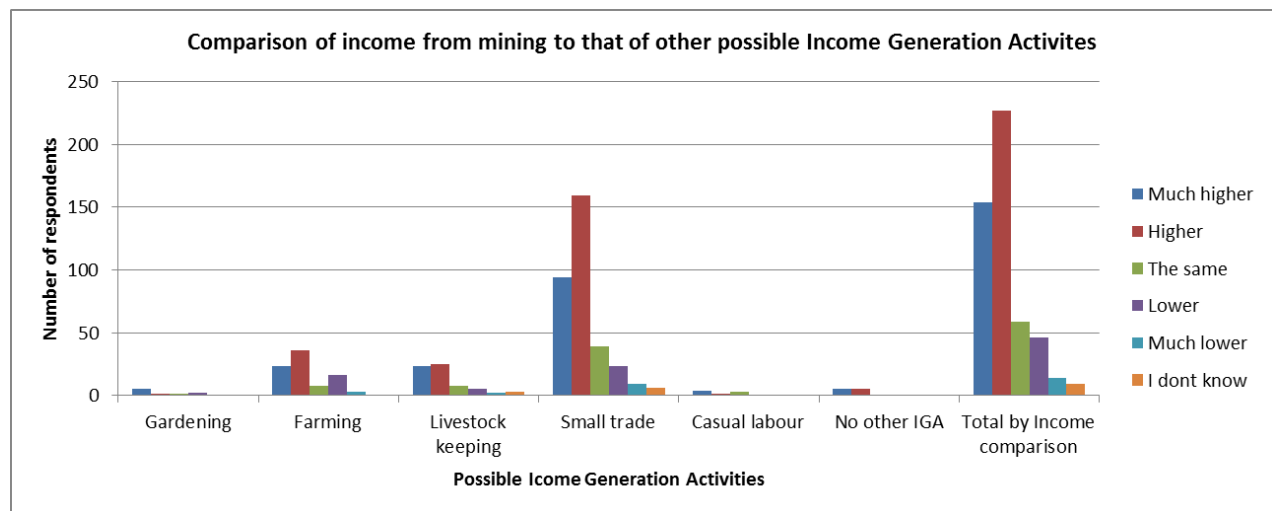
Table 3.2.5: Alternative income generation activities

Alternative income generation activities	Chunya		Geita		Tarime		Overall total
	Mining households	Non-mining households	Mining households	Non-mining households	Mining households	Non-mining households	
Gardening	0 (0.0)	0 (0.0)	6 (2.2)	1 (1.9)	2 (1.2)	0 (0.0)	9 (1.4)
Farming	17 (21.3)	10 (23.3)	70 (25.5)	18 (34.0)	70 (40.9)	1 (25.0)	186 (29.7)
Livestock keeping	8 (10.0)	1 (2.3)	25 (9.1)	5 (9.4)	41 (24.0)	2 (50.0)	82 (13.1)
Small trade	36 (45.0)	26 (60.5)	79 (28.7)	21 (39.6)	35 (20.5)	0 (0.0)	197 (31.5)
Fishing	0 (0.0)	0 (0.0)	3 (1.1)	1 (1.9)	0 (0.0)	0 (0.0)	4 (0.6)
Casual labour	3 (3.8)	4 (9.3)	1 (0.4)	2 (3.8)	5 (2.9)	0 (0.0)	15 (2.4)
No other IGA	16 (20.0)	2 (4.7)	91 (33.1)	5 (9.4)	18 (10.5)	1 (25.0)	133 (21.2)
	80 (100)	43 (100)	275 (100)	53 (100)	171 (100)	4 (100)	626 (100)

The data in the table shows that 21.2 % respondents would not consider other IGAs. 31.5% would consider small trade while 29.7% would consider farming. When asked why they haven't pursued the alternative IGAs proposed thus far, 84.4% of mining households and 91.3% of non-mining households mentioned lack of capital as an obstacle to starting the IGA. 4.7% of mining households and 3.3% of non-mining households mentioned lack of skills. Lack of time was mentioned by 6.2% of mining households.

Respondents were then asked to compare from their general understanding the income they currently gain from mining to that of the alternative IGA that they may consider pursuing outside or alongside mining. In line with the data presented in the table above where 31.5% of respondents would consider small trade, the comparison data shows that most household respondents felt that small trade would pay higher (n= 159) or much higher (n=94) than mining. Overall 44.6% of respondents felt that other possible IGAs would pay higher while 30.3% of respondents felt that other possible IGAs would pay much higher than mining.

Figure 3.2.4: comparison of size of mining income and other income generation activities



An independent t-test shows that there is no statistically observed difference in the perception of income gained from mining in comparison to the income gained from other possible IGAs. The data shows Mining households (M= 4.15, SD = 1.57) and non- mining households (M= 4.02, SD = 1.46) conditions, $t(612) = 1.062, p = 0.46$.

3.3 Production statistics in targeted mining areas

The second objective of the artisanal and small scale mining baseline survey was to collect data on production statistics in the three mining blocks of Chunya, Geita and Tarime. To this end, the survey collected data on the number and location of mines, number of miners working at the mining sites by type of work they do and levels of skills. Data on types and volumes of minerals produced at a mining site were also collected alongside information on mineral trading, the presence and role of the state, as well as the legal status of the mining sites. This data was collected mainly from miners/ pit owners as well as mine owners/ operators questionnaires.

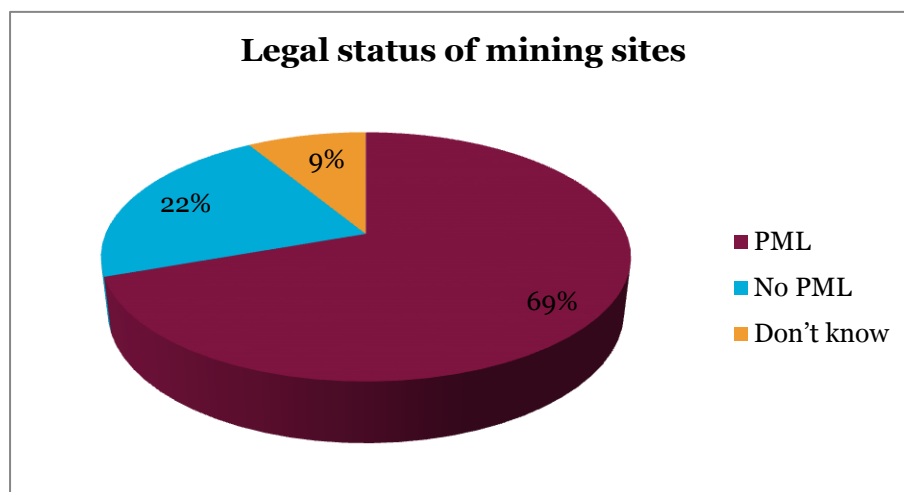


Picture 3.3.1: Extracted gold ore

Legal status

All mines visited in Geita were registered operations with 100% of mine owners reporting having a Primary Mining License (PML) for the mines. In Chunya, 37% of mines were not registered while 59.3% were registered. In Tarime, 75% were registered while the remaining 25% were reported as unknown legal status.

Figure 3.3.1: Legal status of mining sites as reported by mine owners



Distance and accessibility

Mine owners were asked to provide information on the distances from the district capital and accessibility of their mining sites. 71.7% mine owners reported that their mines are over 30 kilometers from the district capital where only 8.7% owners reported to having mines that are less than 10 kilometers from the district capital. Most mining sites in Chunya (81.5%) are only accessible during the dry season. The proximity to the district capital and accessibility of the mining site is important factor in production as the running costs of the mines and thus profitability of mining are affected by these two factors. The table below provides a summary of findings on distance and accessibility.

Table 3.3.1: Distance and accessibility of the mines from the district capital

Distance and accessibility of mining site		Chunya	Geita	Tarime	Total
Distance from the mine to the district capital	Under 10 km	2 (7.4)	0 (0.0)	2 (16.7)	4 (8.7)
	10-20 km	0 (0.0)	0 (0.0)	2 (16.7)	2 (4.3)
	20-30 km	2 (7.4)	2 (28.6)	3 (25.0)	7 (15.2)
	Over 30 km	23 (85.2)	5 (71.4)	5 (41.7)	33 (71.7)
	Sub- Total	27 (100.0)	7 (100.0)	12 (100.0)	46 (100.0)
Is the mine accessible all year or seasonally	All year round	3 (11.1)	5 (71.4)	9 (75.0)	17 (37.0)
	During dry season	22 (81.5)	1 (14.3)	3 (25.0)	26 (56.5)
	Other	2 (7.4)	1 (14.3)	0 (0.0)	3 (6.5)
	Sub- Total	27 (100.0)	7 (100.0)	12 (100.0)	46 (100.0)

In terms of types of minerals produced; 99.3% of miners reported producing gold with 0.2% specifying 'red gold'. The mines were also reported to produce some by-products including 4.3%

reporting construction materials in Geita as a by-product and 6.5% reporting copper as a by-product in Chunya and Geita.

Number of miners working by the type of work they do

The survey collected data on types of work that miners are doing and disaggregated the data by gender. The results show that there are no women operators, crushers or millers while most of women were sluice operators and amalgamators. On the other hand 21.0% of miners were drillers, 10.5% of miners were hoisters, and around 6% of miners were sluice operators and casual laborers. The table below provides a summary of miners by type of work they do, disaggregated by respondent's gender and location.

Table 3.3.2: Miners and pit owners by type of work they do in the mines

	Chunya		Geita		Tarime		Total
	Male	Female	Male	Female	Male	Female	
Operator	6 (2.7)	0 (0.0)	16 (5.0)	0 (0.0)	11 (4.8)	0 (0.0)	33 (3.9)
Helper	1 (0.5)	0 (0.0)	4 (1.3)	0 (0.0)	8 (3.5)	0 (0.0)	13 (1.5)
Driller	54 (24.5)	4 (30.8)	48 (15.1)	2 (6.1)	70 (30.4)	0 (0.0)	178 (21.0)
Blaster	12 (5.5)	0 (0.0)	26 (8.2)	1 (3.0)	4 (1.7)	0 (0.0)	43 (5.1)
Hoister	23 (10.5)	0 (0.0)	50 (15.7)	0 (0.0)	16 (7.0)	0 (0.0)	89 (10.5)
Transporter	1 (0.5)	0 (0.0)	13 (4.1)	1 (3.0)	2 (0.9)	0 (0.0)	17 (2.0)
Crusher	11 (5.0)	0 (0.0)	19 (6.0)	0 (0.0)	6 (2.6)	0 (0.0)	36 (4.2)
Miller	3 (1.4)	0 (0.0)	5 (1.6)	0 (0.0)	0 (0.0)	0 (0.0)	8 (0.9)
Sluice Operator	10 (4.5)	3 (23.1)	18 (5.7)	3 (9.1)	6 (2.6)	11 (31.4)	51 (6.0)
Leach operator	4 (1.8)	0 (0.0)	4 (1.3)	0 (0.0)	2 (0.9)	4 (11.4)	14 (1.6)
Amalgamator	1 (0.5)	1 (7.7)	16 (5.0)	4 (12.1)	4 (1.7)	7 (20.0)	33 (3.9)
Casual laborer	7 (3.2)	1 (7.7)	23 (7.2)	8 (24.2)	11 (4.8)	2 (5.7)	52 (6.1)
Dealer	10 (4.5)	0 (0.0)	18 (5.7)	1 (3.0)	7 (3.0)	0 (0.0)	36 (4.2)
Master dealer	6 (2.7)	0 (0.0)	7 (2.2)	0 (0.0)	8 (3.5)	0 (0.0)	21 (2.5)
Equipment and input supplier	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.4)	0 (0.0)	2 (0.2)
Other	71 (32.3)	4 (30.8)	50 (15.7)	13 (39.4)	74 (32.2)	11 (31.4)	223 (26.3)
Total	220 (100)	13 (100)	318 (100)	33(100)	230 (100)	35 (100)	849 (100)

Skill levels of miners/ pit owners

Effective mining requires various sets of skills to ensure, among other things, appropriate use of technology, environmental sustainability, returns on investments, handling of hazardous materials, etc. The baseline survey assessed the levels of education and on-the-job training opportunities of the miners/ pit owners. The results show a high level of apprenticeship and training happening within the mining sites. 71.3% of miners reported that they have received on-the-job training by others at the mine. These included 63.5% of miners with no formal education and 78.7% of miners with some primary school education. 73.5% of people who received on-the-job training were miners who had completed primary school. Furthermore, there were no geologists in any of the visited mines, no certified blasters were reported in Chunya and only one was reported in Geita. The majority of respondents reported another skill however, upon asking what other skill it was, only one person reported to be accountant while the rest reported that they gained the skills on the job but have no formal training on the skill they possess. Table below provides summary of available skilled workers and the types of skills they have.

Table 3.3.3: Skilled Miners and the type of skill

		Chunya	Geita	Tarime	Total
Skilled workers	1-5 women	20 (74.1)	0 (0.0)	6 (50.0)	26 (56.5)
	6-10 women	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	More than 10 women	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	1-5 men	5 (18.5)	6 (85.7)	6 (50.0)	17 (37.0)
	6-10 men	2 (7.4)	1 (14.3)	0 (0.0)	3 (6.5)
	More than 10 men	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Total	27 (100.0)	7 (100.0)	12 (100.0)	46 (100.0)
What skills do they have	Geologist	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Mine Engineer	0 (0.0)	1 (14.3)	0 (0.0)	1 (2.2)
	Technician	1 (3.7)	2(28.6)	0 (0.0)	3 (6.5)
	Certified Blaster	0 (0.0)	1 (14.3)	6 (50.0)	7 (15.2)
	Driver	4 (14.8)	0 (0.0)	0 (0.0)	4 (8.7)
	Equipment Operator	2 (7.4)	0 (0.0)	0 (0.0)	2 (4.3)
	Administrator	1 (3.7)	0 (0.0)	0 (0.0)	1 (2.2)
	Book keeper	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	First aid	0 (0.0)	1 (14.3)	0 (0.0)	1 (2.2)
	Other	19 (70.4)	2 (28.6)	6 (50.0)	27 (58.7)
	Total	27 (100.0)	7 (100.0)	12 (100.0)	46 (100.0)

Production, processing and trade

The mine owners were asked to provide an estimate of average ore extracted in one pit per day. 13.0% of mine owners reported producing up to 20 kg of gold-bearing ore per day, 17.4% of owners reported 20 – 40 kg of ore per day, 10.9% of owners reported more than 40 kg of ore. The majority of respondents (58.7%) reported measuring production in other terms. Data on other measurements shows that 8.7% reported that the amount depends on the type and quality of the rock. The gold that is produced by artisanal and small scale miners is both alluvial and amalgam gold.

Table 3.3.4: Amount of gold bearing ore extracted per day

Production	Chunya	Geita	Tarime	Overall Total
Containers (bags, buckets) up to 20 kg per day	2 (7.4)	2 (28.6)	2 (16.7)	6 (13.0)
Containers (bags, buckets) 20 - 40 kg per day	2 (7.4)	1 (14.3)	5 (41.7)	8 (17.4)
Containers (bags, buckets) over 40 kg per day	2 (7.4)	2 (28.6)	1 (8.3)	5 (10.9)
Other	21 (77.8)	2 (28.6)	4 (33.3)	27 (58.7)
Total by mining block	27 (100)	7 (100)	12 (100)	46 (100)

From the amount of gold-bearing ore reported to be extracted, mine owners were asked to provide an estimate of the amount of gold produced measured in grams per specific unit of measurement of gold bearing ore. 65.2% of mine owners reported to produce an average of 1 – 5 grams of gold out of whom 13.3% reported to produce 1-5 grams of gold from 20 kg ore, 16.7% reported 1 – 5 grams from 20 – 40 kg ore, and 10% reported 1 – 5 grams of gold from over 40 kg of ore. Majority of mine owners (60%) reported other measures. The table below shows the results per mining block.

Table 3.3.5: Amount of gold produced per specific measurement of gold bearing ore

Amount of gold produced per day	Specific measurement of gold-bearing ore	Chunya	Geita	Tarime	Total
1- 5 grams	Containers (bags, buckets) up to 20 kg per day	1 (5.6)	1 (50.0)	2 (20.0)	4 (13.3)
	Containers (bags, buckets) 20 - 40 kg per day	1 (5.6)	0 (0.0)	4 (40.0)	5 (16.7)
	Containers (bags, buckets) over 40 kg per day	1 (5.6)	1 (50.0)	1 (10.0)	3 (10.0)
	Other	15 (83.3)	0 (0.0)	3 (30.0)	18 (60.0)
		18 (100)	2 (100)	10 (100)	30 (100)
6 - 10 grams	Containers (bags, buckets) up to 20 kg per day	1 (20.0)	1 (50.0)		2 (28.6)
	Other	4 (80.0)	1 (50.0)		5 (71.4)
		5 (100)	2 (100)		7 (100)
11 -15 grams	Containers (bags, buckets) 20 - 40 kg per day	1 (25.0)	0 (0.0)	1 (100)	2 (28.6)
	Containers (bags, buckets) over 40 kg per day	1 (25.0)	1 (50.0)	0 (0.0)	2 (28.6)
	Other	2 (50.0)	1 (50.0)	0 (0.0)	3 (42.9)
		4 (100)	2 (100)	1 (100)	7 (100)
16 - 20 grams	Containers (bags, buckets) 20 - 40 kg per day		1 (100)		1 (100)
			1 (100)		1 (100)
31 - 50 grams	Other			1 (100)	1 (100)
				1 (100)	1 (100)

The mine owners were also asked to provide an average price per gram of gold. The majority of mine owners (60.9%) reported a selling price of 30,001 – 50,000 TZS equivalent to 18.8 – 31.3 USD. Moreover 23.9% of mine owners reported a selling price of 50,001 – 100,000 TZS equivalent to 31.3 – 62.5 USD. An outlier is noted in this case where one respondent reported a selling price of above 1 million TZS equivalent to 625 USD and this figure was discounted on the basis that the respondent may not have understood the question. 76.1% of mine owners reported selling their gold at the nearest town from the mining site. Mine owners generally in all mining sites tend to control ownership of all production in the mining site.

The price is higher for alluvial gold and lower for amalgam gold. The data on the price per gram of gold was compared by the global price of gold on the dates of data collection to understand how the local market is related to the global market

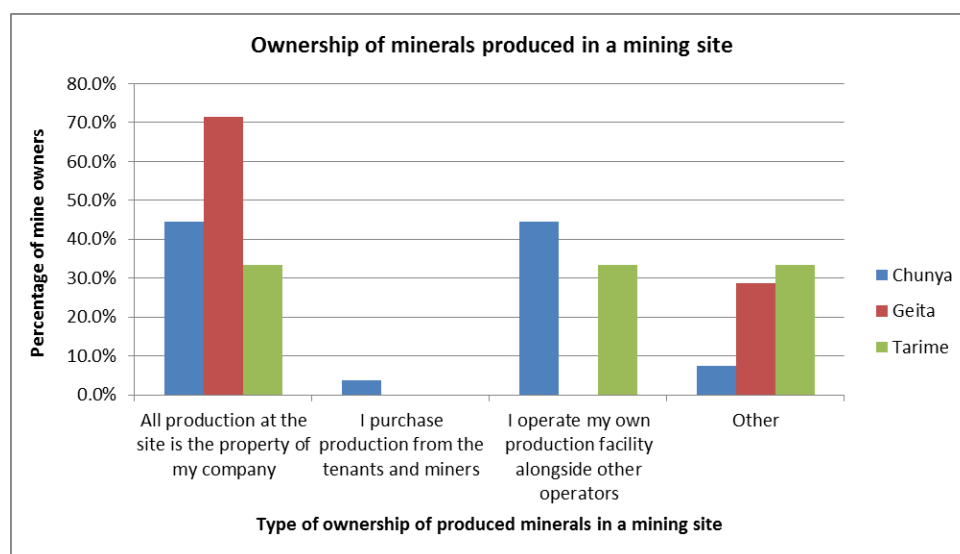
Table 3.3.6: Average price of gold (per gram) and selling points

Price per gram of gold	Chunya	Geita	Tarime	Overall Total
Average price in TZS (USD)per gram of gold produced				
Below 30,000 (18.75)	1 (3.7)	0 (0.0)	1 (8.3)	2 (4.3)
30,001 - 50,000 (18.8 – 31.3)	21 (77.8)	1 (14.3)	6 (50.0)	28 (60.9)
50,001-100,000 (31.3 – 62.5)	5 (18.5)	5 (71.4)	1 (8.3)	11 (23.9)
500,001 - 1 m (312.5 – 625)	0 (0.0)	1 (14.3)	3 (25.0)	4 (8.7)
Above 1 million (above 625)	0 (0.0)	0 (0.0)	1 (8.3)	1 (2.2)
Total	27 (100)	7 (100)	12 (100)	46 (100)
Where do you sell your minerals? (trading centers for the gold produced)				

At the mine	2 (7.4)	5 (71.4)	10 (83.3)	17 (37.0)
In the nearest town	22 (81.5)	6 (85.7)	7 (58.3)	35 (76.1)
Other	3 (11.1)	2 (28.6)	1 (8.3)	6 (13.0)

Mineral processing in Geita and Tarime was reported to occur within the mining sites by 100% of mine owners while the situation in Chunya is different. 74.1% mine owners in Chunya reported processing minerals outside the mining site while 25.9% mine owners reported processing within the mining site. Depending on the distances travelled between mining and processing facilities, this has effects on the profit margin of miners and mine owners as the costs of transporting the ore outside the mining site may tend to be higher than the cost of transporting the same amount of ore within the mining site.

Figure 3.3.2: Ownership of minerals produced in a mining site



Government agents presence at the mining sites

The tables below indicate that the government agents who are regularly present at the mining sites are the District Authorities (58.1%), followed by the Mines Authorities (25.6%). Their presence is at a high level in Geita (85.7%) and Chunya (69.2%) in comparison to Tarime (10%). The interviews suggested that authorities and other government agencies visit Tarime more frequently than they do Chunya and Geita. Furthermore, the frequency of the visits is primarily between monthly to once per year.

Table 3.3.7: Presence of Government officials in the mining sites

		Chunya	Geita	Tarime	Total
Government agents regularly present at the site	District Authorities	18(69.2)	6(85.7)	1(10.0)	25(58.1)
	Mines authority	6(23.1)	1(14.3)	4(40.0)	11(25.6)
	Regional authorities	0 (0.0)	0 (0.0)	4(40.0)	4(9.3)
	Other	2(7.7)	0 (0.0)	1(10.0)	3(7.0)
Frequency of visits	At least once per month	4(25.0)		1(33.3)	5(26.3)
	At least once per quarter	3(15.8)		0	3(15.8)
	At least once per year	6 (37.5)		1 (33.3)	7 (36.8)

	Other	3(18.8)		1(33.3)	4(21.1)
TOTAL		16		3	19

3.4 Valuation of mining assets: mining/ minerals processing equipment and tools

In establishing the value of mining assets, data was collected on types of mining and processing activities conducted in the mining sites. In addition to mining and processing, the survey gathered data on materials used for processing, equipment and tools used for mining including power supply, consumables and servicing information. The baseline also gathered data on the support that the miners and mine owners would need to improve efficiency and productivity of artisanal and small scale mining.

Type of mining / mineral processing activity and materials used



60.9% of mines in the sites visited were underground mines while Chunya has the highest number of open pit mines as reported by 51.9% mine owners. In terms of processing activities, the most common processing types reported by more than 90% of mine owners were crushing and milling. Leaching was reported by 65.2%. Amalgamation was reported by 41.3% whereas smelting was reported by 10.9%.

Picture 3.3.2: Underground mining shaft

Equipment and tools used in mining

Miners were asked to describe the equipment and tools that are used in mining within their mining sites. The results showed that the sluice box and amalgamator are the equipment mostly used with 32.4% of miners and 15.9% mentioning sluice box and amalgamator respectively. The table below provides the summary of equipment and tools used for mining in Chunya, Geita and Tarime.

Table 3.4.1: Equipment and tools used in artisanal and small scale mining

		Chunya	Geita	Tarime	Overall total
Equipment used at the mines	Excavator	2 (0.9)	0 (0.0)	0 (0.0)	2 (0.2)
	Wheelbarrow	0 (0.0)	0 (0.0)	2 (0.8)	2 (0.2)
	Spade	1 (0.4)	0 (0.0)	2 (0.8)	3 (0.4)
	Pickaxe	11 (4.7)	9 (2.6)	1 (0.4)	21 (2.5)
	Scraper	0 (0.0)	1 (0.3)	1 (0.4)	2 (0.2)
	Windlass	1 (0.4)	0 (0.0)	0 (0.0)	1 (0.1)
	Mono rope	31 (13.3)	8 (2.3)	9 (3.4)	48 (5.7)
	Compressor	2 (0.9)	1 (0.3)	5 (1.9)	8 (0.9)
	Water pump	2 (0.9)	0 (0.0)	19 (7.2)	21 (2.5)
	Generator	12 (5.2)	10 (2.8)	8 (3.0)	30 (3.5)
	Ball mill	5 (2.1)	3 (0.9)	0 (0.0)	8 (0.9)
	Crusher	40 (17.2)	8 (2.3)	22 (8.3)	70 (8.2)
	Sluice box	58 (24.9)	144 (41.0)	73 (27.5)	275 (32.4)
	Amalgamator	2 (0.9)	122 (34.8)	11 (4.2)	135 (15.9)
	Other	66 (28.3)	45 (12.8)	112 (42.3)	223 (26.3)
	233 (100)	351 (100)	265 (100)	849 (100)	

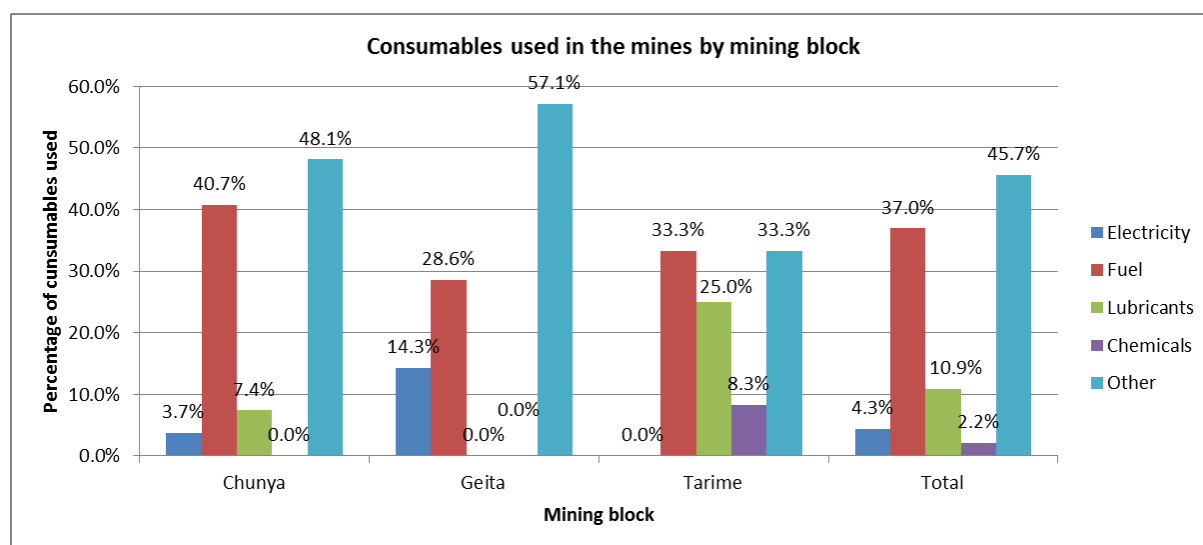
The survey also looked at the ownership of the tools/ equipment used in mining. Out of 46 mine owners interviewed, 36 out of 43 men mine owners reported to also own the equipment used in mining, while 2 out of 3 women reported to own the tools/equipment. 7 men and 1 woman reported that the equipment/tools are owned by the tenant of the mine while the remaining men reported tools/equipment owned by associations or other owners.

Likewise, miner owners were asked on the condition of the above equipment's; the findings show that, among the three regions covered by the survey, respondents in Geita have the widest variety of equipment ownership. They own almost all the different types of equipment except excavator, which was owned only by those in Chunya. In general, most equipment in Chunya are in new and fair working condition, except 88.9% of crusher and 94.6% sluice box are old but working. Whilst everything, but Mono rope (76.9% new and working), in Geita are in old but working condition. The condition of equipment in Tarime varies, with 57.1% of Jack hammers and 56.7% Mono rope are in new good condition, half of the water pumps new but working fairly, and the rest in old but working condition.

Amount and costs of consumables and equipment servicing per month

Mine owners were asked to report the amount of consumables required to run the mine per month. The results show that consumables including explosives, food, and drill bits constitute 45.7% of all consumables while fuel constitutes 37.0% of consumables. (Specifically, fuel constitutes 40.7% of consumables in Chunya, 28.6% in Geita and 33.3% in Tarime.)

Figure 3.4.1: Consumables used to run the equipment/tools used in mining sites



In terms of the costs of the reported equipment and tools consumables, the majority of mine owners (78%) reported using about TZS. 500,000 (312.5 USD) per month. 15.2% of mine owners reported spending between TZS 5 to 10 million (3,125 – 6,250 USD) per month on consumables. The majority of mine owners (65.2%) reported that servicing of equipment per month did not cost more than TZS. 50,000 (31.3 USD) while 13% reported that it costs up to TZS 200,000 (125 USD), 10.9% reported a cost up to 500,000 TZS (312 USD) whereas 8.7% reported a cost of up to 1 million TZS (625 USD).

Equipment and tools needed to improve efficiency

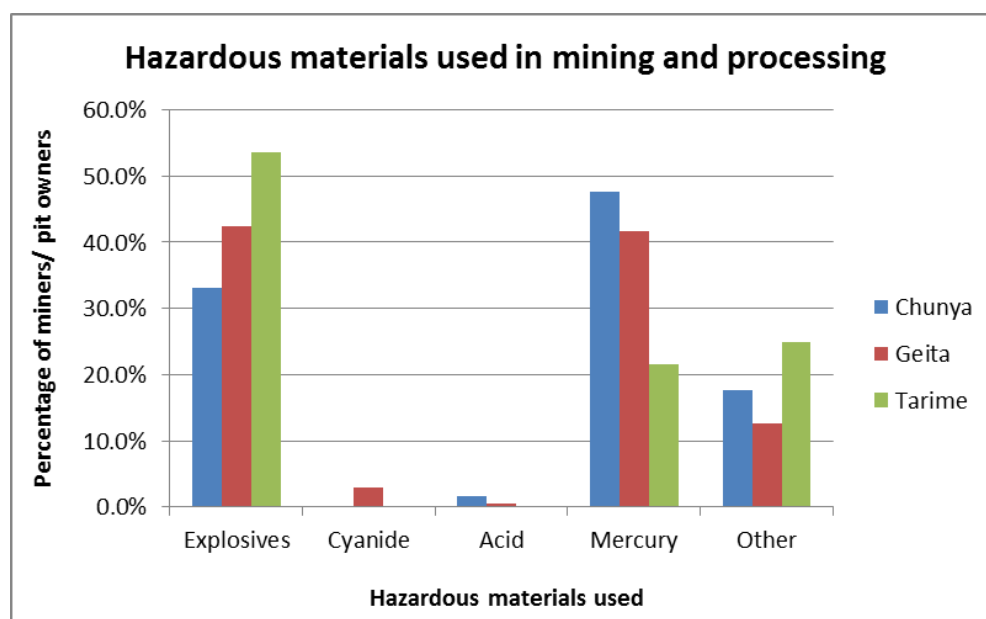
Mine owners were asked what equipment and tools are needed to improve efficiency of artisanal and small scale mining in their areas. The data presented in the table below shows the summary of the results where compressors, excavators and jack hammer were the top three types of equipment needed. 28.3% of mine owners mentioned ‘other’ whereupon further probing they indicated a combination of the tools and equipment listed in the table as well as loans, jaw crushers, lorries for transport and ball mills in varied combinations.

Table 3.4.2: Equipment and tools needed to improve mining

		Chunya	Geita	Tarime	Total
Equipment and tools needed to improve effectiveness of artisanal and small scale mining	Excavator	5 (18.5)	0 (0.0)	1 (8.3)	6 (13.0)
	Jack hammer	1 (3.7)	1 (14.3)	3 (25.0)	5 (10.9)
	Spade	1 (3.7)	0 (0.0)	0 (0.0)	1 (2.2)
	Windlass	2 (7.4)	1 (14.3)	0 (0.0)	3 (6.5)
	Compressor	3 (11.1)	0 (0.0)	4 (33.3)	7 (15.2)
	Water pump	0 (0.0)	1 (14.3)	2 (16.7)	3 (6.5)
	Generator	2 (7.4)	1 (14.3)	0 (0.0)	3 (6.5)
	Ball mill	1 (3.7)	0 (0.0)	1 (8.3)	2 (4.3)
	Crusher	1 (3.7)	0 (0.0)	0 (0.0)	1 (2.2)
	Amalgamator	2 (7.4)	0 (0.0)	0 (0.0)	2 (4.3)
	Other	9 (33.3)	3 (42.9)	1 (8.3)	13 (28.3)
	Total	27 (100)	7 (100)	12 (100)	46 (100)

In terms of hazardous materials used for mineral processing and mining, both mine owners and miners/ pit owners were asked what material was used. Explosives and mercury were mentioned by the majority of mine owners, i.e. in Chunya, 70.4% of mine owners mentioned explosives whereas 81.5% mentioned mercury. Only 7.4% of mine owners mentioned acid. In Geita, 85.7% mentioned explosives and 100% mine owners mentioned mercury, while 14.3% mine owners mentioned cyanide. In Tarime, 83.3% mentioned explosives while 91.7% mentioned mercury. In Chunya miners mentioned mercury more than explosives while in Geita both materials are mentioned equally. In Tarime explosives are mentioned more than mercury. The miners also mentioned Cordtex (a detonating cord with an explosive core of pentaerythritol tetranitrate inside its plastic coating) and patex in the category of other materials used. The chart below provides a summary of results from miners.

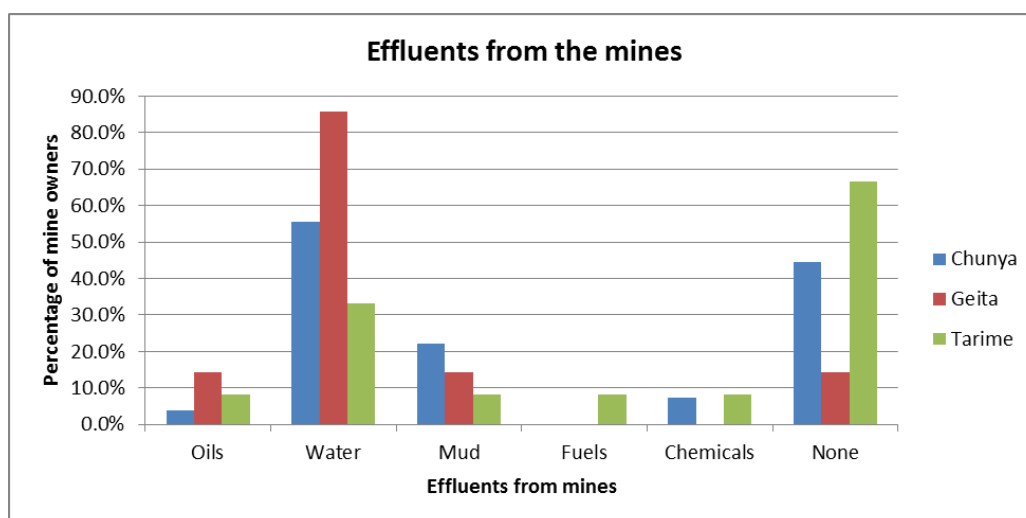
Figure 3.4.2: Hazardous materials used in artisanal and small scale mining



Miners/ pit owners were asked to elaborate reasons why they termed the materials used as hazardous. Most miners were able to articulate the effects of mercury and explosives. Among the effects mentioned for mercury were: it is poisonous if ingested, it affects the skin, it causes tremors/ seizures of the hands, loss of memory and the smoke from burning mercury affects the lungs. On the other hand, explosives were seen as hazardous as they can cause injury from burning or falling rocks in explosion and sometimes they can detonate spontaneously. The smoke from explosives was also said to be bad, causing headaches. Some miners mentioned effects of acid including nose bleeds, headaches and chest pain. Miners were also asked if they are aware of the requirement for a license to use the hazardous materials. The result shows that 55.7% of miners knew that use of explosives requires a license. These include 59.7% miners in Chunya, 45.9% miners in Geita and 65.3% miners in Tarime. Moreover, 38.0% of miners said that use of mercury requires a license including 53.2% of miners from Chunya, 24.8% from Geita and 42.3% from Tarime.

Title Owners and Mine Operators were asked to provide information on the effluents from the mines. As the graph shows, water is the most common effluent from mines in Chunya, Geita and Tarime (with an average of 53%). This was followed closely by mines that had no effluents (an overall total of 45.6%), which was highest in Tarime (66.7%) and Chunya (44.4%) in comparison to Geita (14.3%). Fuels, Oils and Chemicals were used less in comparison to water, oils and the non-production of effluent.

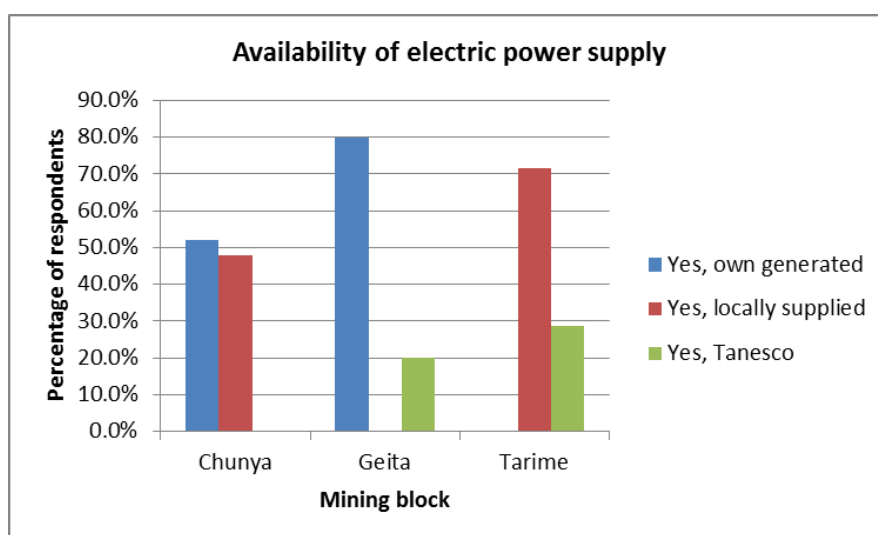
Figure 3.4.3: Effluents from the mines



Power supply to the mining site

In improving production, cost effectiveness of the production is important. One of the factors affecting the cost of production is availability of power supply required to run the mining equipment. Data was collected on the type of power supply that is available in the mining sites visited. The data shows that mining sites in Chunya do not have electricity supply from the national grid but rather depend on local supply (48%) or use their own generators (52%). The situation is a little better in Geita and Tarime where 20% and 28% of mining sites respectively had electricity supplied from the national grid (Tanesco). This however still leaves a large majority of mines operating with their own generated electricity (80%) in Geita and locally supplied electricity (72%) in Tarime. These generators use diesel fuel. The figure below provides a summary of power supply in the mining sites visited.

Figure 3.4.4: Availability of electricity in the mining sites



3.5 Health and safety in mining

Artisanal and small scale miners, in many cases, use poor mining techniques including poor handling of hazardous materials. They risk injury or suffocation in poorly constructed mining shafts that lack proper ventilation and escape routes in case of an emergency. They also face risk of disease from

water and food contaminated by toxins or poor sanitation. These conditions lead to poor health and sickness among miners and people living within mining areas. The baseline survey collected data on the physical well-being of miners including their history of recurrent illnesses, injury and other symptoms of ill health. Data on the HIV/AIDS situation in mining was also collected. The data was statistically compared among mining and non-mining households to determine whether there are significant differences observed.

Overall the results show that 34.0% of household respondents had been ill in the 30 days preceding the baseline data collection. 11.8% of those respondents who had reported being ill, said they were ill at least once a week while the remaining 88.2% said they were ill only a few times. 34.9% of household respondents reported to have been received information about the effects of mining to their health. 35.2% respondents reported to have suffered minor injuries including bruises, sprains and minor wounds in mining accidents. 3.7% respondents had suffered major injuries including broken bones, brain concussions and major wounds. 1.4% had suffered injuries so severe that it prevented them from returning to work.

An independent t-test with equal variance assumed failed to show statistically difference in illnesses between mining households (M=166, SD =0.47), and non-mining households (M= 166, SD = 0.48), t (645+ =-0.08, p= 0.935 and frequency of illnesses between mining households (M= 1.11, SD= 0.318) and non- mining households (M= 1.14, SD = 0.48), t (218) = -0.491, p= 0.624. No significant difference was observed on a t-test with no equal variance assumed for respondents who have received health information about the effects of mining to their health Where results showed mining households (M= 1.64, SD = 0.49) and non-mining households (M= 1.69, SD = 0.46), t (148) = 0.99, P= 0.32. This means that any observed difference in the three health indicators are just by chance and that the likelihood of mining households and non- mining households members to experience frequent illnesses, and receiving health information about effects of mining to their health is the same.

Statistically significant difference was observed in an independent t-test with no equal variance assumed in terms of respondents who reported ever being involved in mining accidents between mining households (M= 2.69, SD = 1.45) and non-mining households (M=3.72, SD = 0.46), t(235) = -9.90, p= 0.00. This means that mining households members are more likely to suffer mining accidents than non- mining households and that the observed difference is not by chance. The table below shows the summary of findings for the four health indicators.

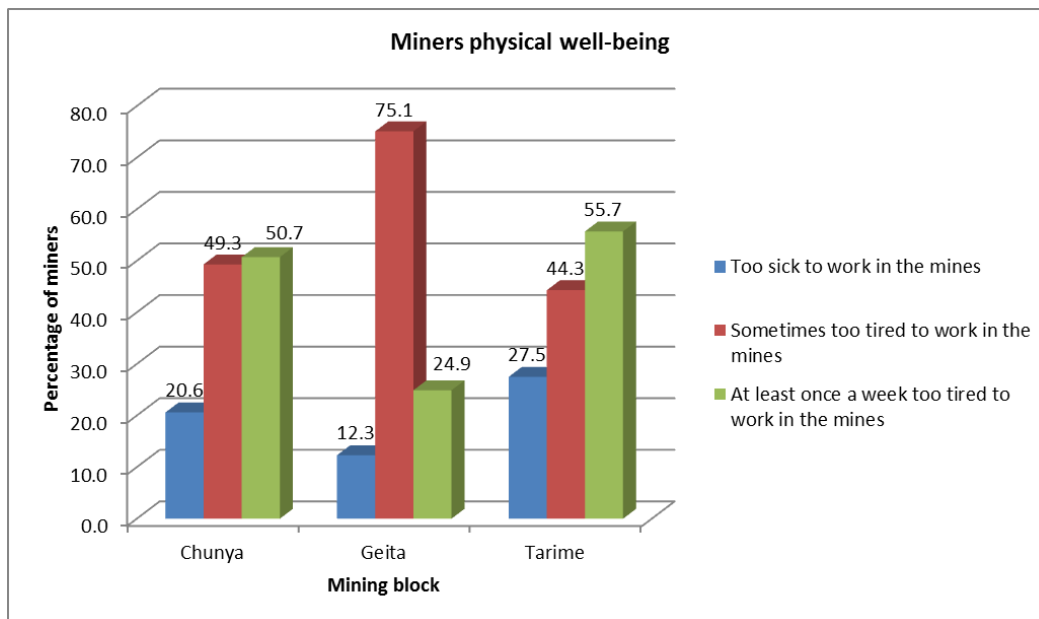
Table 3.5.1: Recurrent Illness and mining accidents

	Chunya		Geita		Tarime		Total
	Mining Households	Non-Mining Households	Mining Households	Non-Mining Households	Mining Households	Non-Mining Households	
Ever been sick in the last 30 days							
Yes	23 (27.4)	12 (27.3)	93 (33.0)	21 (37.5)	69 (39.0)	2(50.0)	220 (34.0)
Frequency of illness							
A few times	16 (69.6)	8 (66.7)	91 (97.8)	20 (95.2)	57 (82.6)	2 (100)	194 (88.2)
At least once a week	7 (30.4)	4 (33.3)	2 (2.2)	1 (4.8)	12 (17.4)	0 (0.0)	26 (11.8)
Have you ever received information on effects of mining on your health							
Yes	39 (46.4)	7 (15.9)	106 (37.6)	24 (42.9)	49 (27.7)	1 (25.0)	226 (34.9)
No	45 (53.6)	37 (84.1)	176 (62.4)	32 (57.1)	128 (72.3)	3 (75.0)	421 (65.1)

Ever suffered mining accident							
Yes, minor injuries (bruises, wounds, sprains)	31 (36.9)	1 (2.3)	109 (38.7)	8 (14.3)	79 (44.6)	0 (0.0)	228 (35.2)
Yes, major injuries (broken bones, brain concussions, major wounds)	5 (6.0)	0 (0.0)	4 (1.4)	0 (0.0)	15 (8.5)	0 (0.0)	24 (3.7)
Yes, Injuries that were so severe that it prevented me from returning to work	2 (2.4)	2 (4.5)	1 (0.4)	0 (0.0)	4 (2.3)	0 (0.0)	9 (1.4)
No	46 (54.8)	41 (93.2)	168 (59.6)	48 (85.7)	79 (44.6)	4 (100)	386 (59.7)

The data on the general wellbeing of miners is also presented here where miners and pit owners were asked whether in the last 30 days they had felt too sick or too tired to work in the mines and how frequently did that happen. The results are presented in the chart below.

Figure 3.5.1: Physical wellbeing as reported by miners and pit owners



Physical exhaustion and feeling of sickness can be associated to the working conditions that the miners are exposed to. In the survey it was revealed that 36.1% of miners in Chunya, 43.9% in Geita and 51.6% in Tarime worked between 11-13 hours a day. Overall 28.3% of miners are working more than 13 hours a day while 49.5% of miners work over 3 night shifts per week. Considering that the mining work is mostly physical, miners are bound to feel exhaustion and resulting to poor productivity. However miners reported to experience more symptoms of ill health than non-miners as the table below shows

Table 3.5.2: Symptoms of mining related illnesses as reported by household respondents

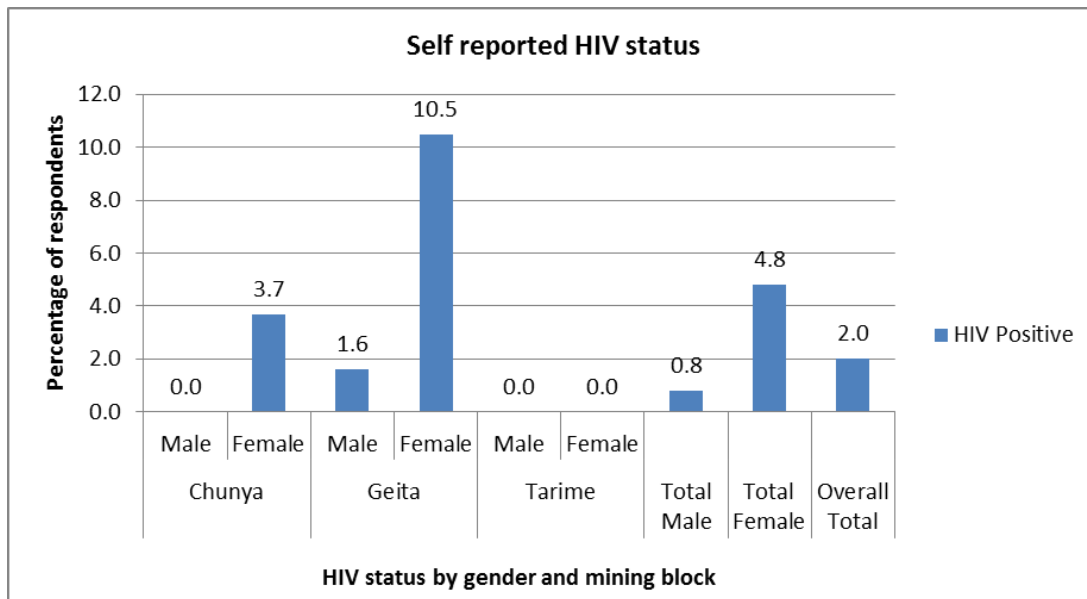
	Chunya		Geita		Tarime		Overall total
	Mining households	Non-Mining households	Mining households	Non-Mining households	Mining households	Non-Mining households	
Muscle pain or weakness (back, neck, arm)	18 (34.0)	1 (6.7)	39 (62.9)	4 (80.0)	48 (49.5)	0 (0.0)	110 (47.4)
Difficulty in breathing	2 (3.8)	1 (6.7)	5 (8.1)	0 (0.0)	5 (5.2)	0 (0.0)	13 (5.6)
Headaches, dizziness	8 (15.1)	2 (13.3)	12 (19.4)	1 (20.0)	15 (15.5)	0 (0.0)	38 (16.4)
Blurred vision	0 (0.0)	2 (13.3)	1 (1.6)	0 (0.0)	2 (2.1)	0 (0.0)	5 (2.2)
Trembling or shaking, seizures	1 (1.9)	0 (0.0)	1 (1.6)	0 (0.0)	2 (2.1)	0 (0.0)	4 (1.7)
Numbness of fingers, toes	8 (15.1)	0 (0.0)	3 (4.8)	0 (0.0)	5 (5.2)	0 (0.0)	16 (6.9)
Skin irritation and sores	3 (5.7)	1 (6.7)	1 (1.6)	0 (0.0)	3 (3.1)	0 (0.0)	8 (3.4)
Burns	1 (1.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)
Change in behavior / irritability	12 (22.6)	8 (53.3)	0 (0.0)	0 (0.0)	17 (17.5)	0 (0.0)	37 (15.9)
Total per mining block	53 (100)	15 (100)	62 (100)	5 (100)	97(100)	0 (0.0)	232 (100)

An independent t-test with no equal variance assumed, showed that there is significant differences in the symptoms between mining households (M= 3.21, SD = 5.15) and non-mining households (M= 5.15, SD = 3.51), $t(21.5) = -2.39$, $p = 0.026$. This means that mining households do suffer more health symptoms that are associated with effects of materials and methods of mining than non- mining households. The difference observed therefore is not a matter of chance but actual difference.

Situation of HIV/AIDS

The respondents in household questionnaire were asked about HIV/AIDS including whether they have ever tested for HIV and would be willing to share their results. The results show that 61.7% of men and 72.4% of women had been tested for HIV/ADS. Of those who have been tested, 49.8% of men and 52.0% of women were tested less than six months preceding the baseline survey while 14% of men and 13.8% of women were tested over one year ago. Over 80% of respondents were willing to share their test results with baseline survey team. The HIV status results are presented in the chart below.

Figure 3.5.2: Respondent's self-reported HIV status



When compared to the national prevalence, overall the HIV/AIDS situation in mining sites is relatively low. The HIV in women seems to be on a higher side than men. However an independent t-test with no equal variance assumed failed to show significant differences in mean number of men who are HIV positive ($M= 1.99$, $SD = 0.09$) and women who are HIV positive ($M= 1.95$, $SD = 0.22$), $t(119) = 1.83$, $p = 0.07$. This means that there is no significant difference between HIV prevalence in men and women and that any observed differences is by mere chance.

4 Discussion of results

The situation of artisanal and small scale mining in Tanzania is presented in the previous chapter in line with the main indicators of the baseline survey. In this chapter the results are discussed and interpreted in line with the existing literature and best practices in artisanal and small scale mining.

4.1 Situation of Artisanal and small scale mining in Tanzania

4.1.1 Miners' levels of education and skills

The data presented in chapter 3 shows that there are high levels of illiteracy among miners. This poses an immediate challenge to the growth and improvement of productivity of artisanal and small scale mining. For artisanal and small scale miners to increase productivity, they need capital which can be offered by many financial institutions, however most financial institutions will require at minimal a sound business plan or project write-up before a client is considered for the loan or grant and this can present a significant hurdle to illiterate applicants. Beyond access to capital, mining is a business activity and, as such, requires the ability to keep sound records of business activities to maximize on financial management, investment and sales. Again, those who are not literate will be unable to meet these basic requirements for good business management.

The situation of women in the three mining blocks is particularly challenging as women have a lower mean level of education than their men counterparts. It is therefore important for the MEM to explore ways of supporting artisanal and small scale miners, both men and women, to improve their levels of literacy as a key element in supporting the improvement of productivity.

The results highlight a major gap in professional skills availability in the mining sites, for instance in Chunya there is no reported certified blaster while explosives are used regularly in mine operations. The use of explosives without a proper license is not only illegal but also dangerous for the hundreds of miners working in the areas. Technical skills are also important in handling the equipment and tools used for mining to ensure longevity of the equipment and to reduce cost of maintenance of the equipment and tools.

Another area of skill that is seriously lacking among artisanal and small scale miners is geology. In order to make mining viable, efficient and cost-effective, a key first step is to ensure that the decision to mine or not to mine in a specific area is informed by an educated assessment of the geological resource. While it may not be possible for each artisanal and small scale mine to afford a professional geologist, it is important to strengthen the extension services through the resident mines office to ensure regular professional assessment and advice to miners. This will significantly reduce the costs and debts incurred in unprofessional exploration work based on history, intuition, rumour and optimism.

4.1.2 Mining practice, technology and accessibility of mines

The Government collects a royalty from all legal mining license holders. The baseline revealed that 22% of mine owners interviewed do not have licenses. This simply put is a loss of 22% of potential revenue from royalties that should be paid to the Government. In addition to the royalty, illegal mining affects legal mining because they have less costs to pay therefore can make bigger profits than legal title holders who have to pay taxes and royalties in addition to paying their annual license fee. The Government needs incentivize legal mining and impose penalties on illegal mining to ensure that legal miners can benefit from their mining activities. These actions could include instituting a requirement for branding of all minerals from legal miners and requiring all dealers only to buy

branded minerals. This condition can be tied to export licensing for the dealers to ensure compliance.

Artisanal and small scale miners have also reported working long and extended hours every day and often feeling too sick to go to work. As artisanal and small scale mining is largely physical work, the longer hours that miners put into work may not pay off in terms of productivity. There is a need to regulate the hours that artisanal and small scale miners work per day. This requires license holders who employ miners to ensure that the working hours and shifts are regulated in such a way that it allows miners time to recuperate. Currently, 11.8% of miners are sick at least once every week. This is 11.8% of manpower, and thus productivity, lost every week.

The fact that most artisanal and small scale mining sites use generators as their source of electricity to run equipment and tools for mining means that the running costs are much higher than their counterparts who have electricity supply from the national grid. Most mining sites visited were using diesel operated power generators to remove water from the mining shafts as well as running the compressors for drilling and supplying air in the shafts. MEM needs to identify economic viability of extending the power services from the national grid to the mining sites so as to boost productivity and reduce the production costs. This will in turn lead to more royalties to the Government as well as more income for artisanal and small scale miners.

In terms of technology used for mining, the majority of mining sites visited utilize underground pit mining technology with extraction focusing on the high concentrates of gold in the veins leaving out less concentrated mineral rock. The tools and equipment used for processing are mainly sluice boxes and amalgamators which leave a lot of gold uncaptured in the processing. The current technology of using cyanide leaching is more effective in terms of the amount of gold produced. Although cyanide is very poisonous, cyanide leaching can be carried out in controlled areas with less risk of effects of poisoning. This is unlike the amalgamation that utilizes mercury exposing users and the environment to mercury contamination and risk of serious health effects.

Accessibility to most of the mines is a challenge as access is seasonal meaning that the mines are inaccessible during rainy season. This situation affects production because services and inputs to sustain mining activities such as food and consumables for equipment cannot reach the mines. Where materials and goods do succeed to reach the mining areas, the cost of production is much higher as the traders have to compensate the costs incurred to transport the goods and services to the mines. Therefore infrastructure to access mining areas is a major factor in productivity and profitability.

4.2 Opportunities within artisanal and small scale mining

4.2.1 Mining as a means of earning livelihoods

50% of miners interviewed get all their income from mining, this means that they are solely miners and have no alternative livelihood. Also, despite the fact that much artisanal and small scale mining is migratory in nature, there is a considerable number of miners (24.4%) that have settled in their mining areas for 5- 10 years period indicating some stability in the industry. This indicates that even during the mass migration of miners such as during the gold rush, the likelihood of miners relocating completely from an area is small and that there is a good number of miners who have settled in their mining areas. This makes it easier for planning on infrastructure development such as water, electricity, health care etc. The settled miners also make more credible candidates for support such as loans and grants as they are traceable and known to the local community.

Most miners felt they could engage in small trading as an alternative income generation activity. This was based on their estimates that small trading pays more than mining. Agriculture was another

means of livelihoods that miners were willing to consider. The two activities are also reported in terms of where miners already reinvest their money.

4.2.2 Skills building through apprenticeship

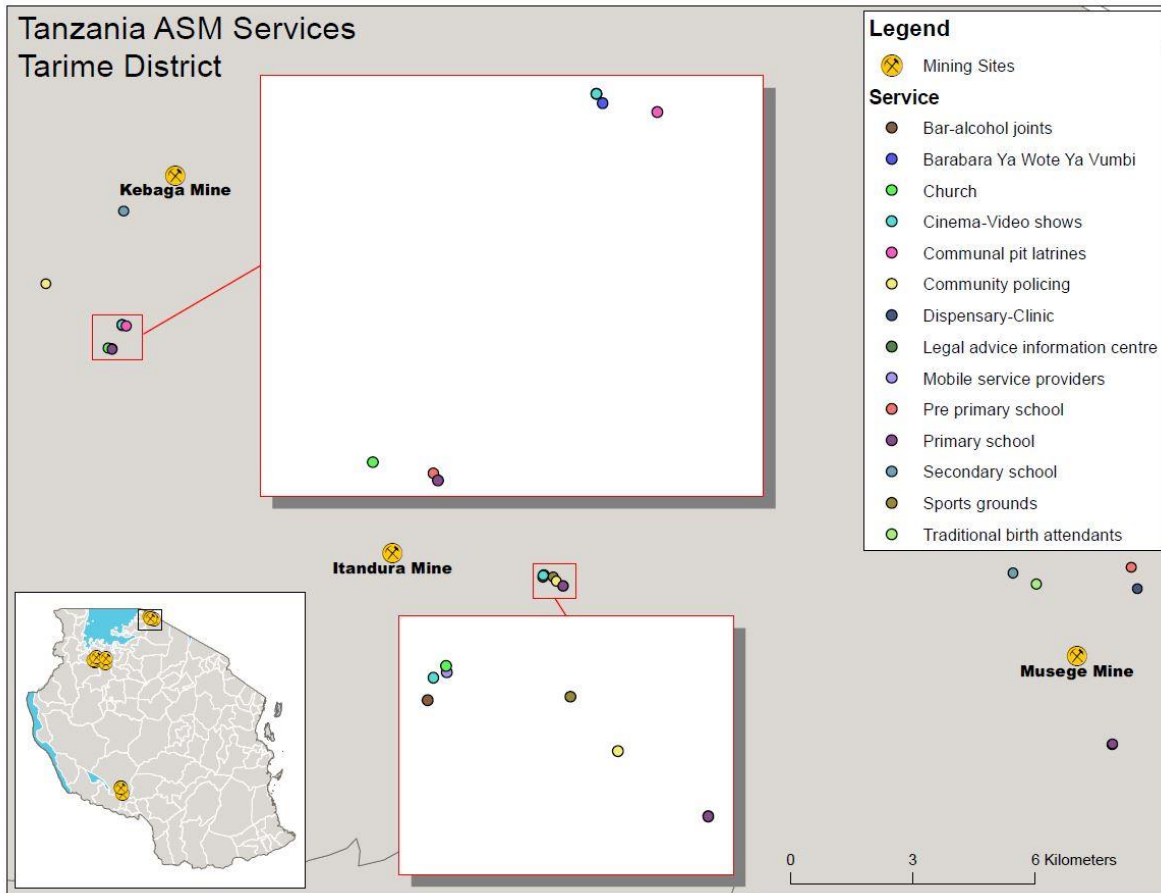
The majority of miners (64.9%) have attained primary school education, however the data shows that large majority of miners (71.3%) have learned the various skills that they possess from their fellow miners. Out of those who gained on job training from peers, 63.5% have no formal education. The existence of informal training system within artisanal and small scale mining industry presents a good opportunity for skills building for the artisanal and small scale miners. There is a need to consider a way of assessing and accrediting some of these apprenticeship skills building on competence basis. This will ensure that miners who receive on the job training, do receive skills that meet some minimal standards of practice in mining. The miners will also be able to utilize the skills gained through the certified apprenticeship when opportunity presents such as employment with large scale miners.

5 Conclusion

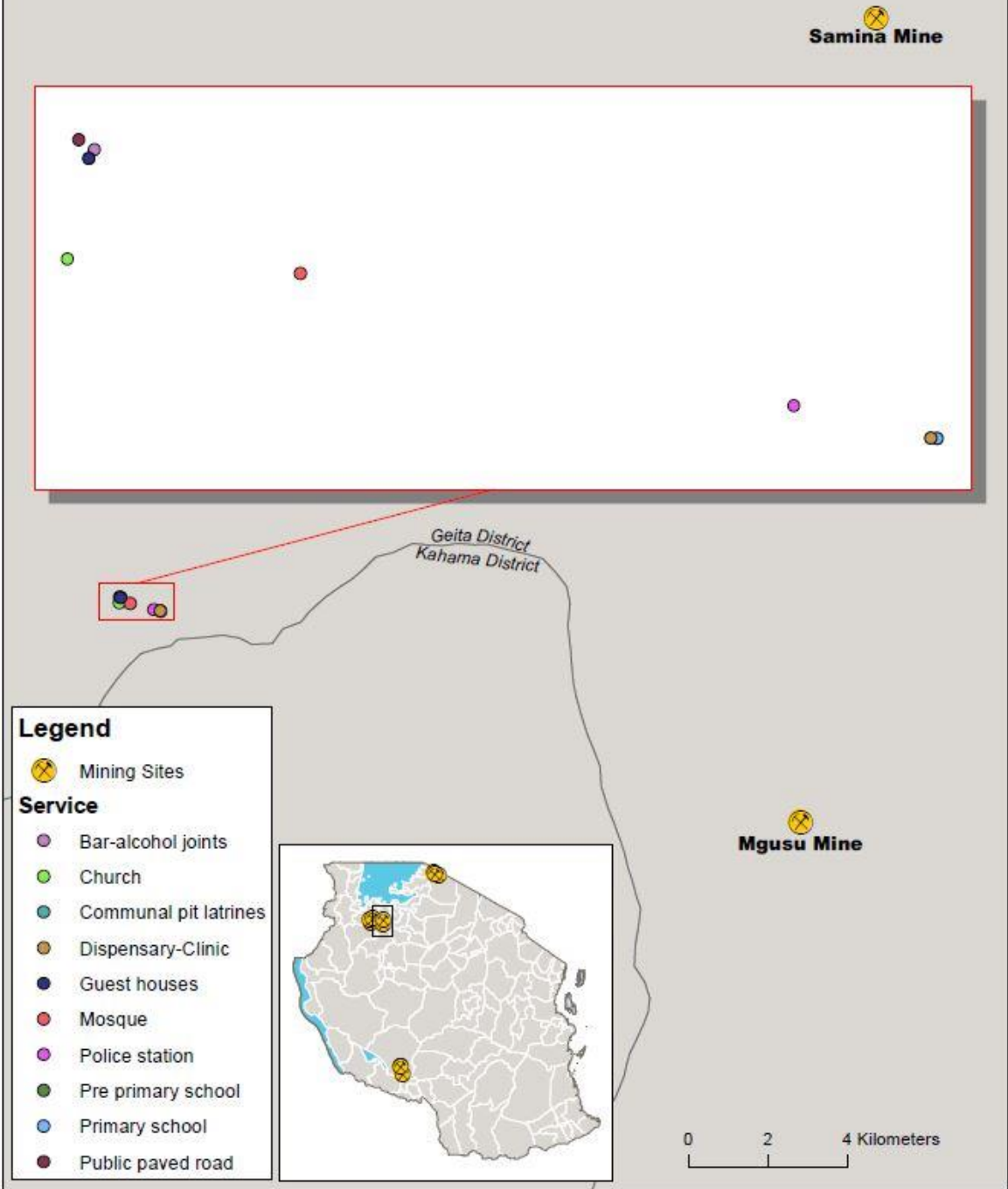
Artisanal and small scale mining in Tanzania is a means of livelihood for majority of miners. Quite a number of miners would not consider any other income generation activities outside mining. However, the industry is not producing enough to meaningfully sustain the livelihoods of the workforce it employs. Miners work long hours using poor mining technologies including mining by intuition rather than being guided by geological surveys that would provide an indication of where mineral deposits are. The poor techniques lead to lower productivity and loss of valuable minerals. Investment in mining technology is required to improve productivity of artisanal and small scale miners. Another issue that needs addressing is the low literacy levels of miners, including financial literacy, to ensure that miners are able to plan and manage their expenses.

Appendices

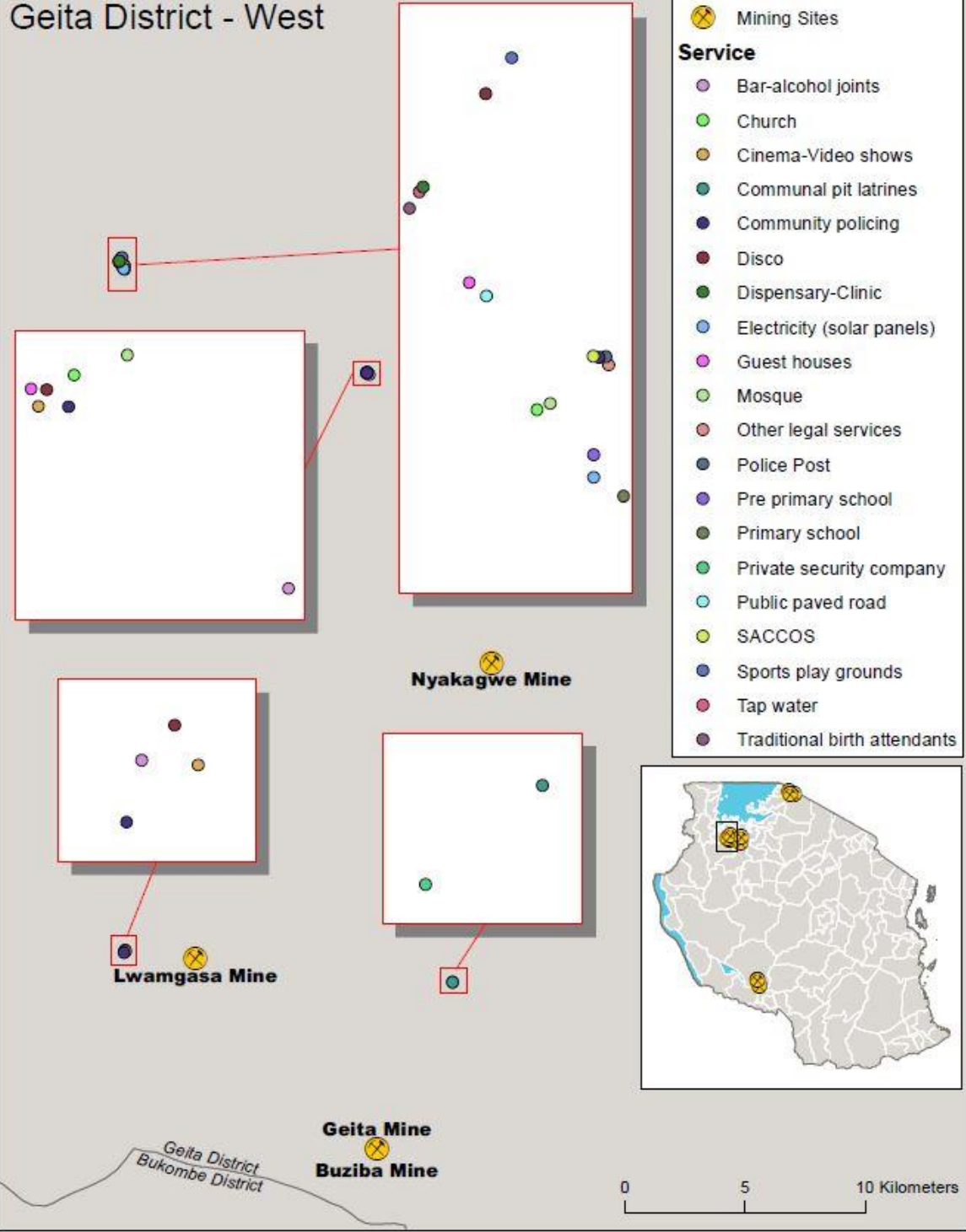
Appendix 1: Social services infrastructures in the mining sites



Tanzania ASM Services Geita District - East

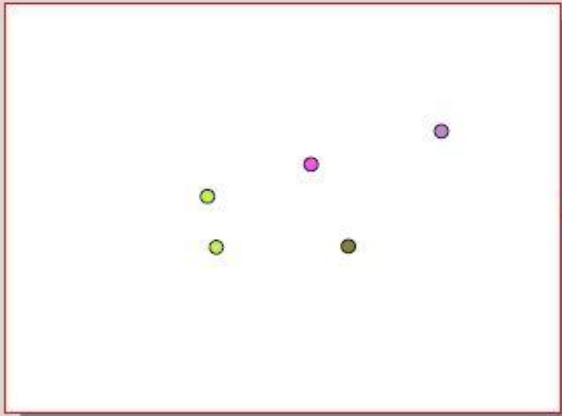


Tanzania ASM Services Geita District - West



Tanzania ASM Services Chunya District

Makongorosi Mine
Mdiva Mine



Izumbi Mine
Itumbi Mine

- Legend**
- Mining Sites
 - Service**
 - Bar-alcohol joints
 - Church
 - Cinema-Video shows
 - Guest houses
 - Mobile service providers
 - Mosque
 - Pre primary school
 - Primary school
 - Public paved road

