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Assessment on Artisanal Gemstone Mining in Konso and Gamo Zone, South Ethiopia Region

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Abstract

The Konso and Gamo Zone in the region is endowed with a wealth of colored gemstones that have been discovered by local people and to some extent, professional experts. However, the area requires further detailed investigation to fully understand and delineate the resources and their potential. The limited mining activity and lack of comprehensive resource mapping suggest significant untapped potential in the region. The gemstone mining industry in the Konso and Gamo Zone faces several challenges, including limited access to modern mining equipment and technology, lack of formal training and skill development programs for miners, inadequate infrastructure, difficulty in securing fair prices due to the presence of middlemen, and environmental degradation caused by improper mining practices. To unlock the full value of the colored gemstones found in this region, a strategic approach focused on comprehensive resource evaluation and stakeholder collaboration will be essential. Addressing the gaps in resource identification, mining capabilities, and community involvement can leverage the natural wealth of the Konso and Gamo Zone to drive economic development and improve the livelihoods of the local people.

Keywords: Artisanal miners, Gemstone, mining machines and equipment's, mining methods.

Introduction

A gemstone is the naturally occurring crystalline or non - crystalline form of a mineral which is desirable for its beauty, valuable in its rarity, and durable enough to be enjoyed for generations[1].Ethiopia is one of the few countries in the world with a diversity of gemstone deposits within its borders[2].There exist over 40 different varieties of colored stones, including emerald, tourmaline green and pink color, opal, aquamarine, jasper, agate, chrysoparse, peridot and amethyst, sapphire, ruby, fossilized amber, transparent ruby, yellow amber and green, Sapphire corundum not transparent/, sapphire, and black tourmaline[3].

The Southern Ethiopia region is endowed with a diverse array of precious and semi-precious gemstones, including agate, aquamarine, amazonite, and emerald, among others[4]. Despite the abundance of these valuable resources, the local mining community and the government have not fully capitalized on the economic potential they offer. The mining operations within the Southern Ethiopia regional state are poised to be a crucial economic catalyst, aligning with the government's export-oriented development strategy. However, the gemstone sector in this region is highly unorganized and lacks a comprehensive profile.

The government recognizes the mining sector's significant contribution to the country's economic growth and has placed a special emphasis on it. To maximize this contribution, it is crucial that all artisanal and small-scale gemstone miners operate at their full potential. Unfortunately, most artisanal gemstone miners face a multitude of challenges related to the market chain, access to modern technology, and other factors[5]. To address these issues, it is essential to gather comprehensive information on production rates, mining methods, marketing strategies, value-addition practices, and other relevant activities. This data will help identify the root causes of the miners' problems and inform the development of targeted solutions.

By addressing the challenges faced by the local mining community and supporting their efforts to unlock the full potential of the region's gemstone resources, the government can harness these assets as a powerful engine for economic growth and development. The research served as a critical step in gathering the necessary data and insights to guide policymakers, industry stakeholders, and development agencies in formulating effective strategies to strengthen and empower the artisanal gemstone mining community in the South Ethiopia region. Primary objective of the study was to assess the status of artisanal gemstone miners and their associations within the Konso and Gamo Zone of the South Ethiopia region.

Materials and Methods

To achieve the targeted objectives of the assessment, the following methodological approach was adopted: i. Review of existing documentation and literature on similar initiatives and assessments related to the gemstone mining sector. This helped

to inform the design of the current study and leverage relevant best practices. ii. A comprehensive record sheet was designed to facilitate the systematic collection and documentation of information during the assessment.This tool was structured to capture relevant data in an organized and coherent manner. iii. Open-ended questionnaires were developed to guide the interviews with artisanal gemstone miners and other key stakeholders. This approach allowed for in-depth discussions and the elicitation of qualitative insights. iv. Focused group discussions were done by involving the staff of mining bureaus, technical experts, and managerial-level officers, as well as representatives from the artisanal miner groups. These discussions enabled the team to gather diverse perspectives and gain a deeper understanding of the challenges and opportunities in the sector.Assessment are performed using an expert wise direct field visit to the mining site, and make detailed discussion about the existing situation and opportunities across the individual site.

Results and Discussion

Gemstone occurrence and Artisanal Miners: Agate deposit in Kamba Woreda: The geological units exposed in the study area are composed of volcanic sequences, primarily basalt and rhyolite. The main gem mineral found in this area is agate, with a smaller amount of jasper. The potential agate site is located in the Kamba woreda, at a specific locality called Shemala. This area is part of a delineated geological block known as the Fudale block, which was previously investigated by the Gem Mineral Exploration Group of the Geological Institute of Ethiopia in 2018. The type of agate found at the Shemala locality is a high-quality blue agate.

The dominant geological unit within the area is rhyolite, with a minor amount of basalt. The agate occurs as secondary material that has been injected into the rhyolite.

Aquamarine and Agate in Martha garda Woreda: The geological units in this area comprise a variety of lithologies, including pegmatite, quartz veins, and gneiss, which form the mountain ranges and ridges. The Chilbo Mountain, in particular, hosts pegmatite and quartz veins that contain deposits of aquamarine, which were previously identified by the Gem Exploration Group of the Geological Institute of Ethiopia. In addition to the aquamarine deposits in the Chilbo Mountain, there is also a blue agate deposit located at the Shakaro locality within the study area.

Figure-1: Blue agate hosted in rhyolite (Kamba woreda).

Figure-2: Aquamarine samples from Chilbo Mountain (from GIE 2018) of Martha garda woreda.

Agate, jasper and aquamarine deposit in Gerese woreda: The Gerese woreda contains several areas with potential deposits of different types of gem minerals, including agate, jasper, and aquamarine. One such locality is Ketele, where these gem deposits can be found. The geology of the agate and jasper deposits in this area is similar to the agate deposits previously identified in the Kamba woreda. Meanwhile, the aquamarine deposits are an extension of the Chilbo block, which was initially discovered in the Martha Garda woreda, and now extends into the southwestern part of the Gerese woreda.

Agate Deposit in Mirab Abaya woreda: The Mirab Abaya woreda is known to host occurrences of agate and other precious and semi-precious gemstone varieties. However, to date, no detailed geological investigations have been conducted in this area. Given the presence of good geological indicators for the potential occurrence of highly prized gemstones, such as ruby and other varieties, this area warrants special investigation and further exploration efforts. The lack of detailed studies in the Mirab Abaya woreda presents an opportunity for more comprehensive geological assessment and potentially the identification of new gemstone deposits in the region.

Black tourmaline in Karat Zureya Woreda: Based on the findings from the assessment, it was observed that in the Karat Zureya Woreda, there are currently no active artisanal gemstone mining operations taking place. This is primarily due to a lack of information and knowledge among the local communities regarding the specific locations where the target gemstone deposits are situated.

However, the assessment team did observe some promising indicators for the presence of black tourmaline in the area. Specifically, outcrops of black tourmaline were observed along the riverbanks near the town of Konso, suggesting the potential for underlying gemstone resources in the vicinity. The absence of active artisanal mining in the Karat Zureya Woreda highlights the need for further exploration and mapping of the gemstone deposits in the region. Providing the local miners and communities with accurate information about the location and nature of the gemstone resources can be a crucial first step in catalyzing the development of the artisanal mining sector in this Woreda.

Aquamarine and Industrial quartz in Kena Woreda: The assessment has identified the presence of two active artisanal mining associations in the region - one focused on extracting aquamarine/quartz, and the other on mining industrial quartz. The artisanal miners who were previously engaged in aquamarine extraction have now ceased their operations. In contrast, the artisanal miners focused on industrial quartz extraction are still operating, albeit at a very limited capacity. This is primarily due to their lack of access to more advanced and efficient mining equipment, which constrains their ability to scale up production.

The challenges faced by the aquamarine miners, in terms of the technical complexity of extracting the gemstones from the hard rock formations, highlight the need for targeted interventions to equip the artisanal miners with appropriate tools, technologies, and skills. This could help them overcome the barriers to accessing and extracting the valuable aquamarine resources. Similarly, the limitations faced by the industrial quartz miners due to the lack of advanced mining equipment underscore the importance of facilitating access to modern, productive mining technologies and machinery. This would enable the artisanal miners to enhance their productivity and unlock the full economic potential of the industrial quartz deposits in the region.

Figure-3: Exposure of river cut black tourmaline.

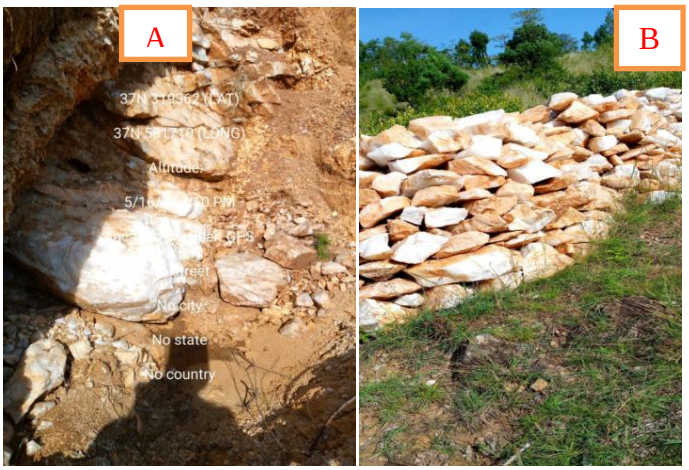

Figure-4: Quarry of aquamarine (A) & industrial quartz product (B).

Emerald in Kolme Woreda: The assessment has identified the presence of artisanal miner associations in the Kolme Woreda that were previously engaged in the mining of emerald and related gemstones. These associations had been operating in a shared business model with a private company. However, the current mining operations have been halted due to a disagreement that has arisen between the artisanal miners and the private company involved in the partnership. The suspension of mining activities due to the disagreement between the artisanal miners and the private company represents a critical juncture. It highlights the need for effective conflict resolution mechanisms and the establishment of clear, mutually beneficial collaborations between the artisanal mining associations and private sector partners.

The emerald deposits in the area are hosted within pegmatite veins, which are associated with biotitic schist mica formations. The extensive excavation and mining activities carried out in the past have significantly disturbed the surrounding environment. Over time, this level of disturbance and extraction has the potential to contribute to serious environmental issues, such as deforestation and ecosystem pollution in the region.

Additionally, the assessment should explore ways to promote more sustainable and environmentally-responsible mining practices in the Kolme Woreda, to mitigate the long-term impacts on the local ecosystem. This could involve the introduction of best practices, technical assistance, and the development of a regulatory framework that balances the interests of the artisanal miners, private companies, and the environment. By addressing these challenges, the assessment can contribute to the reactivation and long-term viability of the emerald mining activities in the Kolme Woreda, while also ensuring the protection of the local environment and natural resources.

Artisanal Miners of Gemstone in Gamo and Konso Zone: Martagarda Woreda: The Martagarda woreda is home to artisanal miners and mining associations that extract agate, aquamarine, and other industrial beryl minerals. There are ten such associations operating at different locations within the woreda.

Most of these artisanal miners utilize traditional mining equipment, such as Doma, Akafa, Digino, Medosha (hammer), Konchera, Jerican, and others. However, this traditional equipment is hindering the miners from reaching their full potential in extraction and production. The aquamarine and other beryl group gem minerals, as well as the industrial beryl minerals, are typically hosted within pegmatite veins, which are very hard rock formations. The traditional mining tools mentioned are not well-suited for excavating these types of hard rock deposits.

Kamba Woreda: The Kamba woreda also has a presence of artisanal miners, primarily focused on extracting agate. There are three associations operating in this woreda that engage in agate mining, utilizing very traditional mining methods and equipment. The most common tools used by these local miners include Akafa, Konchera, Meterebiya, Madaberiya, and Konte. The mining techniques employed by the miners in this woreda are quite rudimentary, as they lack access to more advanced equipment such as Digino, Doma, and other materials that could help penetrate the rock formations hosting the agate deposits.

Unlike the aquamarine and beryl group minerals found in pegmatite veins, which require more sophisticated equipment, the agate deposits in this area are hosted within a highly weathered and friable rhyolite rock. This makes the mining process relatively simpler compared to the extraction of the beryl group minerals. To increase the productivity and efficiency of the local agate miners in the Kamba woreda, they would benefit greatly from access to more advanced tools, such as Digino, hammers, and, if possible, air compressor jackhammers. These upgrades to their mining equipment would enable them to extract the agate deposits more effectively and improve their overall production.

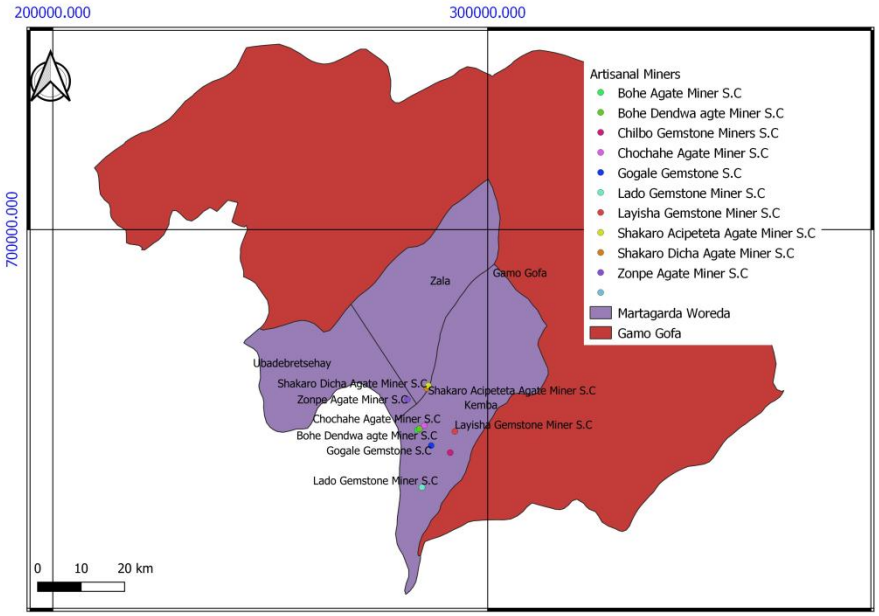

Figure-5: Location map of agate miner associations in Martagarda Woreda.

Table-1: List of Artisanal Miners/of Agate and other Semi- precious gemstone.

Name of Association	Production Amount /Month	Year of establishment	Number of Miners	
			M	F
Bohe Agate Miner S.C	150 kg	2020	10	2
Bohe Dendwa agate Miner S.C	100 kg	2021	12	0
Chochahe Agate Miner S.C	200 kg	220	10	2
Shakaro Dicha Agate Miner S.C	400-500 kg	2022	24	0
Shakaro Acipeteta Agate Miner S.C	450 kg	2022	22	0
Zonpe Agate Miner S.C	300 kg	2022	22	0
Gogale Gemstone S.C	100 kg	2022	14	3
Lado Gemstone Miner S.C	100 kg	2019	32	3
Chilbo Gemstone Miners S.C	100 kg	2019	40	0

Table-2: List of Artisanal Miners of Agate and other Semi- precious gemstones in Kamba Woreda.

Name of Association	Production Amount /year	Number of Miners		Year of establishment
		M	F	
Shamela Kebele Abiren Endide Agate miner S.C	1000 kg	12	0	2023
Shamela Kebele Andinet Agate miner S.C	640.3 kg	26	1	2022
Shamela Kebele Ediget Agate miner S.C	910.5kg	32	1	2022

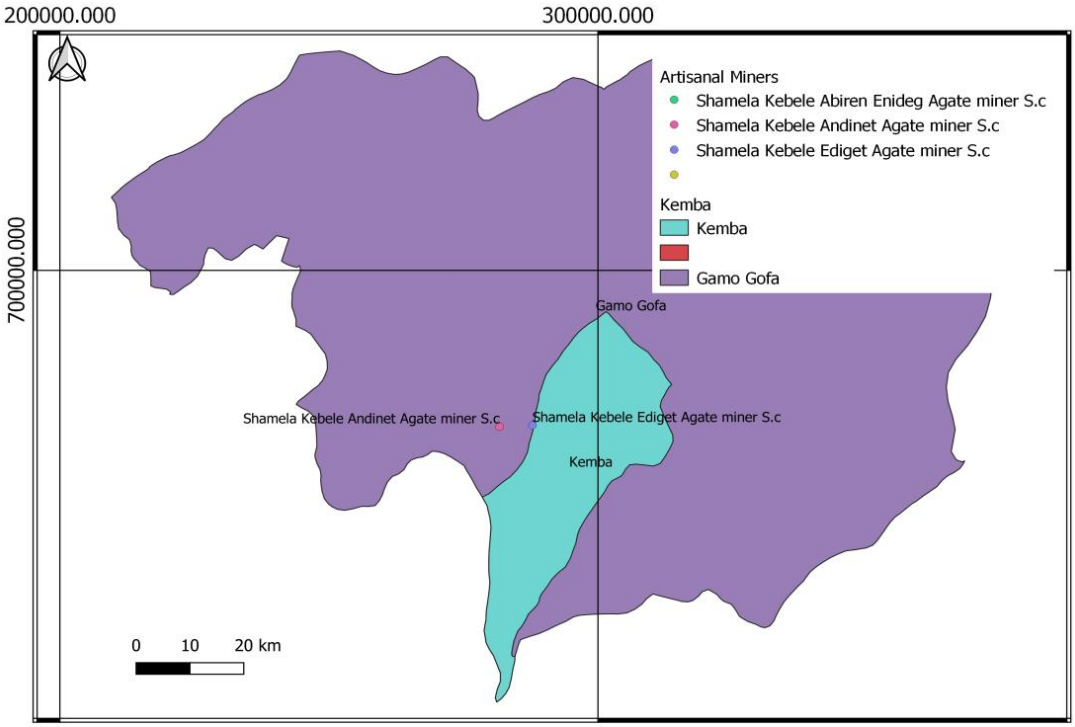

Figure-6: Location map of artisanal miners in Kamba woreda.

Mirab Abaya Woreda: Within this particular woreda, there are only two artisanal gemstone mining associations that extract agate, aquamarine, and other corundum group minerals. Similar to the mining associations in other areas, these local miners utilize very traditional equipment and methods for their extraction activities. The aquamarine and other corundum group minerals in this woreda are primarily hosted within basement rock formations, which are incredibly tough and difficult to disintegrate. This makes it challenging for the miners to effectively extract the target gemstone deposits from their host rock using only traditional tools.

To improve the productivity and efficiency of these local miners, access to more advanced equipment, such as handheld jackhammers, would be crucial. The use of power-assisted tools like jackhammers would enable the miners to more easily penetrate and break apart the hard, basement rock formations, allowing them to more effectively mine the aquamarine and corundum group mineral deposits. Upgrading the miners' equipment from the traditional, manual tools to more modern, power-driven tools would significantly enhance their ability to extract the valuable gemstone resources present in this woreda.

Gerese woreda: The Gerese woreda is home to three artisanal gemstone mining associations that focus their efforts on extracting agate deposits. Similar to the mining practices observed in other Woredas, these local miners in Gerese utilize very traditional methods and equipment for their extraction activities. The common tools employed include Doma, Akafa, Meterebiya, Konichera, Madaberia, Jerican, Konte, and other traditional mining implements.

Table-3: Artisanal gemstone miners in Mirab Abaya Woreda.

Name of Association	Number of Miners	
	M	F
Barkot Jewelery Miner S.C.	13	27
Niftale Jewlery Miner S.C.	28	12

The use of such rudimentary, manual tools and techniques poses significant challenges and greatly hinders the productivity of these artisanal miners. The hosting rock formations for the agate deposits are often quite hard and difficult to penetrate using only these traditional methods. To enhance the productivity and efficiency of the local miners in Gerese, they would greatly benefit from access to more advanced mining equipment, such as air compressor-powered jackhammers. These power-assisted tools would enable the miners to more effectively break through the hard rock layers and extract the agate deposits with greater ease and speed.

Providing the Gerese artisanal miners with access to modern, mechanized mining equipment would be a crucial step in increasing their overall extraction capabilities and improving their economic output from the agate deposits in the woreda.

Table- 4: Artisanal gemstone (Agate) miners in Gerese Woreda.

Name of Association	Number of Miners		Year of establishment
	M	F	
Durbe Azega Agate Miner S.c	15	10	2020
Kuke Terara Agate Miner S.c	11	9	2020
Fudale Ayche Andinet Agate miner S.c	8	2	2021

Major Challenges and Constraints: Market Chain: Marketing has been identified as the primary challenge faced by artisanal miners of agate and other semi-precious gemstones across all Woredas (districts). Due to marketing-related issues, most artisanal miners in Agate and other areas have currently ceased operations. In Martagarda woreda and Gerese woreda, all the associated miners' groups have become inactive. In Kamba woreda, only one association remains active, while the rest are inactive. In Mirab Abaya woreda, there are only two active associations that continue to operate. Overall, the majority of associations engaged in artisanal mining of agate and other semi-precious gemstones lack access to buyers for their products. As a result, most agate artisanal miners have stopped mining activities.

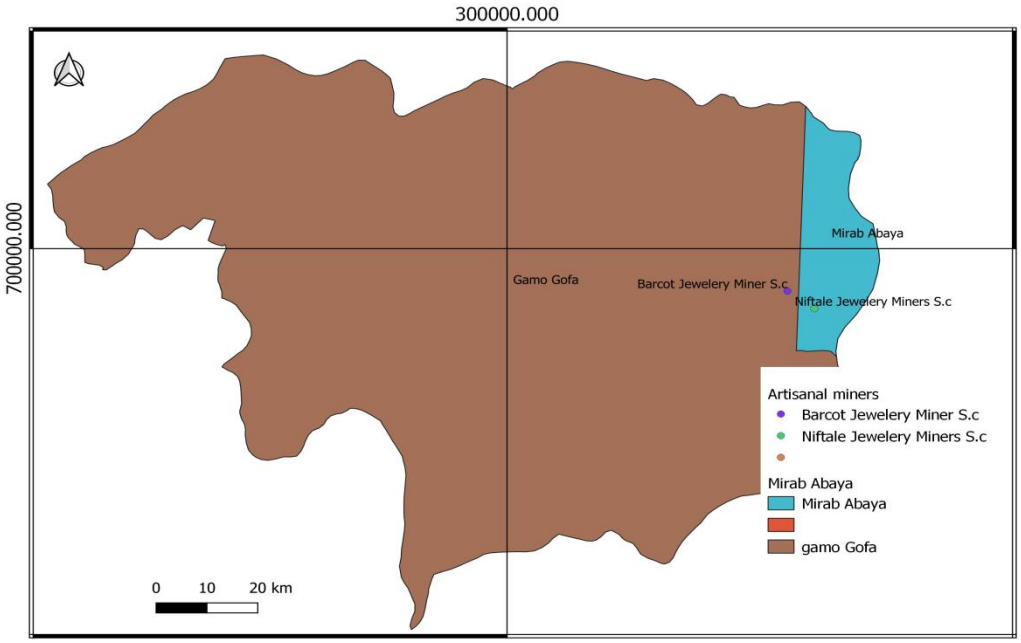

Figure-7: Location map of Agate artisanal miners in Mirab Abaya Woreda.

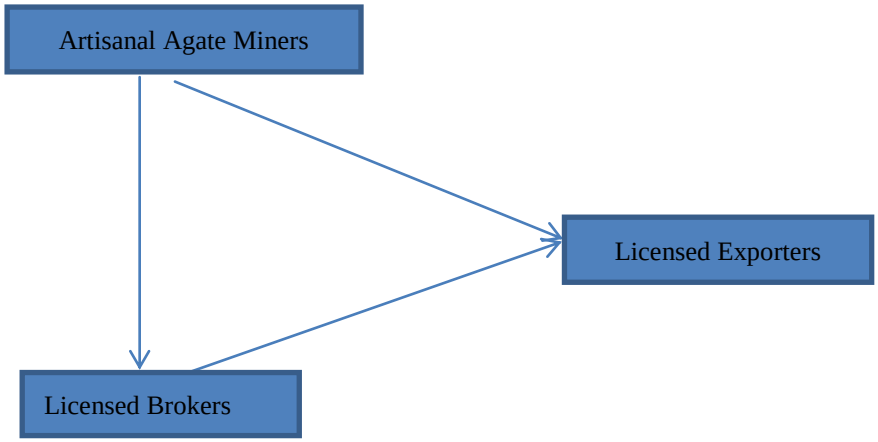

Figure-8: Local market chain frame work.

Grading and Standardized price: Artisanal miners of agate and other semi-precious and precious gemstones typically sell their products either to licensed brokers or directly to licensed exporters, depending on the buyers' preferences[6]. However, there is a lack of standardized practices or mechanisms to mediate between the buyers and sellers. This lack of structure leaves the artisanal agate miners highly vulnerable to exploitation by buyers. The miners may end up selling higher-quality grade 1 agate as lower-grade 2 or 3, since there are no established grading systems or price schedules in place. On average, artisanal miners can only fetch around 100 birr per kilogram of agate sold.

Mining, especially for artisanal miners, is an extremely difficult and energy-intensive endeavor[7]. Selling agate for only 100 birr per kilogram is simply not a viable or sustainable model for these miners. As a result, many have been forced to stop mining activities until a more equitable pricing system can be established.

Mining Equipment's and Methods: Artisanal miners of agate and other semi-precious and precious gemstones across different woredas (districts) utilize very traditional, rudimentary mining equipment and methods. This poses significant challenges for these miners to operate at their full potential.

In particular, the artisanal miners in Martagarda woreda have had to cease mining activities due to a lack of advanced mining equipment, such as jackhammers. Jackhammers would allow them to penetrate the hard rock and liberate the target gemstones from the host pegmatite veins more effectively[8]. The most common traditional mining equipment currently used by these artisanal miners includes tools like konte, akafa, doma, digino, and hammers, along with other supporting implements[9-10]. The reliance on these basic, labor-intensive tools and methods limits the miners' ability to extract gemstones efficiently and at scale.

Figure-9: Current equipment's used for agate mining, Konte (Local name).

Lack of knowledge on Gem identification and Grading: There is a need to provide training to the experts at the woreda (district) level on the identification and grading of gemstones. This skill gap poses a challenge for local artisanal miners when they are selling their products to buyers.

During the sales process, the artisanal miners require mediators who can effectively negotiate between the buyers and sellers. Currently, the geologists from the woreda mining offices are the only available experts who can play this intermediary role. However, these geologists lack the necessary qualifications and expertise to properly identify and grade the quality of agate and other semi-precious gemstones. To address this issue, it is critical to provide training to the experts based in the woreda mining offices on gemstone identification and grading. Equipping these local experts with the right skills will enable them to better serve as effective mediators between the artisanal miners and the buyers, ensuring fairer transactions and pricing for the miners.

Marketing Center and Accessible Road: Artisanal miners of agate and other semi-precious gemstones across different woreda (districts) face significant challenges related to access to marketing centers and transportation infrastructure[11-12]. These miners often have to travel long distances on foot, carrying the gemstones on their shoulders, to reach their residential areas from the mining sites. The mining areas are typically located in highly inaccessible places, with a complete lack of suitable road networks for vehicle access.

The absence of proper transportation options and well-connected marketing centers forces the local miners to expend considerable time and energy just to transport their products. They are compelled to walk for extended periods, burdened by the weight of the gemstones they have extracted. This lack of basic infrastructure and access to centralized marketing hubs poses a significant challenge for the artisanal miners, hindering their ability to efficiently and cost-effectively bring their gemstone products to market.

Conclusion

In conclusion, the Konso and Gamo Zone has an abundance of colored gemstones that have been discovered by local people, and to some extent, by professional experts. However, the area still requires detailed investigation to fully understand and delineate the resources and their potential. The limited mining activity and lack of comprehensive resource mapping indicate that there is significant untapped potential in the Konso and Gamo Zone. Further exploration, assessment, and engagement with the local communities will be crucial to unlocking the full value of the colored gemstones found in this region.

In General, the gemstone mining industry in the Konso and Gamo Zone faces several challenges, including: i. Limited access to modern mining equipment and technology, ii. Lack of

formal training and skill development programs for miners, iii. Inadequate infrastructure, such as access roads and transportation facilities, iv. Difficulty in securing fair prices for their gemstones due to the presence of middlemen and a lack of direct market access, v. Environmental degradation caused by improper mining practices.

By addressing the gaps in resource identification, mining capabilities, and community involvement, the Konso and Gamo Zone can leverage its natural wealth to drive economic development and improve the livelihoods of the local population. A strategic approach focused on comprehensive resource evaluation and stakeholder collaboration will be essential in realizing the zone's gemstone potential.

Recommendation: The majority of artisanal miners have been forced to cease mining of agate and other semi-precious gemstones due to a combination of factors, including a lack of established market channels, access to advanced mining equipment, and standardized systems for grading and pricing. To address the challenges and promote the sustainable development of the gemstone mining industry in the Konso and Gamo Zone, the following recommendations are made: i. Provide training and capacity-building programs for miners to improve their mining techniques and safety practices. ii. Invest in the development of necessary infrastructure, such as access roads and transportation facilities, to facilitate the transportation and marketing of gemstones. iii. Establish a formal gemstone trading and marketing system to ensure that miners receive fair prices for their products and have direct access to domestic and international markets. iv. Implement environmental protection measures, such as the establishment of waste management systems and the promotion of environmentally-friendly mining practices. v. Encourage the formation of cooperative associations or unions to empower miners and strengthen their bargaining power. vi. Collaborate with relevant government agencies and development partners to provide financial and technical support to the gemstone mining industry.

References

1. Matlins, A. L. (2010). Colored Gemstones: The Antoinette Matlins Buying Guide: how to Select, Buy, Care for & Enjoy Sapphires, Emeralds, Rubies, and Other Colored Gems with Confidence and Knowledge. Gemstone Press.

2. Kyngdon-McKay, Y., Jorns, A., Wheat, B., Cushman, T., & Nemomissa, S. (2016). An Analysis of the Commercial Potential of Ethiopia's Coloured Gemstone Industry.

3. Schumann, W. (2009). Gemstones of the World. Sterling Publishing Company, Inc..

4. Rop, B. K. (2014). Economic and Job Creation Potential of Artisanal and Small-Scale Mining in Taita Taveta County.

5. Cartier, L. E. (2019). Gemstones and sustainable development: Perspectives and trends in mining, processing and trade of precious stones. *The extractive industries and society*, 6(4), 1013-1016.

6. Kyngdon-McKay, Y., Jorns, A., Wheat, B., Cushman, T., & Nemomissa, S. (2016). An Analysis of the Commercial Potential of Ethiopia's Coloured Gemstone Industry.

7. Blundi, D., da Silva Loureiro, A. C. N., de Carvalho, S. M. P., Jorge, M. F., Lopes, F. V., da Silva, G. T. P., & Orind, V. (2019). Technology appropriation and technology transfer in the Brazilian mining sector (Vol. 53). WIPO.

8. Weldon, R., Ortiz, J. G., & Ottaway, T. (2016). In Rainier's footsteps: Journey to the Chivor emerald mine. *Gems & Gemology*, 52(2), 168-187.

9. Labonne, B. (1996). Artisanal mining: an economic stepping stone for women. In *Natural Resources Forum* (Vol. 20, No. 2, pp. 117-122). Oxford, UK: Blackwell Publishing Ltd.

10. Chakravorty, S. L. (2001). Artisanal and small-scale mining in India. *Mining, Minerals and Sustainable Development*, 78(October).

11. Geenen, S. (2015). African artisanal mining from the inside out: Access, norms and power in Congo's gold sector. Routledge.

12. Girard, V., Molina-Millán, T., & Vic, G. (2022). Artisanal mining in Africa. In Working Paper Series. No. 2201.