

BRAZIL

PROJECT ASGM SUSTAINABILITY IN PEIXOTO

NAP.Mineração/USP

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1. Executive Summary

This report was prepared as part of the project “ASGM Sustainability in Peixoto” funded by the World Bank’s Extractives Global Programmatic Support (EGPS), Emergency Window for Support to Artisanal and Small-Scale Mining (ASM) Communities Impacted by COVID-19. This 4-month project has developed a strong relationship between the researchers from NAP Mineração/USP (Centre for Small-Scale Responsible Mining of the Dept of Mining Engineering of University of São Paulo, Brazil) and UBC (Norman B. Keevil Institute of Mining Engineering of the University of British Columbia, Vancouver, Canada) with the members of the COOGAVEPE (Cooperative of the Artisanal Miners of the Peixoto River Valley, Mato Grosso State, Brazil), with nearly 6000 associates.

The objective of the study was to investigate key issues related to the performance of the artisanal gold miners and their Cooperative to support suggestions to improve the sustainability of the Peixoto de Azevedo’s mining community. The study was conducted from February to May 2021, by remote interviews and a short field visit. Technical aspects of the gold extraction operation such as gold trading, use of mercury, mining and mineral processing methods, skills and motivations to keep mining, etc. as well as economic and social issues were also investigated and the stakeholders provided hints about the way forward to improve their practices and create more benefits for the local community. Co-existence of artisanal miners with companies, gender issues and the impact of the COVID outbreak on the mining activities were also part of the study and thoroughly discussed with the Cooperative members.

The main findings of the study are outlined as follows:

Related to the Cooperative

- Currently, the COOGAVEPE cooperative has 5952 associates, with 429 women (7%) and 5523 men (93%).
- The annual gold production of the COOGAVEPE associates in 2020 was 4.4 tonnes.
- In general, it was observed that the success of the COOGAVEPE cooperative seems to be encouraging miners to become formalized.
- The local geological knowledge is quite limited to allow a through mining plan, in particular, for the primary ore deposits.
- The results and conclusions of this project have strong support on a survey responded by 57 miners and other members of the COOGAVEPE, and 1 miner not associated with the Cooperative. The ages of the participants ranged from 18 to 59 years. About 14% of the respondents were women.

- When asked about the importance of the Cooperative, the survey participants listed: 1) regularize the mining activity, 2) provide technical assistance, 3) trade gold. The least cited items were: facilitate
- access to credit at financial institutions and to help with the purchase of equipment and supplies such as diesel and food.

Work Regime and Methods Used

- Artisanal miners typically work based on profit sharing by verbal agreement. This is the arrangement reported by approximately 40% of surveyed miners. In contrast, 19% answered they work in partnership based on formal contracts registered in a notary public. About 38% answered that they work for themselves and approximately 3% of those surveyed work on a temporary basis.
- Most group of miners ranges from 4 to 9 individuals but there are operations involving up to 20 people.
- The main ores mined by the 93% of the surveyed artisanal miners in Peixoto are the secondary ones, i.e., colluvial/eluvial ores using hydraulic monitors. A minority mine alluvial ores in water streams using suction dredges. These miners do not crush or grind the secondary ores, only use carpeted sluice boxes for gold concentration. Only 7% of the surveyed miners extract gold from primary ores using hammer mills and copper amalgamating plates as the main process to extract gold. Rarely, but still observed, miners use centrifuges or other more efficient methods to concentrate gold.
- Without any gold metallurgical balance, the perceptions of the miners regarding gold recovery of their processing methods were very optimistic. About 7% of the survey participants said they recover 100% of the gold, 34% answered that they believe that their gold recoveries range between 80 and 100%, 16% answered that the recovery varies between 60 and 80%, 7% between 40% and 60%, 5% answered between 20% and 40%. Only 5% answered less than 20% of gold recovery. About 26% of the miners were more sincere and answered that they do not have idea about their gold recovery;
- Being able to choose more than one option, the survey also collected information about what is needed to improve the work in the gold mining on a daily basis. The responses were diverse: 39 of 58 participants responded by having access to new cheaper and accessible technologies, 34 of 58 responded to increase gold production and have more geological research. It is important to highlight that other options of the survey were substantially selected: 29 of 58 participants responded mercury-free techniques to extract gold and traceability of the sale of the produced gold and 20 of 58 responded reclamation of degraded areas.

- Miners are keen to learn better practices but there are limitations related to the knowledge and capital in new mining and processing techniques.

Alternative Livelihood

- When miners were asked if they would be open to learn new gold recovery methods, 64% answered positively and 36% answered that they would like to know more about the possibility to learn new gold recovery. No miner answered negatively.
- Regarding another type of economic alternative to replace mining, the highlight was that 64% of the survey participants answered that they would not exchange the mining for another activity, 24% said they have never thought about the subject, 10% they answered positively and 2% answered they would work in their own business but also with gold mining.
- When asked how miners invest their earnings, 71% of the participants replied that they purchase machinery for mining, followed by investments in personal properties (e.g., house and land) as well as in child education. About 19% answered that they invest in other alternatives (e.g., aquaculture) and 10% save the money in the bank.

Gold Trade

- Gold trade conducted by the cooperative is well organized with proper documents and registration. This has strong contrast with the informal gold miners in the region, who sell gold to unauthorized buyers.
- The cooperative has been collaborating with the authorities in charge of inspection and control of illegal gold trade in the region. The main objective of such initiatives is to attract informal miners to the cooperative to be formalized.
- Approximately 37% of the participants answered that they produce more than 1 kg per month, followed by 24% with monthly production of 500 to 1000g of gold monthly. 19% answered 100 to 300g, 9% from 300 to 500g, 9% answered less than 100g and 2% did not respond. In short, more than half (52%) of the survey participants produce more than 50 grams of gold per month, 34% of miners produce from 30 to 50 grams and 14% about 1 to 10 grams
- Another relevant data of the study is that gold shops play a fundamental role in the Peixoto de Azevedo economy. About 98% of the respondents answered that they sell the gold to local gold shops authorized to operate by the Central Bank of Brazil and 2% answered that it sells gold to shops in other Brazilian States.
- With the international gold price on May 14, 2021 of US\$ 59.2, the earning of US\$ 1776/month (for those producing 30 g Au/mo.) is 8.5 times higher than the Brazilian minimum wage of US\$ 209.

This is an optimistic simplification, as the gold price paid by gold buyers is subjected to taxes, amount of silver in the bullion, profits of the buyer, etc., but definitely gold mining is still a much more advantageous economic activity for those living in rural communities than any other type of livelihood.

Mercury Use and Release

- Amalgamation is still the dominant process to recover gold from concentrates of secondary ores. Amalgamation of the whole ore in copper plates is used for those (7%) mining primary ores.
- The amount of mercury released to the environment in the region is unknown. Considering that the large majority of the miners (93%) recover gold amalgamating concentrates, then the ratio $Hg_{lost} : Au_{produced}$ should be around 1. For those 7% using the copper-amalgamating plates, this ratio is usually between 3 and 4 (Yoshimura et al., 2021)¹. Therefore, the mercury releases in Peixoto region might be around 5 to 6 tonnes/year.
- Regarding the use of mercury, 57% answered that they buy mercury from a local dealer, 28% buy it through a middleman, 3% answered that they use recycled mercury, 3% buy mercury in another Brazilian State, 2% answered that they do not know where the mercury comes from and 7% did not respond.
- According to the responses, 45% pay Reais 1000 to 2000 (US\$ 190 to 380) for a kilogram of mercury, 34% pay Reais 500 to 1000/kg, 9% answered that they were not in charge of mercury acquisition and 7% pay less than Reais 500. In the same question, 5% answered they pay Reais 2000 to 3000 (US\$ 380 to 570) per kilogram of mercury. For comparison, the FOB Mexico² price of metallic mercury available in the internet ranges from US\$ 100 to 150 per kilogram.
- The results showed that 5% of the survey participants buy more than 2000 g of mercury per month, 12% buy 1000 to 2000g per month, 14% buy 600 to 1000g, 28% between 200 and 600g and 26% buy less than 200g. About 10% answered that they were not in charge of mercury acquisition and 5% do not know.
- About 57% of the survey participants answered that they amalgamate only gravity concentrates using “batea”, 33% using blenders. Therefore, 5% of the miners are using another type of amalgamation process, 3% did not respond and 2% said they do not use mercury.

1 Yoshimura,A., Suemasu,K., Veiga,M.M. (2021). *Estimation of Mercury Losses and Gold Production by Artisanal and Small-scale Gold Mining (ASGM) in selected countries. In press at J. Sustainable Metallurgy*

2 <https://portuguese.alibaba.com/product-detail/virgem-merc-rio-l-quido-de-prata-900000499612.html>
https://articulo.mercadolibre.com.mx/mlm-836547645-hgazoguemercurio-500g-_jm#position=1&search_layout=grid&type=item&tracking_id=1210cd4f-f165-4f39-8b6e-59ccd8905307

- The miners reported difficulties in adopting cleaner technologies replacing the use of mercury. The justification includes the high cost of the alternatives, such as cyanidation, associated with the fact that miners are not familiarized with other technologies. The same difficulties were perceived in relation to other processes such as mining, processing, refining, land reclamation, and health and safety of the workforce.
- The survey revealed that 81% use retort and recover mercury when decomposing the amalgam, 7% use retort but do not recover mercury, 6% of the respondents evaporate mercury in an open pan with torch in the bush or at home, 2% of miners burn amalgams in retorts in gold shops and 4% did not respond.
- With regard to the amalgamation tailings, miners leave the tailings in a water tank and eventually (once a year) they reprocess them by panning. It is not clear if they finally discharge these Hg-contaminated tailings into the rivers but it seems the miners keep these tailings in tanks for long time.
- The cooperative is looking for partnerships with other organizations to assist them in capacity building for miners to reduce and eliminate the use of mercury, especially in primary ore (hard rock) operations.

Gender Issues

- When asked in a multiple-choice question what would be the possible roles that women could play in the mining operations, 44 of 58 surveyed individuals answered administrative assistant, 38 of the 58 answered accounting, logistics and purchase of materials, 29 of 58 answered operation of trucks, excavators or tractors. Positions in the gold trading offices also receives attention of 28 of the 58 surveyed individuals. Also 26 of the 58 participants answered that women could occupy the direction and councils of the cooperative, whereas 10 of 58 expressed that women can work in the production together with the male miners. On the other hand, only 7 of 58 answered participants considered the female participation in artisanal mining activities only in cooking activities and 4 of 58 do not see any role for women in gold mining
- Out of the 5952 associates of COGAVEPE, 429 are women and only 2 of them are involved with the management of operations. The majority of the female associates work in supporting activities, such as cooking, but the current president of COOGAVEPE is a woman, for the first time in the cooperative's history.
- In the approach to what is required to have more women working in mining, 31 of the 58 survey participants answered that they see a greater number of female owners or managers of mining. In addition, 25 of the 58 survey participants pointed out the need for more capacity building for

women but 24 of 58 mentioned that this requires less discrimination in the sector. Twenty two out of the 58 participants mentioned that more women should take care of the direction and councils.

- Miners understand that there is an opportunity to increase the participation of women in the mining operations and in the initiatives relate to local development.

Co-existence of Mining Companies with Artisanal Miners

- For 45% of the survey participants, the relationship between mining companies and artisanal miners is not agreeable due to the preference of the governmental agencies to favor companies and artisanal miners do not engage with conventional companies. However, 19% answered that they have good relationship with companies, 17% had no opinion, 7% answered that there is no conventional gold mining in the region, 7% would you like to know more about this topic, 3% answered that the relationship depends of the company and 2% answered that it is bad because of conflicts of interest by the company, which is a clear indication of not being familiarized with the co-existence concept.
- Regarding the possibility for a mining company to buy the ore produced by artisanal miners to process in its own plant, there was variation in the responses: 24% answered that they would like to do and are interested in knowing more about this subject. About 22% said they do not have an opinion about this system. On the other hand, 19% did not believe in this type of business, 17% answered that a partnership of a company with the COOGAVEPE would be a good opportunity, 12% answered that if the company paid better for the gold contained in the ore, this would be a good opportunity to make more money. Finally, 6% answered other reasons.

Covid-19

- It was observed that 81% of the surveyed individuals have good knowledge about how to protect themselves from COVID, using masks, hand sanitizers and social distancing.
- COOGAVEPE have developed in conjunction with the provincial health authority a program for the health of the miners and community during the recent outbreak. This program has assisted 740 miners.
- The pandemic has shown that the cooperative approach has been efficient to inform and organize artisanal miners regarding the COVID outbreak. Social media have also proved to be a powerful system to disseminate preventive measures.
- Miners with limited incomes have suffered the most with the pandemic. The Cooperative has been assisting these miners with food, facemasks, sanitizers and some out-of-shelf medicines.

- Regarding the virus contamination, despite knowing the risks, miners are still working as this is their main livelihood. The miners mentioned that they believe the risks at the mining sites are lower than at the village.

This study also had a large number of meetings with the Cooperative administrators regarding the advantages of establishing a small laboratory for chemical analyses of ores and mining products as well as to assess the mineral processing techniques to extract gold by gravity separation, flotation and cyanidation. This is the first step to provide guidance to the miners on gold reserves, gold recovery, and efficiency of their processes, which is basic information for improvement of the mining and processing methods.

The projects also delivered 3 Webinars for the Cooperative associates and 1 short course for individuals selected by COOGAVEPE, as shown below.

Activity	Title	Date	Lecturers	Participants	Views
Webinar 1	Best practices that contribute to the sustainability of the ASGM in Brazil	Apr 13 2021	Alex Macedo, OCB; Giorgio de Tomi, NAP.Mineração/USP; Marcello Veiga, UBC; Solange Barbosa, COOGAVEPE	Total 84 (50 men / 34 women)	863 views on YouTube
Webinar 2	Opportunities to improve women's participation in ASM	Apr 27 2021	Dione Macedo, Ministry Energy and Mines Prof. Anabelle Carillo, Univ. Brasília Patricia Soffa, COPEROURI Dr. Luciane Oliveira, ASM Lawyer Solange Barbosa, COOGAVEPE	Total 52 (31 men / 21 women)	324 views on YouTube
Short-course	Practical application of the co-existence model in ASGM	May 5 2021	Giorgio de Tomi, NAP/USP Marcello Veiga, UBC	Total 13 (11 men / 2 women)	Not available on line
Webinar 3	Opportunities for a responsible and sustainable ASM sector	May 11 2021	Giorgio de Tomi, NAP/USP Marcello Veiga, UBC Ieva Lazareviciute, UNDP Brazil Solange Barbosa, COOGAVEPE	Total 47 (28 men / 19 women)	292 views on YouTube
Total direct beneficiaries of the webinars and short-course				Total 196 (120 men / 76 women)	1,479 views on YouTube

Knowing that mineral processing operations involve high capital (around US\$ 30000 to 40000 per tonne of ore being daily processed), the Cooperative has seen the co-existence of their associates with a small-medium company as a good solution to improve cleaner production and provide more income to the associates.

The main outcome of the project was the close and lasting interaction of the COOGAVEPE with the project team. The role of the Cooperative president Ms. Solange L.B. Barbosa was critical to create this long lasting and desirable engagement.

Acronyms

ANM	Brazilian National Mining Agency
APP	Permanent Protection Area
ASGM	Artisanal and Small-Scale Gold Mining
METAMAT	Mato Grosso State Mining Agency
COOGAVEPE	Cooperative of Artisanal Miners of Peixoto
EGPS	Extractives Global Programmatic Support
IOF	Tax on Financial Transaction
IBGE	Brazilian Institute of Geography and Statistics
IBRAM	Brazilian Mining Association
MME	Ministry of Energy and Mining
NAP.Mineração	USP Centre for Responsible Mining
OCB	Brazilian Organization of Cooperatives
PLG	Artisanal Mining Permit
NBK-UBC	Norman B. Keevil Institute of Mining Engineering of the University of British Columbia
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USP	University of São Paulo

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2. Introduction

The study *Sustainability of Artisanal and Small-scale Gold Mining (ASGM) in Peixoto de Azevedo, Brazil* (in short-form “*ASGM Sustainability in Peixoto*”) is a collaborative effort of NAP Mineração/USP, the proponent organization in conjunction with other partners to suggest initiatives to improve the sustainability of the Peixoto de Azevedo ASGM community. This 4-month study involved assessment of the current mining and processing practices by the artisanal gold miners associated in the COOGAVEPE, a local Cooperative of Miners. This comprised specific issues identified by the artisanal miners through interviews and a survey related to mining and processing methods, gender equality, gold production and trading, use of mercury and the impacts of the Covid-19 outbreak on the ASGM operations and the local community.

This project was implemented based on recent interactions between the proponent organization (NAP.Mineração/USP), with the ASGM local cooperative, in collaboration with OCB (Brazilian Organization of Cooperatives), FECOMIN (Federation of ASM Cooperatives of Mato Grosso, Brazil) and the UBC (Norman B. Keevil Institute of Mining Engineering of the University of British Columbia, Canada) to discuss the impacts of COVID-19 in the local ASGM community.

2.1. Statement of the Problem

Over 200,000 artisanal gold miners have been working in the North of Brazil in likely 2000 mining sites. The high rates of unemployment caused by the COVID outbreak together with high prices of gold likely have increased substantially the number of individuals looking for subsistence means in the Amazon region. This has resulted in more gold rushes and informality in the sector accompanied by increasing pollution and social degradation. An example of this is the increasing use of mercury in artisanal gold mining everywhere. According to AMAP (2018)³ the amount of mercury released by Brazilian artisanal miners to the environment in 2017 was around 105 tonnes.

The technical and socio-economic issues of artisanal miners in the Peixoto de Azevedo region, State of Mato Grosso have been a constant preoccupation of the ASGM Cooperative of the region, the COOGAVEPE, founded in 2008. The Cooperative of nearly 6000 associates, has a clear understanding that technical improvements must be applied to the artisanal mining sites in order to improve efficiency, reduce accidents, introduce cleaner methods and accommodate more formalized associates. So far, operations in the Amazon have been working blindly, with little or no information about gold grades, geological reserves and gold recoveries of the processes currently used by the miners. In many cases miners dispute with

³ AMAP - Arctic Monitoring & Assessment Programme, UNEP - UN Environment Programme (2018) *Technical Background Report for the Global Mercury Assessment 2018 technical report electronic annex*. UNEP/AMAP.
<https://www.amap.no/documents/download/3411/inline>.

technical people that they recover 100% of gold with rudimentary concentration methods and amalgamation. Therefore, many miners refuse to change their poor practices. The influx of new people into artisanal mining activities have also exacerbate the amateurism of the gold extractions and increased pollution, occupational health problems and social issues such as domestic fights, drinking and many misconceptions about the role of women in this macho-dominant environment. The main ways evolve artisanal miners to become small responsible miners are: engagement, education and investment.

2.2. Justification of the Project

The proponents of this short-term project support responsible small-scale mining practices with a social and technical approach oriented to the integrated management of mineral exploration, mine development, governance and sustainability. This group has a long experience in different countries impacted by ASGM and it has been promoting communication and integration between the different areas of knowledge related to ASGM. The project team and their organizations collaborate closely with the mineral industry, the Government and other institutions such as research agencies, mining cooperatives in Brazil and other countries.

The results of the work carried out by the Delve's COVID-19 Impact Reporting Project in the ASGM region of Peixoto de Azevedo in 2020 indicated that the local community has shown a high degree of concern with the gold production and trading processes as well with arrival of more miners in the region. This concern has been particularly evident when artisanal miners mention that they feel more vulnerable to government actions, companies' takeover of the mining sites, middlemen and illegal gold traders, lack of ore deposits to work, low gold production, lack of technical advisors, among many others.

An initial diagnostic of the current technical, social and economic conditions of the artisanal gold miners in Peixoto de Azevedo was a necessary first step to design future actions to improve their practices. The effects of the COVID restrictions somehow stimulated the artisanal miners to look for more efficient methods to organize themselves, plan for the future in order to produce gold with less environmental and health impacts.

The tax contribution from gold operations to the municipality of Peixoto de Azevedo was nearly Reais 1.6 billion (US\$ 303 million) in 2019. Peixoto de Azevedo, like other ASGM communities, experience challenges related to mercury use, water siltation, land degradation, illegal trading and mining operations and many technical issues that cause environmental-health impacts, social problems and tax evasion. This proposal addresses the advantages and the risks associated to responsible gold processing to respond to the relevant issues already raised by the artisanal miners from Peixoto de Azevedo.

2.3. Objectives of the Project

This short-term project had a broader objective to narrow the relationship of the technical experts from USP and UBC with the artisanal mining community of Peixoto de Azevedo, Brazil and with other stakeholders such as the Organization of the Brazilian Cooperatives. In short, the main objectives were listed as follows:

- Assess the current technical, social and economic conditions of the artisanal gold miners associated with the COOGAVEPE,
- Propose initiatives to improve sustainability of the Peixoto de Azevedo ASGM community in the medium- and long-term;
- Determine what are the main issues reported by the artisanal miners in the region related to the topics of gender equality, gold trading, use of mercury for gold recovery, alternative livelihood and the impact of the Covid-19 in their operations;
- Engage the COOGAVEPE and understand the expectations of the associates for a more sustainable future of their operations;
- Disseminate the findings and outcomes of the project to a wider audience of ASGM miners and their communities through webinars and training sessions.

2.4. Contents of this Report

Chapter 1 contains an executive summary of the findings of this study.

Chapter 2 introduces the problem previously identified by other reports and by the experience of the team, describing the objectives of the study and the study site with technical aspects of the production methods.

Chapter 3 summarizes the methodology employed,

Chapter 4 describes the project implementation with a summary of the activities carried out by the project team and an overview of the risks identified and the mitigation measures adopted to overcome those risks.

Chapter 5 discusses the sustainability of the project, with a perspective on how the project can have a continuity in terms of replication and scaling up opportunities identified by the project team and by the project beneficiaries.

Chapter 6 summarizes the project overall expenses and their relation to the key activities carried out during the project, including the dissemination initiatives undertaken by the project team and the beneficiaries.

Chapter 7 highlights the innovation aspects of the project and the main lessons learned by the project team and the beneficiaries.

Chapter 8 lists the main recommendations for the Cooperative, the miners and the local community, taking into account the findings and the discussions between the project team and the beneficiaries.

Chapter 9 contains the various appendices to support the information of the report, including the survey employed to collect data from the miners and other Cooperative members and a summary of the dissemination events organized as part of the project.

2.5. Study Site

2.5.1. Town of Peixoto de Azevedo

Peixoto de Azevedo is in the north-central region of the State of Mato Grosso and still part of the legal Amazon region. The municipality emerged in the process of the Amazon occupation expansion initiated by the federal government in the 1970s. The BR-163, Cuiabá-Santarém highway, that connects the central part of Brazil with the north, played a crucial role in allowing the development of the southern Amazon region (Figure 1). Farmers from the south of Brazil were enticed to occupy the region. While preparing the poor lateritic soil for agriculture, they discovered gold. In 1979, the discovery of large alluvial/colluvial/eluvial gold deposits in the States of Mato Grosso and south of Pará, associated with the increasing price of gold, promoted the emergence of the city of Peixoto de Azevedo. This attracted migration of people from other Brazilian States, mainly from the North and Northeast, where the land problem has been endemic. The gold rush started (Souza et al., 2008)⁴.

In 1980, the mining activity intensified in the region. It has been estimated that during this period the village of Peixoto de Azevedo registered a population of more than 90,000 inhabitants and was responsible for about 10% of all national gold production, reaching more than one tonne of gold per month (Ferreira, 2008)⁵. The “Business Street” has been known as the starting point of territorial and urban formation of the village of Peixoto de Azevedo.

It was the first social and economic area in the village where shops, bars, cabarets, lodgings, gold shops, hotels, etc. were established (Farias and Carvalho, 2018)⁶.

⁴ Souza, L. C. D.; Carvalho, M. A. C.; Corrêa, B. S.; Silva, M. *Rio Peixoto de Azevedo no perímetro urbano do município Terra*, v.8, n.2, p. 2020-232.

⁵ Ferreira, J. C. V. (2008). *Cidades de Mato Grosso: Origem*

⁶ Farias, A. B. and Carvalho L. R. (2018). *Análise do Avanço Nacional de Geógrafos. Pensar e Fazer a Geografia Brasileira*. <http://www.eng2018.agb.org.br/resources/anais/8/15331todeAzevedo.pdf>.





Figure 1 – Location of Peixoto de Azevedo and BR 163

Source: http://archive.boston.com/news/world/latinamerica/articles/2005/12/27/Map_of_BR163_Highway/

Due to the large circulation of gold and cash in the village during the 1980s, some local bank agencies and institutions were locally established and used by residents to transfer funds to their families in other States. In the village it was also implemented an agency of the Federal Savings Bank (Caixa Econômica Federal), responsible for much of the gold purchase of the region, as well as an office of the Federal Police, which then also functioned as a small claims court (De Theije et al., 2018)⁷.

In 1981, Peixoto de Azevedo left the condition of a village to become a district linked to the municipality of Colíder. On May 13, 1986 it became a municipality with political and administrative emancipation. The municipality was called after its main river named in honor of the militia lieutenant Antônio Peixoto de Azevedo, who in 1819, commanded an expedition looking for transportation alternatives from the south towards, Belem, the capital of Pará State (Farias and Carvalho, 2018 – op.cit.).

With the fall in gold prices at the end of the 1990s and early 21st century, Peixoto de Azevedo lost large part of its population. One way for the municipal government to encourage the permanence of the population in the region was the formation of a rural settlement, now known as the Union of the Norte District to enable the subsistence of artisanal miners through agricultural activity (Farias and Carvalho, 2018

⁷ De Theije, M.; Andrade, L.; Mathis, A. and Gibson, A. 2018. Estudo de caso 2: Vale do Peixoto (ouro). Relatório Socioeconômico e Ambiental da Mineração em Pequena Escala. In Diagnóstico Socioeconômico e Ambiental da Mineração em Pequena Escala no Brasil (MPE) (Contrato 001/2016 - SEDP/SE/MME, v.2, p. 390–490. São Paulo: Assistência Técnica dos Setores de Energia e Mineral—META.

– op. cit.). Currently Peixoto de Azevedo has an estimated population of 35338 people and has a population density of 2.16 inhabitants/km² and human development index of 0.649 (IBGE, 2020)⁸. In addition, the population is concentrated in the age group from 20 to 29 years, and the population distribution of men and women is nearly the same, being 15,970 and 14,842, respectively.

The municipality faces many structural and social problems such as lack of basic sanitation, problems in the health and education sectors, lack of street structures and others. A survey conducted by Farias and Andrade (2020)⁹ between April and October 2016, cites that of the 355 people interviewed in Peixoto de Azevedo, 315 said that deforestation is the main damage caused to the environment, 228 indicated that mining also causes pollution of rivers (banks and springs) and another 42 pointed to soil degradation and air pollution as the main environmental problem caused by mining.

GDP per capita of the town is Reais15,680.52 (IBGE, 2020 – op.cit.), and all revenue comes from internal sources, mainly from the gold extraction activities that are responsible for 80% of the jobs in the region. There are also secondary activities such as livestock, fruit growing, family farming and fish farming. The reflection of mining activity in the local commerce is evident as artisanal miners are the main consumers of products to the mining sites, such as, the manufacture and sale of spare parts for machinery, supply of diesel oil, food, and other articles.

2.5.2. Mining Operations

Artisanal mining in Peixoto de Azevedo has different configurations. It began in a "manual" way characterized using simple tools (shovel and panning), which runs from the late 70s to the early 1990s. After this period, the Peixoto de Azevedo region underwent several transformations. While some mining fronts are still rudimentary and without formalization, others operate in an organized fashion, following guidelines of the licensing process of the mining areas.

The mechanization of the mining has brought advantages both for artisanal miners who work in less stressed conditions and for owners of the mining claims who have expanded the extraction areas. Over the years, other extraction methods have been introduced and mechanization changed the dynamics of the production in the region. The use of high-powered pumps, crushers, mills, tractors, and trucks, increased the quantity of ore being daily processes and allowed exploitation of different secondary deposits (e.g., colluvial and eluvial ores). The primary ores were discovered and, despite the small amount of quartz veins

⁸ IBGE - Instituto Brasileiro de Geografia e Estatística. (2020). <https://cidades.ibge.gov.br/brasil/mt/peixoto-de-azevedo/panorama>.

⁹ Farias, A. B.; Andrade, L. N. P. S. (2020). Gold exploration in the municipality of Peixoto de Azevedo, Mato Grosso, Brazil: a historical, socioeconomic and environmental analysis. *Revista Geográfica Venezolana*, v. 61, p. 148-161.

being exploited nowadays, the trend is to intensify the mining activities in these richer materials than the secondary ores. (Paes de Paes Barros, 2007; Oliveira, 2017)^{10,11}.

Most miners exploit secondary deposits, using excavators and/or hydraulic monitors for colluvial and eluvial ores and dredged for alluvial ores in the rivers. Most processing methods consist on gravity concentration on riffled or carpeted sluice boxes but infrequently some plants use centrifuges, which are practices also observed in other parts of South America (Seccatore et al., 2014; Veiga and Gunson, 2020).^{12,13}. Working in colluvial and eluvial ores, which represent the large majority of the mining operations, artisanal miners use excavator to remove the soil, and with 4-to-6-inch water pumps, blast the weathered ore with hydraulic monitors with high pressure. The disaggregated ore is then pumped to the gravity concentrators. The concentrates are discharged from the carpets once a day and amalgamated to separate gold from other heavy minerals.

Underground mining is done by opening shafts and drifts in competent rock deposits. The choice of the front to be mined is based on the presence of the quartz vein, previously identified by the miners as the main gold-bearing structures. The rock is blasted and the fragmented material is transported to the surface by cable winches. The material is then ground in hammer mill and usually the whole ore is amalgamated in copper-mercury plates.

River dredges consist of extracting gravel from the bottom of the river through suction, with the hoses up to 8" in diameter, operated manually by divers or mechanically, controlling the height and flow of gravel entering the submerged pipe. The dredges at the Peixoto de Azevedo River are small, with teams of 3 to 6 miners, taking turns in shifts. The dredges also have sluice boxes and the amalgamation of concentrates is performed on board.

2.5.3. Mining Cooperative of Peixoto de Azevedo

Mining organizations play a fundamental role in the organization and formalization of artisanal mining activity in Peixoto de Azevedo. Cooperatives and associations of artisanal miners have the common

¹⁰ Paes de Barros, A. J. (2007). *Granites of the Peixoto de Azevedo: Novo Mundo region and auriferous mineralization relation - Alta Floresta Auriferous Province (MT)*. Doctorate Thesis – Institute of Geosciences. State University of Campinas. <http://repositorio.unicamp.br/jspui/handle/REPOSIP/287713>.

¹¹ Oliveira, D. R. P. (2017). *O Depósito de Au Porteira, Peixoto de Azevedo (MT): Geologia, Petrologia, Geocronologia e Metalogênese*. Dissertação de Mestrado. Universidade de Brasília, Instituto de Geociências. Programa de Pós-Graduação em Geologia. <https://repositorio.unb.br/handle/10482/31579>.

¹² Seccatore, J., Marin, T., De Tomi, G., Veiga, M.M. (2014). A Practical Approach for the Management of Resources and Reserves in Small-Scale Mining. *Journal of Cleaner Production* v.84, p.803-808.

¹³ Veiga, M.M. and Gunson, A.J. (2020). Gravity Concentration in Artisanal Gold Mining. *Minerals* 10(11), 1026. 49p, <https://doi.org/10.3390/min10111026>

objective of ensuring institutional security and supporting associates in the daily bureaucratic affairs and in technical assistance contributing to increase the gold productivity.

COOGAVEPE, the Cooperative of Artisanal Miners of the Valley of the Peixoto de Azevedo River, was founded in 2008 by 28 artisanal miners with the initial objective of having access to gold extraction claims (PLG – Artisanal Mining Permit) offered by the federal government. Currently there are 5,952 members, 429 women and 5,523 men. The objective of its creation at the time was to support for the region's artisanal miners to act within the legality. Many of the difficulties of the miners were resolved with the organization coordinated by the cooperative's leaders. The Cooperative manages approximately 300 mining operations, distributed among 133 mining claims distributed in seven municipalities (Nova Santa Helena, Terra Nova do Norte, Nova Guarita, Peixoto de Azevedo, Matupá, Guarantã do Norte and Novo Mundo).

The gold production in 2020 in COOGAVEPE areas corresponded to 4383.62 kg as illustrated in Figure 2.

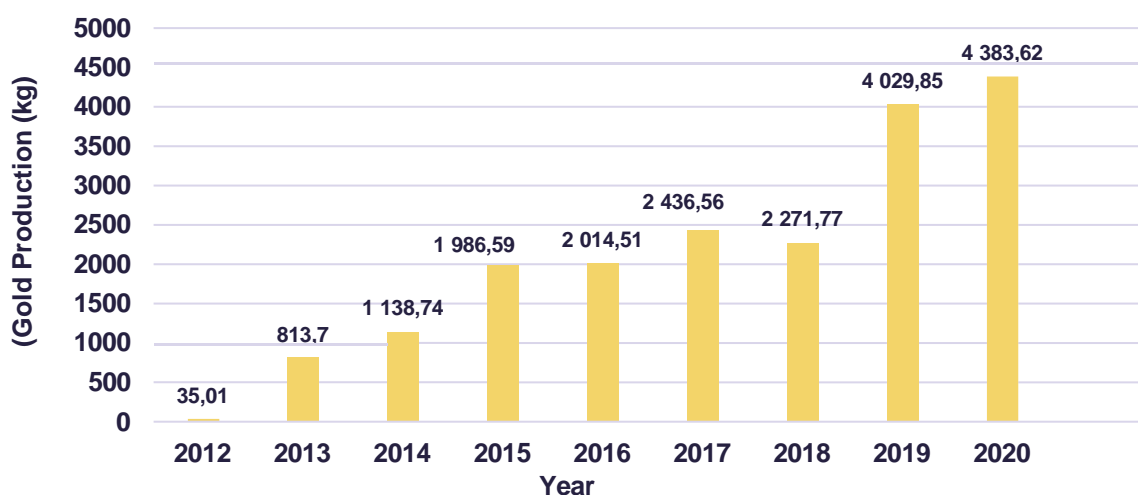


Figure 2 - Gold production in Peixoto de Azevedo region (2012 – 2020)

The Cooperative directors are a president, who is also a financial director, and a technical director (responsible for legalizations and projects to meet the cooperative members). Assisting the directors there are many administrative assistants, a press officer, a field technician, a biologist, a geologist, and a mining engineer. The Cooperative has a board consisted of traditional artisanal miners, and other local leaders. They also take part on a council of ethics and supervision of the Cooperative expenses. Those decisions involving important regulatory and financial resolutions are brought the General Assembly of Miners.

COOGAVEPE has developed an education and monitoring work for artisanal miners and area managers to encourage environmental protection and to develop and execute plans for reforestation to reclaim mined areas. More than 1 million seedlings have already been distributed to the Cooperative members. This initiative started from the requirements of legislation on reclamation of degraded areas.

With the technical support of the Mato Grosso State Mining Company (METAMAT), the Cooperative also assisted members in the introduction of two fish farms into abandoned pits (Otchere et al., 2004)¹⁴. According to the president of the Cooperative, these projects have not advanced due to the remarkably high taxes that make fish production unaffordable for a small or medium scale producer.

Another aspect to be highlighted is the problem of investment in geological exploration. Currently the exploration of new areas for mining is deficient and many Cooperative members use trial-and-error procedures which cause financial losses. Drilling and geophysics methods involve high costs and there is no available specialized company in the region. The chemical analyses for any geochemical prospecting is also lacking in the region. The COOGAVEPE has been discussing internally and with companies how to fulfil this gap.

¹⁴ Otchere, F.A., Veiga, M.M., Hinton, J.J., Farias, R.A., Hamaguchi, R. (2004). *Transforming Mining Open Pits into Fish Farms: Moving towards Sustainability*. *Natural Resources Forum*, v. 28, p. 216-223

3. Project Achievements

3.1. Methodology

The methodological for this assignment was developed focusing to conduct the activities remotely, as shown in Figure 3.

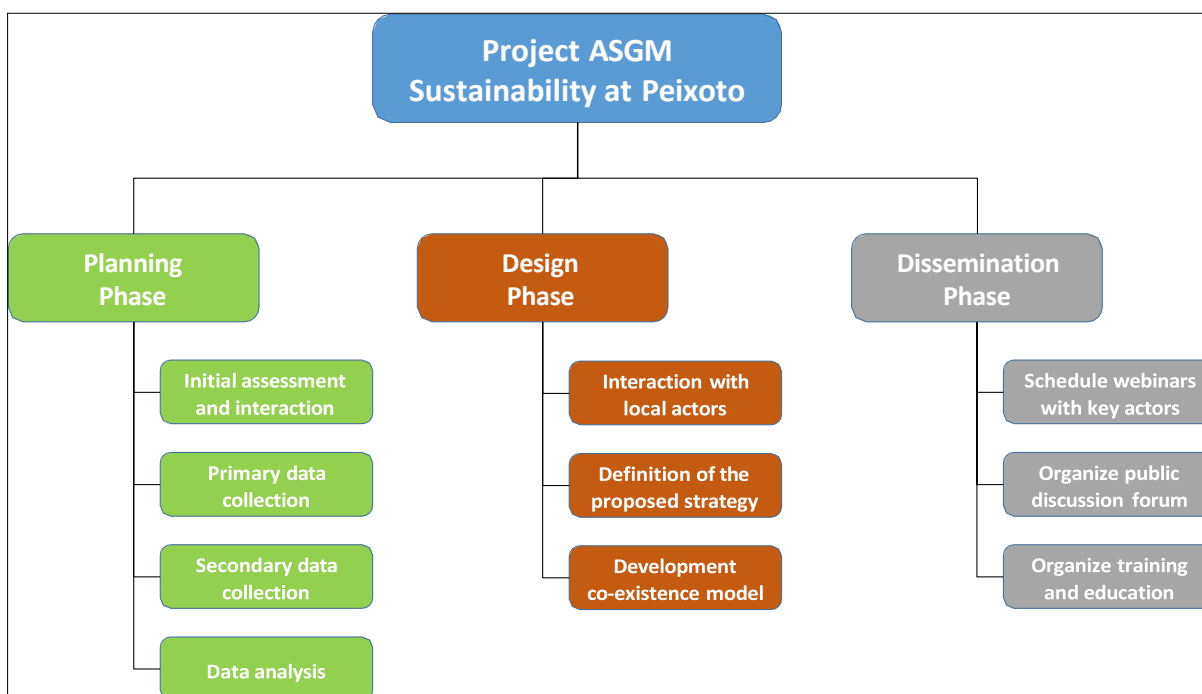


Figure 3 - Methodology approach of the project

The approach for the Planning phase was based on collecting primary and secondary data. The primary data collection was based on semi-structured interviews with members of the COOGEVEPE. Data was collected in the first half of February 2021 with assistance of the Cooperative president and the technical team. The interviews were conducted virtually in three ways: (i) interviews via videoconference, (ii) interviews via WhatsApp and (iii) online forms. The secondary data was carried out by consulting literature and other reports.

The approach for the Design and Dissemination phases was based on a survey designed by the team to obtain information from the miners on their activities and opinions. The survey was an essential component as it composes a diagnostic of the production methods as well as opinions about the future of the mining activities in the region. It is important to note that before applying the survey, the team consulted local

miners and those working in artisanal mining operations in the States of Pará and Amapá to validate the questions.

The survey strived to understand the socioeconomic status of the interviewees related to age, marital status, level of education, housing, and family income. It was also focused on knowing the interviewees' overview of preventive measures against COVID-19. Another attention of the survey was on the characteristics of the methods of mining, processing used and use of mercury. This aspect is fundamental to know the interviewees' opinions to establish possible technological alternatives to improve their gold production and reduce or eliminate mercury use. The survey also assessed how respondents think about women's participation in artisanal mining. The survey encompassed the interviewees' perception of the relationship between mining activity and conventional mining companies. The final emphasis of the survey was about the opportunities and paths to responsible and sustainable artisanal mining. Please, see the questions of the survey in Appendix A.

3.2. Purpose and Expected Results

The project deliverables are initiatives to contribute to a more responsible and environmentally friendly practices of the Peixoto de Azevedo ASGM. The project was implemented on schedule. The team has delivered all proposed activities and participated in two extra dissemination activities: Webinar with the Brazilian Ministry of Environment (11 participants, 8 men and 3 women) and a Webinar with the WWF - World Wildlife Fund Inc. (23 participants, 14 men and 9 women).

In addition, the project introduced and discussed with the COOGAVEPE and some miners the idea of co-existence between artisanal operations and conventional mining companies as an example of success observed in other Latin American countries to eliminate mercury, increase formalization, reduce artisanal miners' investment and provide better remuneration for the gold extracted (Veiga and Fadina, 2020).

Three webinars and one short course were delivered to the miners. A total of 196 people (120 men and 76 women) were directly engaged in these four activities. To date, the three webinars together have reached 1,479 viewers on YouTube. As part of our dissemination strategy and enhance the project's impact, our project partner, the Organization of Brazilian Cooperatives, has distributed the webinars video to all 95 mining cooperatives, which a total above 59,000 miners.

The Objectives, Outputs and Activities of the project are outlined in the phases, the activities and expected outputs as per the technical proposal.

Table 1 - Phases of the project

Phase	Objective	Outputs	Activities
Planning	This phase identified the requirements and expectations related to the implementation of any initiative to respond to the issues of the ASGM in Peixoto de Azevedo	Report of the requirements and expectations for addressing the main identified problems	Initial assessment and interaction with local actors. Quick fieldwork taking into account the precautionary health measures. Data collection of primary data on-site and secondary data from the literature, local cooperative files and public reports; Data analysis and interaction with the local actors to identify, select and propose initiatives to be implemented as required.
Design	To prioritize the initiatives required to design a process to improve production and reduce impacts of the artisanal mining operations	Report of recommendations to improve production, reduce pollution and increase sustainability of the activities	Interaction with the local, regional and federal entities and ASGM actors to prioritize the initiatives required to design methods to improve production of the ASGM in Peixoto de Azevedo (total of 21 people, 14 men and 7 women). Definition of a strategy to promote a sustainable model to respond to the challenges raised by the artisanal miners and by the community to improve not only the technical and economic aspects of the value chain but also the social and environmental challenges faced by the ASGM miners. Development and discussion of an idea of introducing a co-existence model for Peixoto de Azevedo based on responsible sourcing concepts, with particular emphasis on the elimination of mercury, promotion of gender equality and combating illegal trading.
Dissemination	Communication of results with the local and regional ASGM communities.	Final report of the project, including the findings and results of the assignment and details of the webinars and training sessions, including the recommendations for the continuity of the dissemination program.	Three webinars with key actors of the community to assist in the dissemination of the ideas of the project to improve ASGM practices (total of 1,479 views on YouTube). Forum for public discussion to raise awareness towards the benefits of different business models, such as co-existence and responsible sourcing of gold. Engaging the local cooperative in an education & training program to enable local actors as promoters of ideas developed within the project to improve cleaner gold mining.

3.3. Activities Completed and Key Outputs and Outcomes

Although this project was focused on the Peixoto de Azevedo region and the COOGAVEPE was the direct partner and beneficiary, the positive impacts of this project can be extrapolated and duplicate in other regions. An example of the spin-off effects of the project was the strong participation of the OCB (Organization of the Brazilian Cooperatives) who has access to 95 mining cooperatives with a total of 59,000 miners. Many of the project outputs, such as the videos of the three webinars, are available on YouTube and were distributed to all OCB associated cooperatives.

The following is a summary of the activities completed, the number of beneficiaries, key outputs and outcomes presented considering each phase of the project.

Table 2 - Outline of the outcomes and outputs of the project

PHASE 1: PLANNING	
Activity:	Description
Title	Assessment of the COOGAVEPE and Peixoto de Azevedo region
Objective	Initial assessment of the context, interaction and coordination with local actors, in particular, COOGAVEPE
Beneficiaries	COOGAVEPE and its members
Outcomes	Increased knowledge of 5 people from COOGAVEPE leadership about the current situation of ASGM in Peixoto de Azevedo region
Outputs/knowledge products	Assessment report (interim report) shared with COOGAVEPE Technical meeting with COOGAVEPE leadership team
Dissemination	COOGAVEPE has presented the results of the assessment to its members during the general assembly on March 3, 2021 COOGAVEPE has put up a 9 m ² outdoor banner related to COVIDI prevention measures on one of the main roads that give access to the town of Peixoto de Azevedo

PHASE 2: DESIGN	
Activity:	Description
Title	General view of how to improve business in ASGM
Objective	In coordination with COOGAVEPE, discuss ASGM better practices
Beneficiaries	COOGAVEPE leadership and its members
Outcomes	10 attendees, 8 men and 2 women, improved knowledge related to better practices and co-existence models in ASGM
Outputs/knowledge products	A preliminary idea of a business model using co-existence systems was discussed with COOGAVEPE as well as methods to improve their capacity to respond to the artisanal miners technical requests (e.g. creation of a local lab)
Dissemination	Several activities promoted the dissemination of the methods to improve the mining business and recorded in Webinar 1 and 3, short-course delivered to COOGAVEPE. Two Technical meetings with COOGAVEPE + a short-course.

PHASE 3: DISSEMINATION

Activity: Webinar #1	Description
Title	Best practices that contribute to the sustainability of the ASGM in Brazil
Date	13/4/2021
Objective	Disseminate results of the Interim report and show best practices that can improve gold production used by ASGM in other countries
Beneficiaries	Primary beneficiary: Artisanal miners Other beneficiaries: Academic community, NGOs and Government organizations
Outcomes	84 online participants improved knowledge about gold concentration, mercury risks and methods to recover more gold.
Outputs/knowledge products	3 PowerPoint presentations YouTube viewers of the webinar 1 at the time of the preparation of this report: 863
(Further Impact (Potential)	59,000 artisanal miners from other cooperative can have access to information related to better practices and risks of mercury use.
Dissemination	The YouTube link with the webinar recording was shared with the 95 cooperatives affiliated with the OCB - Brazilian Cooperative Association, which was shared with their members—having the potential to reach 59,000 Brazilian artisanal miners. Furthermore, the recording will be available on the NAP Mineração and the OCB webpages, having the potential to reach other further audiences. Finally, this knowledge product is now part of the resources available at the SESCOOP, which is the educational arm of OCB and has over 7,000 members (current and former students). HTTPS://WWW.CAPACITA.COOP.BR/SESCOOP/SUBSCRIBE/LOGIN
Permanent link on YouTube	https://www.youtube.com/watch?v=UbCwhkM8kP8
Activity: Webinar #2	Description
Title	Opportunities to improve women's participation in ASM
Date	13/4/2021
Objective	Raise awareness about women's roles in the ASM sector
Beneficiaries	Primary beneficiary: Artisanal miners Other beneficiaries: Academic community, NGOs and Government organizations
Outcomes	52 online participants raised awareness about women's role in ASM.
Outputs/knowledge products	YouTube viewers: at the time of the preparation of this report: 324
Further Impact (Potential)	59,000 OCB associates also have access to the webinar in the YouTube.
Dissemination	The YouTube link with the webinar video was shared with the 95 cooperatives affiliated with the OCB - Brazilian Cooperative Association, which has shared it with their members—having the potential to reach 59,000 Brazilian artisanal miners. HTTPS://WWW.CAPACITA.COOP.BR/SESCOOP/SUBSCRIBE/LOGIN
Permanent link on YouTube	https://www.youtube.com/watch?v=olcpokxj4nu
Activity: Webinar #3	Description
Title	Opportunities for a responsible and sustainable ASM sector
Date	11/05/2021
Objective	Increase knowledge of participants about co-existence models through examples
Beneficiaries	Primary beneficiary: Artisanal miners Other beneficiaries: Academic community, NGOs and Government organizations
Outcomes	47 online participants raised awareness about women's role in ASM
Outputs/knowledge products	3 PowerPoint presentations YouTube viewers: at the time of the preparation of this report: 292
Further Impact (Potential)	Access to further 59,000 individuals in OCB .
Dissemination	The YouTube link with the webinar video was shared with the 95 cooperatives affiliated with the OCB - Brazilian Cooperative Association, which has shared it with their members—having the potential to reach 59,000 Brazilian artisanal miners. HTTPS://WWW.CAPACITA.COOP.BR/SESCOOP/SUBSCRIBE/LOGIN
Permanent link on YouTube	HTTPS://WWW.YOUTUBE.COM/WATCH?V=DAWG5UW512M
Activity: short course	Description
Title	Practical application of the co-existence model in ASGM

Date	11/05/2021
Objective	Build capacity at COOGAVEPE leadership on issues related to mercury abatement, clean technologies and co-existence models
Beneficiaries	Primary beneficiary: Artisanal miners, COOGAVEPE executive team
Outcomes	13 people in attendance, 11 men and 2 women, have improved knowledge about better practices and co-existence models around the world
Outputs/knowledge products	1 PowerPoint presentations
Dissemination	COOGAVEPE will disseminate the short course results and the ppt presentation with other members to educate miners about the co-existence model in ASGM.
Activity: Linked In post	Description
Title	ASM Sustainability in Peixoto
Date	11/04/2021
Objective	Raise awareness about ASM and promote the EGPS-USP-NAP project
Beneficiaries	Society at large
Outcomes	Post 1: 200 viewers Post 2: 50 viewers
Outputs/knowledge products	2 linked In posts (April 11, 2021 and May 13, 2021)
Dissemination	Post available on LinkedIn

The results of the survey to the miners are analyzed below:

Sociodemographic aspects

- 58 participants answered the questionnaire, 86% men and 14% women. Ages of the respondents ranged from 18 to 59 years. The majority of the respondents have a position of leadership, as 45% are Head of mining team (responsible for on-site management), 23% are equipment owners, 20% land owners, 9% are machine operators, while 3% responded that they work in other functions as miners.
- The majority (48%) of the respondents are formally married, 28% live with their partner, 19% are single, 3% separated/divorced and 2% widowed.
- In terms of education, 36% of the respondents have high school degrees, 22% post-graduation degrees, 16% technician degrees, 10% elementary school education, and 16% did not complete their studies.
- Income for the respondents is associated to their leadership positions, with 41% earning more than R\$ 10.000 a month, 31% between R\$ 10.000 and R\$5.000 a month, 26% between R\$1.000 and 5.000 a month and only 2% earn less than R\$ 1.000 a month. On average, each participant supports at least 3 dependents.
- More than half (66%) of the respondents answered that they live in their own houses in the municipality of Peixoto de Azevedo and use the mining site lodge's accommodation while they are

working. 21% answered that they live in rented accommodations, 10% live in the common dormitory for miners, and 3% have other arrangements.

Preventive measures against Covid-19

- Regarding preventive measures against Covid-19, 81% of the participants answered that they know and are sure how to protect themselves, 17% answered that they are aware of preventative measures but still have uncertainties and 2% participants answered do not know how to adopt preventative measures. The most cited prevention methods were face masks, gel alcohol, hand washing and social distancing.

Profile of the gold miners

- Only one of the respondents is not yet associated with the Cooperative and another participant answered that it has no interest in the membership.
- There was a question about the role and importance that the Cooperative and the most cited answers were): Regularization of the ASGM activity; Provide technical assistance; and Gold trading. The least mentioned were: Facilitating access to credit in financial institutions; and Assisting the purchase of equipment and supplies (diesel and food, for example).
- More than half (52%) of the participants answered that they earn more than 50 grams of gold per month, 27% earn up to 30 grams of gold per month, 14% earn up to 10 grams of gold per month and 7% gave other answers.
- Regarding the work regime, 40% of the participants work with a profit share with verbal agreements; 38% work on their own in the mine face; 19% work with percentage of profit share a formal contract and 3% of the participants adopt temporary work regime.
- The typical arrangement for a mine face is to work with 15 to 20 miners, while some of faces operate with 4 to 9 miners.
- In terms of motivation to continue working in artisanal gold mining in Peixoto de Azevedo, the most cited answers were: Supporting the family; Mining family tradition; Choice to earn a living without study. The participants also answered that is as an extra income option, either because it's a worthy activity that generates jobs, or because they simply like what they do.

Mining and processing methods

- The predominant mining method is open pit (hydraulic mining), which represented 57% of the answers; 37% of the participants work with dredging in excavated parcels, 3% work with dredging in riverbeds and 3% work with vein-based underground mining.
- About 86% of the respondents answered they do not require grinding before concentrating, while 7% work reprocessing material, 5% work with primary ore extraction and use the hammer mill in processing before concentrating the material and 2% did not respond.
- Sluice boxes with carpets is the most common processing method adopted by 96% of respondents. Only one miner answered that they use centrifuges as a method of gravity separation of gold ore and another participant did not answer the question.

Mercury use

- 57% of the participants buy mercury with local dealers, 28% use an intermediary supplier, 3% use recycled mercury, 3% bring it from another state, 2% answered that they are unaware the origin of purchase of mercury and 7% did not respond.
- According to the answers, 45% pay between R\$ 1.000 to R\$ 2.000 per kg of mercury, 34% pay between R\$ 500 to R\$ 1.000, and the other 21% pay other prices or are not informed of the current price.
- About 28% of participants buy on average 200g to 600g of mercury per month, 26% buy less than 200g per month, 14% between 600g and 1000g per month, 12% between 1000g to 2000g per month, 10% answered that they only work with mercury but do not buy, 5% buy more than 200g per month, and 5% answered that they do not know how much mercury they purchase.
- About 57% of the participants answered that they amalgamate the concentrates in bateas, 33% use mixers, 5% use other types of amalgamation processes, 3% did not respond and 2% said they did not use mercury.
- 75% of the participants use individual amalgamation tanks, 21% use a tank with water, 2% use the cooperative's amalgamation plant and 2% did not respond.
- 81% use retorts and recover mercury, 7% use retort but do not recover mercury, 6% burn mercury with a blowtorch in the open, 2% use retorts in gold shop post in Peixoto de Azevedo and 4% did not respond.
- As for the percentage of gold recovery, the answers were quite varied. 34% said they recover between 100% and 80%, 16% recover between 80% and 60%, 7% said they recover 100%, 7%

recover between 60% and 40%, 5% recover between 40% and 20%, 5% answered less than 20% and 26% did not know how to answer.

Gold production

- 37% of the participants answered that they produce more than 1 kg per month, 24% produce between 500g and 1000g of gold per month, 19% between 100 and 300g per month, 9% between 300g and 500g, 9% less than 100g and 2% did not respond.
- The survey indicates that gold shops play an important role in the economy of Peixoto de Azevedo. About 98% of the interviewees answered that they sell the gold produced for these gold shops and one participant (2%) answered gold is sold to another Brazilian state.

Participation of women in the mining

- In terms of the possible roles of women in the ASGM activities in Peixoto de Azevedo, the most cited answers were administrative assistant; mine management activities (logistics, procurement, others), equipment operators (trucks, tractors etc.), gold shop activities.
- On how to have more women working in mining, the most cited answers were: a greater number of women in leadership positions would allow an increase in the number of women working in mining; the need for more training for women; less discrimination would allow more women in mining.

Co-existence in Peixoto de Azevedo

- For 45% of the participants, the relationship with conventional mining companies with the miners would restrict new permits for the miners to work, while 19% answered that co-existence is positive and had no criticism, 17% had no opinion, 7% mentioned that there is not enough gold mining in the region, 7% would you like to know more about co-existence, 3% answered that the relationship would depend on the conventional mining company and 2% indicated potential conflicts of interest on the part of the mining company.
- About the possibility of a conventional mining company buying the tailings from the miners, there was range of responses. 24% answered positively and are interested in knowing more, 22% have no opinion on the subject, 19% do not believe in this type of business, 17% answered that a partnership with the Cooperative would be a good opportunity, and 12% answered that if the mining company paid better prices, it would be a good opportunity to make more money. Finally, 6% answered other reasons, which included:

"I believe that this would work in cases of ore from veins where the use of greater technology and equipment would ensure a better recovery"

“That approach does not work, and mining companies do not generate profit and profitability for the region, since wages are low, because they do not a pay percentage per production.”

“Large mining companies don't buy anything in the region's trade. They do not exploit the areas of alluvial deposits.”

New opportunities

- The participants were asked if they would be open to trying out a new method of gold recovery: 63% answered yes and 37% said they would like to know more about it.
- In terms of other activities to replace the work in mining, 64% of the participants answered that they are not interested in other activities, 24% never thought about it, 10% said yes and 2% gave other answers.
- For the priorities of investment, 41 of the 58 participants answered that they prefer to invest in new equipment for mining, followed by investments in personal property (e.g., house, land) and in the education of their children. 11 answered that they invest in other activities (e.g., aquaculture) and 6 answered they save their profits.
- The survey also collected information on how to improve the miners' daily routines. The answers included: to access to new technologies cheaper and more accessible; to increase gold production and have more geological exploration; to extract gold without the use of mercury and tracking the gold produced; to increase land reclamation.

Networks impacted by the project

- The following networks were impacted by the project:
 1. COOGAVEPE: ASGM Cooperative of Peixoto, the object of this project
 2. COOGAL: Mining Cooperative of Lourenço (COOGAL) is located in the Lourenço District, State of Amapá.
 3. COOPERTRANS: Cooperative of Moraes Almeida and Transgarimpeira, located in the Morais de Almeida District, state of Pará.
 4. IBRAM: Brazilian Mining Association through EXPOSIBRAM 2020, where the project team was invited to coordinate the panel discussion on the challenges of the ASM sector in Brazil
 5. WWF Brazil: through a meeting to discuss ASGM Operation and Technology in South America, challenges and suggested solutions.
 6. OCB: Organization of Brazilian Cooperatives, it has organized meetings as a joint effort to communicate the project outcomes and lessons learned with other mining cooperatives in Brazil

7. FECOMIN: Federation of ASM Cooperatives of Mato Grosso, it has organized meetings as a joint effort to communicate the project outcomes and lessons learned with other mining cooperatives in a regional context
8. MME: Ministry of Mines and Energy, it has organized meetings as a joint effort to communicate the project outcomes and lessons learned with other mining stakeholders in the Brazilian government.
9. MINAM: Council for the Sustainable ASM in the Amazon, it has organized meetings as a joint effort to communicate the project outcomes and lessons learned with mining cooperatives and other stakeholders in the Brazilian Amazon.

3.4. Measuring impact

Due to the COVID-19 restrictions and the short implementation period of the project (4 months), it was not possible to confirm how the project beneficiaries are applying the training and lessons learned. However, the perception of the project implementation team members and the project partners that most viewers of the webinars and courses understood some key points that the project tried to pass to the audience:

The current technical methods used by artisanal miners in Peixoto de Azevedo are neither efficient nor safe.

- Mining operations cannot continue to operate blindly without previous evaluation of the resource and no monitoring of the gold recoveries.
- Mining as a business is expensive requiring high capital which usually is not available to artisanal miners.
- Palliative measures exist to improve production but they cannot avoid all environmental impacts and transform artisanal into responsible small-miners,
- Short-courses for miners and Cooperatives on how to produce cleaner and more efficiently are important but they do not generate sustainable changes; a more constant presence of capacity builders is needed. The Cooperative should play this role of being a source of technical training, provides analytical service and suggests business development.
- Cooperative is the only sustainable entity to sustain dissemination of better practices and improving the small-scale mining profile in Brazil.
- Women have excellent abilities in ASGM in any activity, since they work more carefully and criteria than the usual male miner,

- Co-existence of artisanal miners with conventional processing companies is a proven method of profit sharing, increase efficiency and reducing impacts,

Nevertheless, during the technical meetings and the short course with COOGAVEPE, it was encouraging to observe that the Cooperative has been planning to build an analytical and processing lab to attend its almost 6,000 members, generating important data for the geological exploration as well as for the monitoring of the processing plants performance. The cooperative is keen to explore the idea of co-existence with a conventional mining company; thus, miners can compare the benefits of this with the traditional business model.

In terms of the total number of direct beneficiaries of the project activities, we have added up the number of participants in webinars and other key meetings, including the environment outputs and health outputs as follows:

- Total direct beneficiaries of health outputs: 196 people (120 men and 76 women)
- Total direct beneficiaries of environmental outputs: 370 people (231 men and 139 women)
- Overall total direct beneficiaries of the project activities¹⁵: 454 people (231 men; 139 women and 84 without gender desegregation).

¹⁵ Please note that the 196 beneficiaries (120 men and 76 women) in the health output report have also participated in in the environment output report and were not double counted in the indicators of the final outcomes of the project.

4. Implementation Challenges and Risks

During the project's planning phase, the project team was able to identify some potential risks, which were managed properly as the project developed. In addition, other challenges came to light as the project activities were developed.

The main unexpected challenges, due to the outbreak and short term, were related to understanding local community needs and demands and to the difficulties to communicate the project's goals to the miners. The use of remote platforms to communicate with the COOGAVEPE was good but the communication with the miners were very limited. A summary of the main challenges managed by the project team and the associated mitigation measures are shown in Table 3; these are organized according to the key project activities.

Table 3 - Challenges and risks

#	Description of the risk	Type of risk	Mitigation measures
1	Travel restrictions and lockdown measures imposed by the authorities	Internal and external	<ul style="list-style-type: none"> - Re-schedule data collection activities - Structure interactions by audio and video conferencing - Choose dates and times appropriate to reach out miners
2	Lack of engagement of interested people	Internal and external	<ul style="list-style-type: none"> - Periodic alignment meetings - Listening to the team's demands - Activities with collaborative participation - Approximation to all interested
3	Lack of support from the Cooperative's Board and technical team	External	<ul style="list-style-type: none"> - Participation and integration at all as designed activities - Identifying its own challenges - Establishing bond of respect and politeness
4	Lack of task divisions alignment	Internal	<ul style="list-style-type: none"> - Establishing goals and organization of activities - Treasuring internal work
5	Lack of result dissemination	Internal and external	<ul style="list-style-type: none"> - Establishing promotion goals - Periodic alignment meetings
6	Lack of engagement on the webinars	Internal	<ul style="list-style-type: none"> - Promotions on various platforms - Inviting external partners to participate and promote events
7	Lack of response in the online survey	Internal	<ul style="list-style-type: none"> - Promoting anonymity and confidentiality - Participation of the project's team and of the Cooperative on the survey

In order to mitigate the interaction with local players, pre-assigned project awareness meetings were held with the Cooperative's team to understand how the project team could organize an inclusive collaboration with the participation of all interested parties. At these meetings, conducted through both audio and video conferencing platforms such as Zoom, WhatsApp texting and voice messaging, the team was able to plan the data collection activities. The Cooperative's president has participated in most of these meetings and the findings and outcomes were always shared with her and other Cooperative members. The results of these meetings have increased the level of trust between the Cooperative and the project team. This fact has had a positive impact in the planning of the project activities. The first project awareness meeting was held with cooperative representatives and the Federation of ASM Cooperatives of Mato Grosso (FECOMIN), with 7 people (5 men and 2 women). The second project awareness meeting was held with OCB and the Ministry of Mines and Energy, with 11 people (5 men and 6 women).

Regarding the data collection, the information available in the literature about the region is limited but some information was obtained in the Cooperative and Universities. Governmental agencies also had reports. All collected material was in Portuguese, with very few in English. In this phase, the Cooperative's support was important as they provided access to technical information that was not available in the Internet.

The collection of primary data and analysis were divided into two parts. The first part was to understand how the COOGAVEPE has been operating, with a focus on the main objectives of the project. The main challenge in this activity was to develop an appropriate methodology for structured surveys. To overcome this challenge, the team used UNITAR's methodology that provides an approach for data collection and analysis in the ASGM sector (UNITAR, 2018)¹⁶.

The main challenge was to guarantee that a significant portion of the Cooperative associates would answer the survey applied by Internet. The team identified that respondents usually avoid answering sensitive questions such as mercury losses, gold production, prices, etc. The approach to overcome this challenge was based on previous test of the survey with a smaller group of artisanal miners who work in another State (Amapá). After the validation and adequacy of the questions the project team started sending the survey to the COOGAVEPE miners. With the support from the Cooperative to validate and disseminate the survey in the social media, 58 answers were obtained. The team decided to concentrate the survey to mining managers, which in fact reduced the cohort size to close to 300 people. Even reducing the focus of the survey, the task was not easily applied and the support of the COOGAVEPE administration was important to achieve the expected results.

¹⁶ UNITAR – UN Institute of Training and Research (2018). *Mobile Data Collection tool for National ASGM Overview–User Guide*. UNEP, Chemicals and Waste Management Program, Geneva. 20p. https://stg-wedocs.unep.org/bitstream/handle/20.500.11822/22463/MobileDataCollectionToolForASGMOverview_Manual_21112017.pdf?sequence=1

The interaction with different stakeholders was definitely the largest challenge of the project team. This activity was again carried out together with the COOGAVEPE and the partner institutions (Brazilian Organization of Cooperatives, Ministry of Mines and Energy, Brazilian Federation of Mining Cooperatives and University of British Columbia). This enabled the project team to prioritize the main stakeholders should be consulted to reach the outcomes. Definitely this was a limitation of the project but due to the restrict circumstances of the implementation the outreach was very reasonable. The physical presence of the team interacting with miners would be the desirable condition.

A sound discussion of the co-existence models used in other countries would be desirable as the subject is not familiar to Brazilians let alone for the local artisanal miners. This activity would require several interactions with the Cooperative leadership and with some of the miners. The main challenges were to transmit the concept of co-existence to miners. These challenges were partially overcome with a number of remote meetings with the miners and the Cooperative. Examples of co-existence were explained and discussed with the audience. The feedback of this idea has been positive, but it became clear that further efforts are required in order to educate miners about the benefits of a proper co-existence business model.

The organization and realization of the three webinars required intense collaboration among all involved parties. The challenge was to find room in the busy agenda of the Cooperative key personnel and the project team. Definitely remote meetings facilitate the process and meetings and webinars were successfully arranged reaching a diversified audience (Peixoto de Azevedo's community, artisanal miners, as well as other local stakeholders). The schedule of webinars and the dissemination posters/communication are shown in Appendix B and Appendix C.

The main challenge for the organization of the training was to identify the target audience and to understand their needs, motivations and skills to follow the courses and webinars. In order to overcome this challenge, the project team agreed with the Cooperative's approach: 1) prioritize the course subjects based on the main and immediate needs of the miners; 2) do not extend the level of information and avoid too much details. Meetings usually lasted 60 to 90 minutes and further training sessions have been planned. Appendix D shows a set of screenshots of the training session and the webinars produced in this project.

5. Project sustainability

As specified in the Technical Proposal, the project intended to reinforce both institutional and capacity measures to ensure the sustainability of the results and the continued use of the project outcomes by the ASGM miners and the local community.

The following institutional measures are being implemented by the project partners:

- Commitment of the Cooperative COOGAVEPE to assist miners by installing a laboratory for chemical analysis and processing tests of gold samples. This is the first step for a more ambitious view of the Cooperative to provide training to the associates and establish future agreements with specialized mineral processing companies to process ores, tailings and waste rocks from the current mining operations. The Cooperative is also committed to assist in the dissemination of the lessons learned in the project through their website. An example is the recent news posts related to the project.¹⁷
- Commitment by OCB (partner institution) to increase the dissemination of technical training for the miners in connection with the webinars and technical training sessions provided by the project. These measures include the communication in their news site¹⁸ and bulletins in the network of local organizations.¹⁹
- Commitment by NAP Mineração/USP (proponent) to structure the access to all project products through the institutional webpage (www.usp.br/nap.mineracao), that will host all projects outputs, reports and presentations upon the successful conclusion of the project. This webpage is being re-structured as part of the project and will operate as a central repository of the project outcomes. Another relevant measure was the launch of a dedicated channel to share the recordings of the ASGM webinars by the project.²⁰

The project team also undertook capacity measures to assist the ASGM of the Cooperative COOGAVEPE with their technical issues. These measures included:

- Distribution of an orientation poster presenting preventive measures for the COVID-19 outbreak appropriate for artisanal miners. The digital copy of the poster was based on the work of the Artisanal Gold Council and it was adapted and translated to Portuguese to be displayed in different health centers of the Peixoto de Azevedo district as well in the offices of the COOGAVEPE;

¹⁷ <https://www.coogavepe.com.br/Noticias/A-coogavepe-participa-de-projeto-de-sustentabilidade-com-visao-no-futuro-da-atividade-garimpeira-81>

¹⁸ <http://sescoop.ocbmt.coop.br/noticias/ocb-apoia-projeto-de-sustentabilidade-mineral-em-mt/7194>

¹⁹ <https://www.mundocoop.com.br/ocb/serie-de-webinarios-sustentabilidade-no-cooperativismo-mineral.html>

²⁰ <https://www.youtube.com/channel/UCADPNCYYQ8xovY2Kgamdabw>

- The project team has organized a technical training session for the miners and for the technical team of the COOGAVEPE, led by Prof. Marcello Veiga, an international consultant to the project. The technical training session addressed different mineral processing methods and gold recovery techniques, which were presented and discussed with the audience. The presentation materials, including demonstration videos, were shared with the Cooperative and the audience of 13 people (11 men and 2 women).

Several requests for replication of the project in other sites were received by other ASGM Cooperatives in Brazil. The main highlights are included as follows:

- The ASGM Cooperative of the State of Amapá and an emerging cooperative in the State of Mato Grosso have also participated in the webinars and courses of the project. The webinars were also promoted to the social media group MINAM (Council for the Sustainable ASM in the Amazon) that involves many artisanal miners from the States of Amazon and Pará. The artisanal miners requested during the Q&A sessions to receive more material from the project team and to extend the project to their regions.
- The project group also gave a 2.5 h talk to the MINAM group with 57 participants about the need of a permanent training facility in the Amazon region for capacity building of the artisanal gold miners in the region (total 57 people, 43 men and 14 women).
- The project team has also been invited to discuss the challenges of the ASM sector in Brazil, in a panel organized by the Brazilian Mining Association (IBRAM). Two of the principal investigators of the project discussed the project scope and expected outcomes of the event, that took place on November 26th, 2020 with an audience of 84 people.²¹
- Another invitation for the project team to speak publicly about ASGM challenges was recently sent by the Brasil Mineral communications group. It is an event organized by Metso/Outotec to discuss the challenges for ASM mining in the north of Brazil, which will take place on June 18th, 2021. This event represents another occasion to present the results of the project and to generate new opportunities for replication of its outcomes in other ASM associations and cooperatives in Brazil.

The project outcomes have also generated a number of spin-off opportunities as follows:

- A relevant opportunity to disseminate the project's outcome is related to an invitation by the Brazilian National Mining Agency (ANM), that has attended the webinars and the meetings organized during the project. The invitation is for the project partners, in particular NAP Mineração/USP, to establish an agreement to assist ANM in proposing a transformation strategy to the ASGM Cooperatives throughout Brazil. The agreement is still being drafted by the parties, and it represents an important mechanism to induce change in the ASGM sector in Brazil,

²¹ <https://www.poli.usp.br/comunicados-internos/44347-exposibram-2020.html>

benefitting hundreds of miners and their communities in the coming years. The ANM officer responsible for the contact with NAP Mineração is Mr. Caio T. Seabra Filho (caio.seabra@anm.gov.br).

- Another opportunity for the project team together with COGAVEPE is to submit an Expression of Interest for the Selection # 1274387, assignment “Reducing Mercury and Boosting Gold Miners Earnings in Colombia or Brazil: Public-private partnerships for development” of the EGPS-2 Emergency Response Round 2 for Artisanal Mining Communities Impacted by COVID-19. The Expression of Interest was submitted on May 11th, 2021 by NAP.Mineração/USP in partnership with OCB and UBC.
- Two undergraduate mining students of USP will use the subjects initiated by the project to write their graduation final reports. The first one will be about the certification process to curb illegal gold trading issues and it will be carried out by Ms. Sherida Figueiredo (sherida.figueiredo@usp.br). The second report will address the design of a gold recovery plant for reprocessing ASGM tailings using clean technologies, to be written by Mr. Andre L. Zanella Silveira (andrelzs@usp.br).

All project activities have been coordinated with the project partners, who have directly involved and actively participated in all events of the project. This commitment by various partners, in particular the COOGAVEPE, represents an encouraging incentive for future projects

Due to the COVID-19 outbreak, all webinars have been transmitted online and have been made available in a permanent streaming channel. This has enabled a large audience of artisanal miners to be aware of the project outcomes, many of them from other cooperatives in the region and countrywide as well. One of the project partners, OCB, has published a note²² about the project outcomes, where it gives a special emphasis on the long-term partnerships established as a result of the project. The slides of the webinar presentations are show in Appendix E, whilst Appendix F contains a summary overview of the training session.

In terms of the resilience of ASGM miners to challenges such as the COVID-19 outbreak, the key learning points perceived by the miners according to the COOGAVEPE were listed as follows:

- The project activities have encouraged more intense digital communications among the miners and the local community. Although the local communications’ network is somehow precarious, the miners and the community developed means to improve communications by encouraging shared wi-fi connections among themselves and the use of 3G-based networks. The same applies to the audience of the webinars and the technical training session.
- The organization of specific webinars and training sessions for artisanal miners and their communities was also an innovation of the project. Normally, these events have a broader scope

²² <https://somoscooperativismo.coop.br/noticia/22434/coops-minerais-debatem-sustentabilidade>

and are not necessarily focused on the miners' needs but on dissemination of regulations and norms that usually are not beneficial to the miners. Some informal feedback received from the audience acknowledged the fact that, for the first time, artisanal miners had practical and useful events that definitely collaborated with their profession.

The key beneficiary of the project, the COOGAVEPE, has a proactive attitude in assisting the project team. They are committed to keep working with the project team in knowing more about the co-existence models and implementing technical improvements for the associates. In this regard they are advancing in the design and implementation of an analytical and mineral processing laboratory at the mining site (which will be the first of its type in an ASGM cooperative in the world) and have discussed with the project team a conceptual model of co-existence for the site (see Appendix G).

It is clear for the project team that the main sustainable outcome of the project was the close and long-lasting interaction of the COOGAVEPE with the project team. The role of the Cooperative president Ms. Solange L.B. Barbosa was essential to create this desirable engagement and trustworthy environment. A series of meetings with the COOGAVEPE technical group are already planned after the end of the project. This will allow the artisanal miners from Peixoto de Azevedo to show to the rest of the world that it is possible to do this in small gold deposits using cleaner techniques and applying ethical procedures.

Brazilian artisanal gold miners are very isolated from the rest of the world and virtually did not evolve in their techniques and behaviors. Information from mining and processing techniques, already used for decades by artisanal and small-scale miners in other Latin American countries, are received with surprise by the Brazilian miners. Clearly the sector has huge potential to evolve but a strong leadership and organization is needed. The noble example of COOGAVEPE of fighting against bureaucratic hurdles and pushing for the improvement of the living conditions of their associates is to be followed by other mining cooperatives in Brazil and other countries. The future of the ASGM sector in Peixoto is bright as the evolution to the small-scale gold producers is a matter of time.

6. Innovation and Learning

Although, COVID-19 restrictions prevented the research team to travel to the project region and to carry out face-to-face activities, the successful implementation of the project was possible through the use of social-media, coordination with the project partners and direct and dedicated cooperation of the COOGAVEPE members. The project team had recognized the importance of presence at the mining sites for planning and execution of the project. The main learning points of this project were the hybrid approach combining short field visit and remote communication and strong contact with local stakeholders that provided important diagnostic material to support the outcomes and future actions.

The key innovations brought by this project are listed as follows:

- Key aspects of this project involved gathering input and feedback from Cooperative associated miners and the members of the community related to the current and future situation of ASGM in Peixoto de Azevedo. The survey distribution and all the interviews carried out in this project were successfully completed using remote means of communication. The risks and challenges related to the precarious communications infrastructure and the remote nature of the ASGM sites were overcome by having a dedicated team member coordinating directly with COOGAVEPE and the project partners.
- Another important innovation of the project, which turned into an added value was the recording of the webinar series and one short course. The recordings, available as an open source on YouTube are now a resource to the miners and the community members to access the contents off-line and on-demand.

Regarding the lessons learned, the project team has listed the following items as a contribution to future assignments:

- Flexibility in the choice of the time of contact for remote interviews: the replacement of face-to-face interviews with remote consultations have worked very well as the miners had more flexibility to choose the time of the interviews, including late hours in week days and flexible hours during the weekends.
- Another key lesson learned was the confirmation of the importance of holding open, multistakeholder meetings to discuss the project aims, activities and to share the findings and outcomes of the project with Cooperative members. The fact that the project team had to work through remote communication platforms has enabled a more appropriate environment to hold meetings, in particular, during the webinar series, when a significant number of queries and issues raised by the on-line audience were addressed by the panel participants in a very successful fashion.
- An additional learning point of the multistakeholder approach was the fact that the project outcomes included a list of key expectation issues by the Cooperative members, most notably, the

fact that the miners perceive more benefits of being associate to the Cooperative than being individually formalized. They expressed interest in issues such as the Cooperative developing initiatives to promote centralized procurement of supplies to obtain more competitive and in organizing a structure to provide technical support to the miners, among other ideas.

The project team believes that by re-organizing the project activities to be carried out remotely was an important motivation point for the miners and the Cooperative members as well. The unconditional support of the project partners in particular the Cooperative staff was essential to convey an optimistic message to the miners and community members.

7. Recommendations

The recommended from the project team, the project beneficiaries and for the EGPS program are presented below.

7.1. General Recommendations

- The project shaped a strong relationship between the project team and the COOGAVEPE members. This relationship represents an important opportunity for replicating and apply the lessons learned of the study with initiatives for the technical assistance of the miners, including training sessions and pilot studies with improved mining methods and current mineral processing equipment.
- The project team should also look or opportunities to replicate the approach developed within this study to assist other ASGM Cooperatives and Associations to map out their challenges in the post-pandemic phase.
- The COOGAVEPE is making significant progress in improving the governance of the ASGM activities in Peixoto de Azevedo. The role of the Cooperative in the mediating dialogues of the miners with the various public authorities has been acknowledged by different stakeholders. However, the projects results show that the Cooperative should offer more services to reduce costs and improve the miner's activities, such as centralized procurement and centralized gold trading.
- Labor relations in Peixoto include a significant portion of informal employment established by verbal agreement between the parties involved. Although this is a well-established standard in ASGM districts in Brazil, the Cooperatives and Mining Associations should play a significant role in encouraging formal employment.
- The results of the present study have shown that women play an important role in the Cooperative activities. Most notably, the survey carried out in the study indicated that most miners acknowledge the competence of female workers and see an opportunity for a large participation of women in many direct or indirect mining activities. The Cooperative should continue with studies and assessments focused on gender equality and develop new strategies to increase the participation of women in all activities.

- The COVID-19 outbreak has exposed infrastructure deficiencies in Peixoto, in particular, in the public health sector. However, the circumstance has also stimulated local collaborative responses and encouraged self-organization. The Cooperative has been an important pillar to provide health care means and economic support for miners and their families. The Cooperative should articulate further initiatives in partnership with the local authorities to provide health care and improve preventive measures for miners and local community.
- Also during the COVID-19 outbreak, the Cooperative has been operating as a network to disseminate information related to the defensive measures to the local community. It is recommended that the Cooperative organizes its communication channels to continue sharing information with miners and community.
- One specific demand identified by the project team during the interaction with miners is the importance of installing a gold analysis lab as well as a mineral processing facility controlled by the Cooperative. At the moment, gold analysis can only be processed by labs located in the State capital, Cuiabá and other States, incurring in significant costs and extensive delays for the miners to obtain information of gold contents in their ores and processing products.
- This situation can be improved significantly if the Cooperative installs and operates a lab locally. A processing lab is also important to access the easiness of gold extraction from different ore types.
- Another potential scale-up opportunity for the Cooperative is the installation of a pilot plant to train the miners in more efficient and cleaner technologies to recover gold. This matter has been extensively discussed during the present project and it is recommended that the Cooperative evaluates the feasibility of such an initiative.

7.2. Recommendations for the Bank in future project designs:

- The results of this study have shown that the miners welcomed very well academics and other professionals who can bring practical contributions for the improvement of their gold production with consequent reduction of pollution. Miners are keen to learn and implement different ways to improve their processes, but lack of skills and economic limitations are still the main hurdle to make significant changes in the production system. Future assignments of the EGPS program should be designed to encourage the interventionists to learn and listen to the claims of the miners in order to bring realistic proposals to attend their demands.
- It seems clear that the most efficient and sustainable solution to reduce pollution and improve gold recovery is the co-existence of artisanal miners with conventional processing companies of any size. The co-existence is the only method observed in other Latin American countries that brings

financial benefits for the artisanal miners, as they obtain more value for the ore, they sell it to a processing company as well eliminated completely the use of mercury or cyanide by artisanal miners.

- The system has also the possibility to improve the mining methods of the artisanal operators avoiding accidents. This subject is not easily accepted by artisanal miners as they have the wrong perception that they have very high gold recoveries with rudimentary gravity concentration methods and amalgamation. A long process of engagement and education is badly needed.

8. Appendices

- Appendix A: Survey for the miners
- Appendix B: Webinars and short-course schedule
- Appendix C: Dissemination posters and communication
- Appendix D: Screenshots of the webinar sessions
- Appendix E: Webinars' materials and presentations
- Appendix F: Summary overview of the training session
- Appendix G: Conceptual co-existence model for Peixoto

APPENDIX A: Survey for the miners

Introduction

1. Do you agree to participate in this research?
 - a) Yes
 - b) No

2. Are you associated with ASGM Cooperative?
 - a) Yes,
 - b) No, but I intend to join some ASGM Cooperative
 - c) I have no interest in joining any cooperative

3. For you, what is the main function of the ASGM cooperative? Select all that apply
 - a) I do not need a cooperative
 - b) To sell gold
 - c) Access Equipment & Supplies (Diesel, food, etc.)
 - d) Access to credit in financial institutions
 - e) For the sustenance of the family
 - f) To provide technical assistance
 - g) To regularize mining activity
 - h) other...

4. How long have you lived and worked in the area?
 - a) Less than 1 year
 - b) 1 to 5 years
 - c) 5 to 10 years
 - d) 10 to 20 years
 - e) More than 20 years
 - f)

Demographic Section

1. Gender:
 - a) Male
 - b) Female

2. Age:
 - a) Under 18 years old
 - b) 18 to 24 years old

c) 25 to 49 years old

d) 50 to 59 years

e) Over 60 years

3. What's your marital status?

a) Single

b) Married with legal document

c) Married but there is no legal document or religious marriage

d) Separated/Divorced.

e) Widow

4. What's your education Level?

a) No school

b) Primary incomplete

c) Primary complete

d) Secondary incomplete

e) Secondary complete

f) Higher education incomplete

g) Higher education complete

h) Postgraduate studies

5. Where do you live?

a) Currently living at accommodation in the mine site

b) In the city in my own house and spend a few days in the mine site

c) In the city in rented house and spend a few days in the in the mine site

d) Other...

6. How many people live in your household, including yourself?

a) I live alone.

b) 1 to 3 people

c) 4 to 7 people

d) 8 to 10 people

e) More than 10 people

7. What is your family's monthly income?

a) Less than R\$ 1000

b) R\$ 1001 and R\$ 3000

c) R\$ 3001 and R\$ 4000

d) R\$ 4001 and R\$ 5000

e) R\$ 5001 and R\$ 10000

f) More than R\$ 10000

8. What is your main occupation in the mining?
- a) Miner (Digger, extraction-focused laborer)
 - b) Landowner (surface)
 - c) Owner of the Machine
 - d) Head of mining team (responsible for on-site management)
 - e) Machine operator
 - f) Kitchen services
 - g) Miner, working in extraction
 - h) Other:

Covid-19: Measures to Prevent Section

1. Do you know how to prevent yourself becoming sick from COVID?
- a) I do not know.
 - b) I know, but I am not sure.
 - c) I know and, I'm sure.
2. What methods do you use?
- a) Hand washing
 - b) Physical distancing (keeping minimum 1 meter between you and other persons)
 - c) Use of disinfectants/alcohol in gel.
 - d) Wearing a face mask

ASGM Activity

1. What kind of mining do you work in?
- a) Open pit – hydraulic monitors
 - b) Underground - manual
 - c) Underground – explosives
 - d) Alluvial with dredge
 - e) Alluvial – open pit
2. How long are you in the mining business?
- a) Less than 1 year
 - b) 1 to 5 years
 - c) 5 to 10 years
 - d) 10 to 20 years
 - e) More than 20 years
3. How do you work in the mine?
- a) Signed employment contract
 - b) Percentage of profit share with verbal agreement

- c) Percentage of profit share with legal contract
- d) On your own
- e) Temporary

4. Why do you work in the mining?

- a) I stay close to family and friends.
- b) Option to earn well without studying.
- c) To support my family
- d) For lack of alternatives
- e) My family is tradicionais gold miners
- f) Other

5. How much do you earn (in grams) on the average monthly?

- a) 1 gram to 5 grams
- b) 10 grams
- c) 30 grams
- d) 50 grams
- e) 50 grams

6. How many people work with you in the mine site?

- a) Less than 4 people
- b) 4 to 6 people
- c) 7 to 9 people
- d) 10 to 12 people
- e) More than 12 people

Mining Conditions and Mercury

1. Do you grind your ore?

- a) No... is river ore and has no grinding before concentrating.
- b) No... it is alluvial ore and has no grinding before concentrating.
- c) yes... it is primary ore, and I must grind in ball mill.
- d) yes... it is primary ore, and I must grind in hammer mill.
- e) No.....I do not process.

2. How do you make gold concentrate?

- a) Sluice boxes or carpets
- b) Centrifuge
- c) Shaking table or jig
- d) Other

3. How do you buy mercury?

- a) Local dealer
 - b) Internet
 - c) Exporter
 - d) In another Brazilian state.
 - e) Intermediary.
 - f) Other
4. How do you use mercury?
- a) In the grinding with the whole ore, all together
 - b) Concentrate amalgamation in batea
 - c) Concentrate amalgamation in mix
 - d) In copper-amalgamating plates
 - e) I do not use mercury.
 - f) Another amalgamation processes.
5. Where do you do the amalgamation?
- a) On board the dredger
 - b) On the riverbank
 - c) In a tank with water
 - d) In the bush, hidden
 - e) In the amalgamation plant in my mining site
 - f) Other
6. What do you do with the amalgamation?
- a) I burn with blowtorch in the bush.
 - b) I burn with blowtorch at home.
 - c) I use retort and recover mercury.
 - d) I use retort, but I do not recover mercury.
 - e) Other
7. What do you do with amalgamation rejecting?
- a) I use retort and recover mercury.
 - b) Drop in the river.
 - c) I leave it in the tank.
 - d) Drop in a place where everyone uses.
 - e) Re-use
 - f) Takes amalgam concentrate to burn in gold purchase.
8. How much gold (in grams) do you produce monthly?
- a) Less than 100g
 - b) 100g to 300g
 - c) 300g to 500g

- d) 500g to 1000g
- e) More than 1000g

9. What percentage do you recover from concentrated gold?

- a) 100%
- b) Between 100% and 80%
- c) Between 80% and 60%
- d) Between 60% and 40%
- e) Between 40% and 20%
- f) Less than 20%
- g) I do not know.

11. How much mercury do you buy per month?

- a) Less than 200g
- b) 200g to 600g
- c) 600g to 1000g
- d) 1000g to 2000g
- e) More than 2000g
- f) I only work with mercury, but I do not buy.

12. How much do you pay for the pound of mercury?

- a) Less than R\$ 500
- b) R\$ 500 to R\$ 1000
- c) R\$ 1000 to R\$ 2000
- d) R\$ 2000 to R\$ 3000
- e) More than R\$ 3000
- f) I only work with mercury, but I don't pay

Co-existence

1. How is the relationship between artisanal miners working in the concession areas of the large-scale mining company in your region?

- a) There is no large-scale mining company in my region
- b) It is good and I have no criticism
- c) It is bad because the company doesn't release any more permission consent for the miners to work on the concession areas of the company.
- d) I have no opinion.
- e) It would be interesting to know more.
- f) Other

2. What do you think if a mining company bought the ore produced in the mine to process?

- a) It would be interesting to know more.

- b) If you pay well for the gold contained, it would be great... I would earn more.
- c) If we did an association of this company with the cooperative would be great
- d) I have no opinion.
- e) I do not believe in this business scheme, I would rather be like my own, even if I earn less.
- f) Other

3. Who do you sell the gold you produce?

- a. For the purchase of gold in the region
- b. For buying gold in another state
- c. For commercial (Export)
- d. For other artisanal miners
- e. For intermediaries
- f. Other

Gender Equality

1. What function do you think a woman could have in the mine? Select all that apply.

- a) As an administrative assistant
- b) Management and cooperative advice
- c) In the management of the mining (Logistics, Purchase of materials, etc.)
- d) In the operation of machinery (Trucks, tractors, etc.)
- e) In mining front together with the miners
- f) I do not see any function for women to work in the mining.
- g) At gold trading
- h) Only in the kitchen
- i) Other

3. What's left to have more women working in the mine? Select all that apply.

- a) More women mining owners/managers.
- b) More financial credit for women
- c) More women in the direction or councils in ASGM Cooperatives
- d) More training and training for women
- e) Less discrimination in society
- f) More trust from women's partners/partners
- g) Better division of household chores between men and women
- h) Other

New Opportunities

1. If there was a method that offered a greater recovery of gold produced, would you like to try it?

- a) Yes
- b) No

- c) I would like to know more about it
- d) I have no interest.

2. If you had an economic alternative, would you quit your job at the mine?

- a) yes
- b) No
- c) I never thought about it

3. How do you invest your income? Select all that apply.

- a) I invest in the mine (e.g., in machinery...)
- b) I invest in alternatives (e.g., pisciculture...)
- c) I investment in personal property (e.g., home, land, vehicles...)
- d) The acquisition of land to expand the mining area
- e) I spend it on nonsense.
- f) I invest in saving
- g) In my children's education
- h) There is no money left to invest.
- i) I do not know.
- j) Other

4. What is necessary to improve your mining work? Select all that apply.

- a) Extracting gold without using mercury
- b) Recover more degraded areas.
- c) Increase my production of gold extracted.
- d) Access to new and affordable technologies
- e) Having access to credit in financial institutions
- f) Traceability of gold.
- g) More geological research to find out where you have gold.
- h) Other

APPENDIX B: Webinars and short-course schedule

Activity	Webinar #1
Title	Best practices that contribute to the sustainability of the ASGM in Brazil
Date	13 April 2021
1 st Block	Welcoming and guest's introduction
	Description: Introduction event Mediation: Alex Macedo – Brazilian Cooperatives Organization (OCB)
2 nd Block	ASGM Project - Sustainability in Peixoto de Azevedo
	Description: Presentation of the ASGM Project – Sustainability in Peixoto, financed by the World Bank's EGPS fund. Guest: Prof. Dr. Giorgio de Tomi – NAP.Mineração/USP
3 rd Block	COOGAVEPE's role for the Mineral Cooperativism
	Description: Importance of mineral cooperativism to the gold miners in Peixoto de Azevedo. Guest: Solange Barbosa – COOGAVEPE President
4 th Block	Paths for a sustainable artisanal and small-scale mining future in Brazil
	Description: ASGM's concept in the world focusing on the best practices for a responsible and sustainable ASGM, that can be applied in Brazil. Guest: Prof. Dr. Marcello Mariz Veiga – University of British Columbia, Canada
5 th Block	Questions and answers
	Description: The moderator selects questions from the audience Mediation: Alex Macedo – Brazilian Cooperatives Organization (OCB)
6 th Block	Closing event
	Description: Acknowledgement to the guests and presentation of the next webinars' programme. Mediation: Alex Macedo – Brazilian Cooperatives Organization (OCB)

Activity	Webinar #2
Title	Opportunities to improve women's participation in ASM
Date	27 April 2021
1 st Block	Welcoming and guest's introduction
	Description: Introduction event Mediation: Dione Macedo – Ministry of Mines and Energy (MME)
2 nd Block	Invisible, but necessary: Working women in mining
	Description: Reflection about gender equality that may be of interest and applicable to artisanal and small-scale mining reality in Brazil. Guest: Prof. Dra. Anabelle Carrilho – University of Brasília (UNB)
3 rd Block	Women's participation at COOGAVEPE
	Description: Importance of gender equality discussion in Peixoto de Azevedo Guest: Solange Barbosa – COOGAVEPE President
4 th Block	Women's participation at COOPEROURI ASGM Cooperative in Pará State
	Description: Importance of gender equality discussion in Ourilândia do Norte, State of Pará. Guest: Patricia Sôffa – COOPEROURI President
5 th Block	Legal insight about women's role in ASGM
	Description: Which are the legal challenges and specificities of female labour in gold mining. Guest: Luciane Oliveira – ASGM Lawyer
6 th Block	Questions and answers
	Description: The moderator selects questions from the audience Mediation: Dione Macedo – Ministry of Mines and Energy (MME)
7 th Block	Closing event
	Description: Acknowledgement to the guests and presentation of the last webinar's programme. Mediation: Dione Macedo – Ministry of Mines and Energy (MME)

Activity	Webinar #3
Title	Opportunities for a responsible and sustainable ASM sector
Date	11 May 2021
1 st Block	Welcoming and guest's introduction
	Description: Introduction event Mediation: André Xavier - University of British Columbia
2 nd Block	ASGM Project – Sustainability in Peixoto
	Description: Presentation of the ASGM Project results - Sustainability in Peixoto. Guest: Prof. Dr. Giorgio de Tomi – NAP.Mineração/USP
3 rd Block	UN Sustainable Development Goals
	Description: Presentation of the concept and implementation of the 17 Goals for the Sustainable Development in the ASGM perspective. Guest: Ieva Lazareviciute – Territorial Development Advisor – UNDP Brazil.
4 th Block	Coexistence model in artisanal gold mining
	Description: Recommendations to the coexistence in artisanal gold mining approach. Guest: Prof. Dr. Marcello Mariz Veiga – University of British Columbia
5 th Block	Cooperation to promote the best practices into mineral cooperativism
	Description: Cooperation among various stakeholder to promote the best practices into mineral cooperativism. Guest: Solange Barbosa – COOGAVEPE President
6 th Block	Questions and answers
	Description: The moderator selects questions from the audience Mediation: André Xavier - University of British Columbia
7 th Block	Closing event
	Description: Acknowledgement to the guests and presentation of the last webinar's programme. Mediation: André Xavier - University of British Columbia

Activity	Short-course
Title	Practical application of the co-existence model in ASGM
Date	5 May 2021
1 st Block	Welcoming and guest's introduction
	Description: Introduction event Mediation: Prof. Dr. Giorgio de Tomi – NAP.Mineração/USP
	Description: Practical application of the co-existence model in ASGM Guest: Prof. Dr. Marcello Mariz Veiga – University of British Columbia
2 nd Block	Questions and answers
	Description: The moderator selects questions from the audience. Mediation: Mediation: Prof. Dr. Giorgio de Tomi – NAP.Mineração/USP
3 rd Block	Closing event
	Description: Acknowledgement to the guest Mediation: Prof. Dr. Giorgio de Tomi – NAP.Mineração/USP


APPENDIX C: Dissemination posters and communication





PROJETO ASGM SUSTAINABILITY PEIXOTO

Improve sustainability of the Peixoto de Azevedo ASGM community by addressing specific issues:

- More competitive gold trade
- Equal opportunities for men and women in the various activities of the mining
- Alternatives to reduce the use of mercury
- Preventative measures against Covid-19.

Our objective is to present the best practices and discuss the possible transformations to sustainability for the Cooperative of Artisanal Miners (COOGAVEPE), located in the municipality of Peixoto de Azevedo, in Brazil.



For more informations: nap.mineracao@usp.br




SCHEDULE:



Series of Webinars: SUSTAINABILITY IN MINERAL COOPERATIVISM

Time: 20:00 PM (BRT)

Youtube Channel: [NAP.Mineração/USP](https://www.youtube.com/channel/UCNAPMineracao)

April 13th	Best practices that contribute to the sustainability of the ASGM in Brazil
April 27th	Opportunities to improve women's participation in ASM sector
May 11th	Opportunities for a responsible and sustainable ASM sector

Institucional Support:



Series of Webinars

SUSTAINABILITY IN MINERAL COOPERATIVISM

Theme: Best practices that contribute to the sustainability of the ASGM in Brazil



Giorgio de Tomi,
NAP.Mineração/USP



Solange
Barbosa,
COOGAVEPE



Marcello Veiga,
Professor Emeritus of
University of British
Columbia



Mediator: Alex
Macedo, Brazilian
Cooperatives
Organization (OCB)

Date: April 13th, 2021

Time: 20:00 PM (BRT)

Youtube Channel: NAP.Mineração/USP

Institutional Support:



Series of Webinars

SUSTAINABILITY IN MINERAL COOPERATIVISM

Theme: Opportunities for a responsible and sustainable ASM sector



Giorgio de Tomi,
NAP.Mineração/USP



Ieva
Lazareviciute,
UNDP Brazil



Marcello Veiga,
Professor Emeritus
da University of
British Columbia



Solange
Barbosa,
COOGAVEPE



Mediator: André
Xavier, University of
British Columbia,
Canada

Date: May 11th, 2021

Horário: 20:00 PM (BRT)

Youtube Channel: NAP.Mineração/USP

Institutional Support:



Figure 1 – Poster of the 2st webinar



The poster is for a webinar titled "PRACTICAL APPLICATION OF THE CO-EXISTENCE MODEL IN ASGM". It features a circular portrait of Marcello Veiga, Professor Emeritus of University of British Columbia. The event is a "SHORT COURSE" held on April 5th, 2021, at 18:00 PM (BRT) via Zoom Transmission. The objective is to build capacity at COOGAVEPE leadership on issues related to mercury abatement, clean technologies, and co-existence models. The poster includes logos for EGPS, nap.mineração, and various institutional supporters: UBC, OCB, FECOMIN, MINISTÉRIO DE MINAS E ENERGIA, and PÁTRIA AMADA BRASIL GOVERNO FEDERAL.

EGPS
Extractives Global
Programmatic Support

nap.mineração
Universidade de São Paulo

SHORT COURSE:

**PRACTICAL
APPLICATION OF THE
CO-EXISTENCE
MODEL IN ASGM**

Marcello Veiga
Professor Emeritus
of University of
British Columbia

Date: April 5th, 2021
Time: 18:00 PM (BRT)
Zoom Transmission

Objective: Build capacity at
COOGAVEPE leadership on
issues related to mercury
abatement, clean technologies
and co-existence models.

Institutional Support

UBC
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FECOMIN
MINISTÉRIO DE
MINAS E ENERGIA
PÁTRIA AMADA
BRASIL
GOVERNO FEDERAL



nap.mineração
Universidade de São Paulo
Núcleo de Pesquisa para a
Tecnologia Mineração Responsável

COVID-19 medidas preventivas para o setor da mineração artesanal de ouro



Conteúdo criado pela
Artesanal Gold Council



Se você não se sentir bem, fique em casa!

Fique em casa e evite contato próximo com outras pessoas se não se sentir bem. Se você tiver sintomas típicos de COVID-19 e o contato não puder ser evitado, use uma máscara de proteção. Consulte um médico, se tiver febre ou dificuldade em respirar.





Proteja-se - mantenha distância!

Mantenha-se afastados por pelo menos 1 metro (comprimento de 2 braços) para evitar contato próximo com outros garimpeiros. As condições externas são consideradas de menor risco em comparação às condições internas com ventilação limitada.



Proteja os outros – Use máscara!

Se o distanciamento físico não for possível, use uma máscara de pano no garimpo e em público para proteger outras pessoas. Cubra o rosto quando precisar espirrar ou tossir (por exemplo, com o cotovelo dobrado). Não cuspa!





Evite tocar seu rosto!

Não toque na boca, nariz ou olhos com as mãos sujas. Suas mãos podem estar contaminadas com o corona vírus depois de tocar em um objeto contaminado. Evite tocar em objetos manuseados com frequência. Não compartilhe itens pessoais.



Lave as mãos!

Lave as mãos frequentemente com água e sabão por 20 segundos, especialmente antes de tocar seu rosto e colocar uma máscara e depois de tocar em objetos compartilhados ou espirrar. Como alternativa, use desinfetante para as mãos com um mínimo de 60% de álcool.





Mantenha limpo!

Desinfete as superfícies tocadas com frequência, como ferramentas de escavação ou botões de acionamento. O vírus pode sobreviver nas superfícies de objetos por vários dias, especialmente em ambientes internos e subterrâneos. A luz direta do sol pode inativar o coronavírus em objetos de forma mais rápida.



Fontes: Organização Mundial da Saúde *, Centros para Controle e Prevenção de Doenças **
 (**) Info: ** (gratuito)



Sobre o Corona vírus (COVID-19)



Como é espalhado?

O COVID-19 é transmitido principalmente de pessoa para pessoa. Uma pessoa infectada libera gotículas respiratórias enquanto espirra, tosse, fala ou apenas respira. Pessoas em contato próximo (de menos de 1 a 2 metros) podem pegar o vírus se entrar na boca, nariz ou olhos. O vírus também pode ser transmitido se uma pessoa tocar em um objeto contaminado (por exemplo, um martelo, uma maçaneta da porta) e depois tocar em seu rosto.

Uma pessoa infectada geralmente desenvolve sintomas de 5 a 6 dias após a exposição, mas pode levar até 14 dias. Algumas pessoas não desenvolvem sintomas. As pessoas infectadas são mais contagiosas (podem infectar outras pessoas) 2-3 dias antes de perceberem algum sintoma e também por cerca de 8 dias após o início dos sintomas. Pessoas que nunca desenvolvem sintomas também podem transmitir o vírus, embora seja menos provável.

Quais são os sintomas?

O coronavírus pode afetar diferentes órgãos! Os principais sintomas são febre, tosse e falta de ar.

Outros sintomas frequentemente relatados incluem: dor muscular, perda de paladar ou olfato, dor de garganta e/ou calafrios.



FEBRE



TOSSE



FALTA DE AR

Alguns sintomas mais inespecíficos são diarreia, náusea/vômito, dor de cabeça e congestão nasal. O COVID-19 afeta as pessoas de maneira diferente. Enquanto algumas pessoas nunca desenvolvem sintomas, a maioria das pessoas sofre de sintomas leves; cerca de 15% desenvolvem uma infecção grave (por exemplo, com falta de ar, pneumonia) e 5% desenvolvem uma condição crítica que pode levar à morte (como insuficiência respiratória da disfunção de múltiplos órgãos).



Quem está em risco?

Adultos com idade mais avançada (acima de 60 anos) e pessoas de qualquer idade com um sistema imunológico comprometido e/ou condições médicas subjacentes graves (por exemplo, asma, silicose, diabetes, problemas cardiovasculares, obesidade, tabagismo, intoxicação crônica por mercúrio) são em maior risco de desenvolver uma infecção grave de COVID-19 com complicações. Mas pessoas de qualquer idade podem desenvolver uma infecção leve ou grave.

COVID-19 LINHA DIRETA NACIONAL:

Conteúdo traduzido por Carlos Henrique Xavier Araújo

Observe que as informações sobre a COVID-19 estão evoluindo todos os dias e que as diretrizes podem mudar. Procure informações da sua autoridade de saúde e siga as políticas nacionais.

Fontes: Organização Mundial da Saúde * Instituto * Centros dos EUA para Controle e Prevenção de Doenças ** OMS ** (9 de julho, ** atualizado)



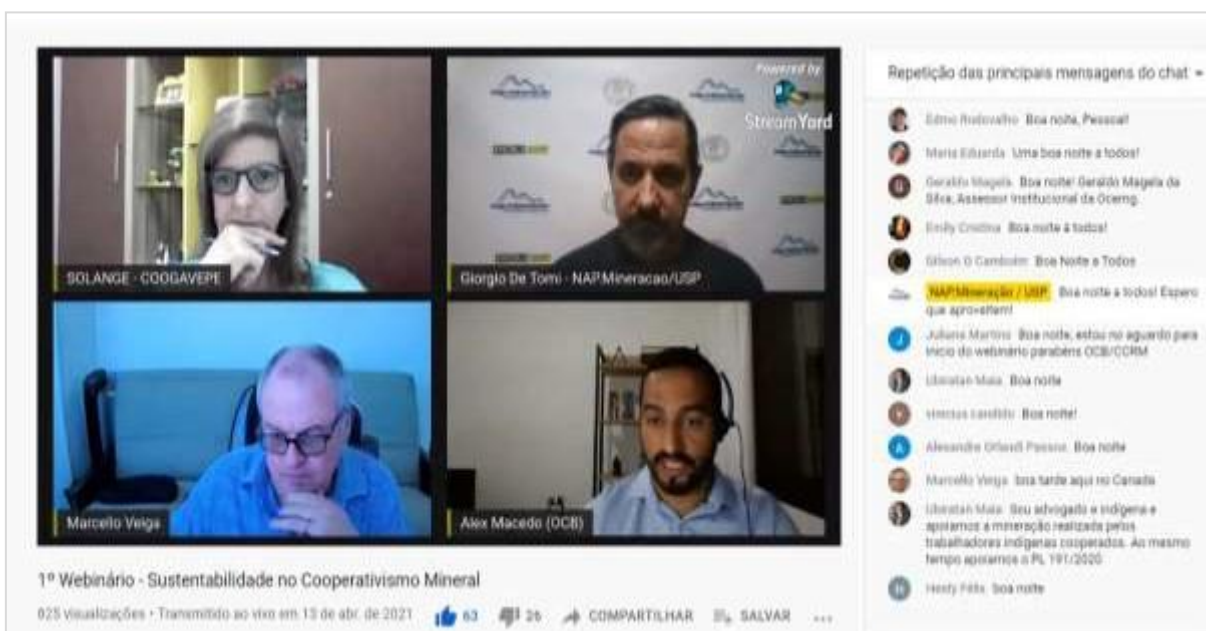
Poster on the highway BR-163.

Located 700 meters from the entrance to the municipality of Peixoto de Azevedo/MT.



Solange Barbosa, President of COOGAVEPE discussing about the activities of the Project ASGM to the artisanal miners associated to the cooperative.

APPENDIX D: Screenshots of the webinars and training session



Webinar #1 - Best practices that contribute to the sustainability of the ASGM in Brazil



Webinar #1 – President Solange Barbosa presenting in the webinar

Powered by StreamYard

2º Webinar - Oportunidades de Trabalho para Mulheres na Mineração

311 visualizações • Transmitido ao vivo em 27 de abr. de 2021

47 0 COMPARTILHAR SALVAR

Repetição das principais mensagens do chat

- curso produtivo, regularizar e da o devido valor as mulheres que ali labuta todos dias, de inverno a verão.
- Monira Monnerat: Boa noite a todos! Boa oportunidade de discutirmos as mulheres no garimpo, tema atual na realidade brasileira
- Gláucia D Camboim: Boa Noite a todos, parabéns
- Lucas Pavani: boa noite, parabéns pela iniciativa.
- NAPMineração / USP: Olá a todos, esperamos que aproveitem bastante o 2º Webinar - Sustentabilidade no Cooperativismo Mineral!
- Odilon Roberto Santos: Parabéns a todas participantes... parabéns todas
- NAPMineração / USP: Respondem a nossa enquete. É muito importante para a dinâmica da apresentação
- Graciele Aparecida de Souza Filho: Boa Noite Mulheres Trabalhadoras Mineradoras, Sistema DCB-MT presente, Minhas Congratulações, att Graciele
- Deborah Lopes: Uma gigante oportunidade de mostrar para a sociedade a importância das mulheres na frente da mineração de pequeno e grande porte! Boa iniciativa!

Webinar #2 - Opportunities to improve women's participation in ASM

Powered by StreamYard

2º Webinar - Oportunidades de Trabalho para Mulheres na Mineração

311 visualizações • Transmitido ao vivo em 27 de abr. de 2021

47 0 COMPARTILHAR SALVAR

Repetição das principais mensagens do chat

- debate com discussões sobre desigualdades de gênero. O que seria então das pessoas homossexuais?
- George de Toni: Secretária Fabiana, obrigado por prestigiar o evento é parabéns pela sua atuação no Tapajós.
- Januária Mello: Vocês poderiam dar exemplos de como os atores e práticas das mulheres na mineração traz (pode trazer) mudanças para melhores condições ambientais, sociais, etc?
- Ailton Soares: A história vem se transformando a partir da participação ativa das mulher
- heleen balerno
- Luis Carlos: O acesso ao uso do título mineiro como garantia para acesso ao crédito poderá resolver os problemas dos garimpeiros? os garimpeiros serão beneficiados com a regulamentação desta norma?
- erótides santos rodrigues
- erótides santos rodrigues
- Karine Ferraz: Dona Erotides, grande garimpeira!
- Gabrielly Modesto
- NAPMineração / USP: Obrigado pelas participações pessoais, seguimos anotando tudo...

Quais os principais fatores que inibem uma maior participação da mulher na atividade garimpeira?

Webinar #2 - Opportunities to improve women's participation in ASM

Powered by StreamYard

3º Webinar - Oportunidades para a mineração artesanal responsável e sustentável

271 visualizações • Transmitido ao vivo em 11 de mai. de 2021

36 0 COMPARTILHAR SALVAR

Webinar #3 - Opportunities for a responsible and sustainable ASM sector

Powered by EGPS

Síntese dos Principais Resultados

- Igualdade de oportunidades para mulheres**
As entrevistadas indicaram que as mulheres pode contribuir no garimpo como assistente administrativo, com 79% das respostas, seguido da administração (logística, compra de materiais) com 59%, e em terceiro um empate entre a operação de máquinas e postos de comercialização do ouro, ambos com 52%.
- Existência em Peixoto de Azevedo**
45% dos entrevistados preferem a atuação para os garimpeiros trabalharem. Sobre a possibilidade de um minerador comprar o minério produzido, houve uma variação média entre os que tem interesse em saber mais e dos que ainda não tem uma opinião formada.
- Métodos limpo e sustentável para recuperação do minério de ouro**
62% responderam que estão abertos e interessados em experimentar um método limpo e sustentável para recuperação do ouro. 36% gostariam de saber mais sobre o assunto.

3º Webinar - Oportunidades para a mineração artesanal responsável e sustentável

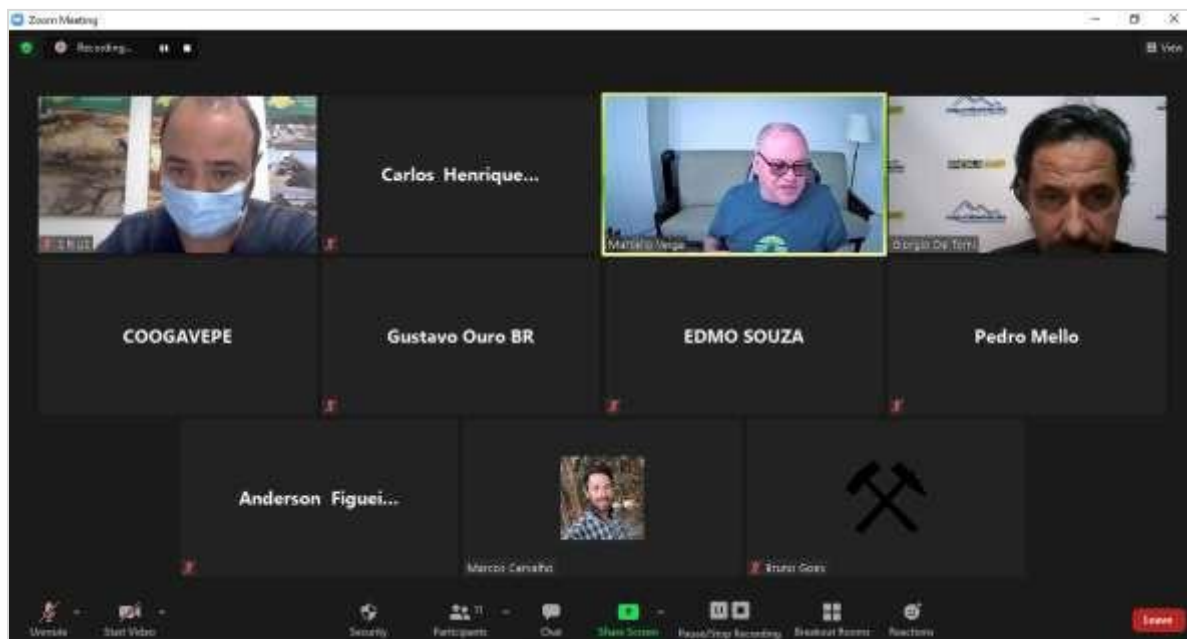
271 visualizações • Transmitido ao vivo em 11 de mai. de 2021

36 0 COMPARTILHAR SALVAR

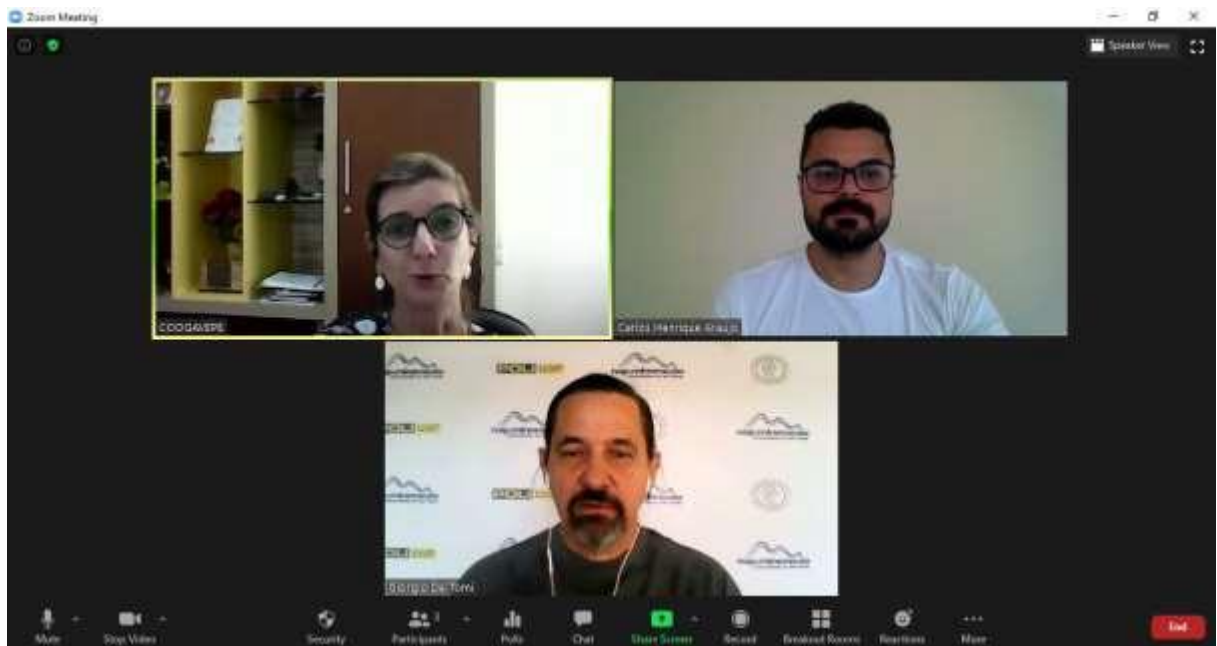
Webinar #3 - Opportunities for a responsible and sustainable ASM sector



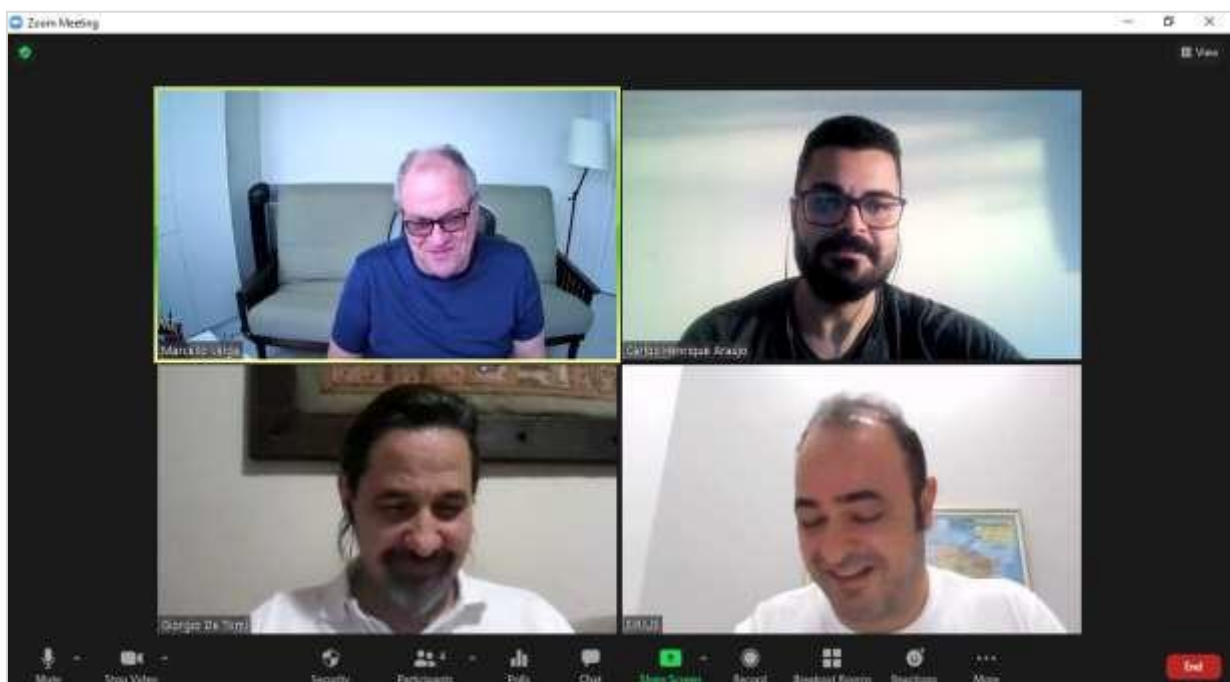
Short-course – Practical application of the co-existence model in ASGM



Short-course – Practical application of the co-existence model in ASGM



First meeting to discuss the Project ASGM with the Solange Barbosa, president of the COOGAVEPE.



Meeting Planning of the Project team with member of the cooperative's management.



Meeting with the Project team, president and geologist of the COOGAVEPE and Brazilian WWF - World Wildlife Fund Inc representative.



Webinar with the WWF - World Wildlife Fund - ASGM Operation and Technology in South America

Zoom Meeting

Try out meeting Marcello Veiga's screen

View Options

Carlos Henrique... Deborah Gol... Giorgio De T... Marcello Veiga... Edgar WWF... Michel David...

Recording

But all these techniques are for **micro-ducklings**!!! Are they the main problem in Artisanal Gold Mining?




	Micro Miners	Proc. Centers
World Artisanal Gold Mining Population	90%	10%
Gold Production	20%	80%
Mercury Pollution	10%	90%
Attention of the Interventions	90%	10%

Unmute Start Video Participants Chat Share Screen Record Reaction Leave

Digite aqui para pesquisar

12:34 PM 23/04/2021

Webinar with the WWF - World Wildlife Fund - ASGM Operation and Technology in South America


University of British Columbia
 Norman B. Kevill Institute of Mining Engineering
 Vancouver Canada


nap.mineração
 Universidade de São Paulo


EGPS
 Extractives Global
 Programmatic Support

Mercúrio em Mineração Artesanal de Ouro: Problemas Ambientais e de Saúde



Marcello Veiga
Professor Emeritus
veiga@mining.ubc.ca

MINAM TALKS 11: O MERCÚRIO NA MINERAÇÃO ARTESANAL

Webinar - MINAM – Sustainable Mining in the Amazon

EGPS
Empreendedorismo e Gestão em Pequenas Empresas

COOGAVEPE
"Desenvolvimento Mineral & Sustentabilidade"

Sustentabilidade no Cooperativismo Mineral

A perspectiva da Cooperativa dos Garimpeiros do Vale do Rio Peixoto (COOGAVEPE)

Solange Barbosa
Presidente da COOGAVEPE
presidencia@coogavepe.com.br

Peixoto de Azevedo – MT, 13 de Abril de 2021


Cômputos – COOGAVEPE

Histórico:

- **Data da Fundação:** 03 de Dezembro, 2007;
- **Nº de fundadores:** 23 garimpeiros;
- **Abrangência:** 8 municípios (Norte de Mato Grosso);

Números atuais:

- **Nº de cooperados ativos:** mais de 6.000;
- **Licenças ativas:** 116;
- **Processos protocolados:** 95;
- **Processos aguardando publicação de PLG para emissão de L.O.:** 13;
- **Permissão de lavra garimpeira – PLG:** 117;
- **Requerimentos aguardando publicação (PLG):** 18.



EGPS
Empreendedorismo e Gestão em Pequenas Empresas

Surgimento da COOGAVEPE

União de esforços em busca de um objetivo comum:

- Organizar;
- Fortalecer;
- Legalizar a atividade de mineração (Garimpo);
- Somar conhecimentos em busca da melhoria da atividade.

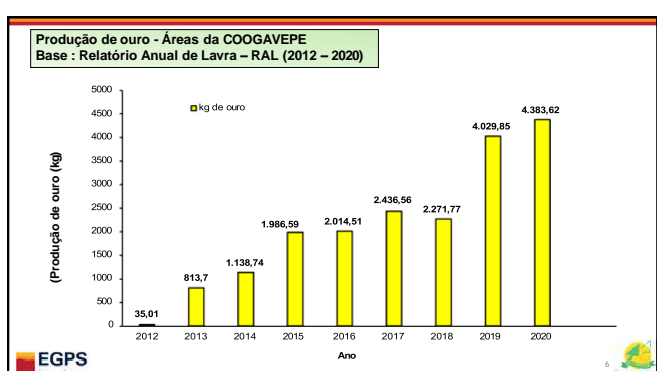
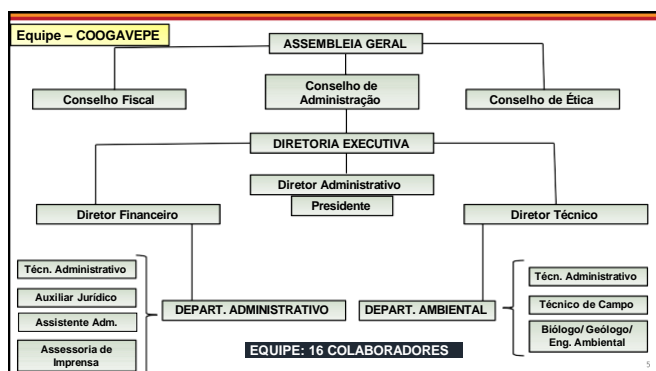
EGPS
Empreendedorismo e Gestão em Pequenas Empresas

Objetivos sociais

- Parcerias com hospitais e farmácias para obtenção de descontos aos cooperados;
- Empréstimo de cadeiras de roda e banho, e muletas;
- Doação de cestas básicas;
- Doações diversas à entidades (APAE, Lar do Idoso, CASAI/ Indígena).



EGPS
Empreendedorismo e Gestão em Pequenas Empresas



Desafios futuros

Busca de novos conhecimentos;

- Tecnologias para evoluir as práticas da atividade de mineração, visando principalmente a sustentabilidade, a recuperação ambiental e o melhor aproveitamento do material extraído (ouro), aumentando a produtividade;
- Erradicar e/ou mitigar os impactos do mercúrio;
- Despertar a consciência e a responsabilidade do pequeno minerador (garimpeiro) na recuperação ambiental;



Desafios futuros

- Captar recursos para investimentos voltados aquisição de equipamentos e acesso a novas tecnologias;
- Instigar a participação da mulher na mineração (igualdade de oportunidades);
- Fortalecer a importância de realizar a comercialização da produção de maneira legal (Nota fiscal).



Projeto ASGM – Sustentabilidade em Peixoto

Financiamento:



Organização e implementação:



Apoio institucional



THE UNIVERSITY
OF BRITISH COLUMBIA



9



MINISTÉRIO DE
MINAS E ENERGIA



MUITO OBRIGADA!!!!

Solange Barbosa
Presidente da COOGAVEPE
presidencia@coogavepe.com.br





Melhores práticas para o futuro sustentável da mineração artesanal e de pequena escala de ouro no Brasil



Marcello Veiga
 Professor Emeritus
 veiga@mining.ubc.ca
 University of British Columbia
 Norman B. Kevill Institute of Mining Engineering
 Vancouver, Canada

Mineração Artesanal (definição)

- Aproximadamente 45 milhões de indivíduos em mais de 70 países extraem mais de 30 minerais diferentes de maneira **artesanal** (rudimentar)
- Globalmente, o número de pessoas que dependem dessa atividade econômica pode chegar a 450 milhões
- Cerca de **20 milhões de mineradores artesanais de ouro**
- Em todo o mundo 450-500 toneladas/a de ouro produzido pela Mineração Artesanal de Ouro

Estoque de Ouro no Mundo

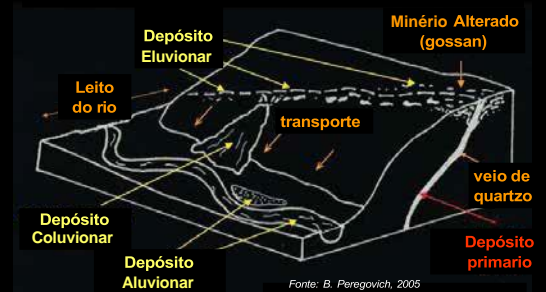
- Total acima da terra (até 2019): **197.576 t**
- Joalheria : 92.947 t, **47.0%**
- Reservas geológicas (ainda na terra): **53.000 t**
- Se não for descobertas novas jazidas
- ...e se a demanda de ouro novo for 3.500 t/ano...
- Não haverá ouro **NOVO** após **15 years**

Todo o ouro que já foi minerado no planeta →

<https://www.visualcapitalist.com/12-stunning-visualizations-of-gold-bars-show-how-rarely/>
<https://www.gold.org/about-gold/gold-supply/gold-mining/how-much-gold>



Exemplos de Tipos de Depósitos de Ouro



Depósitos Secundários de Ouro



<https://howtofindgoldnuggets.com/the-use-of-hydraulic-mining-in-gold-country/>

Monitores hidráulicos num depósito aluvionar seco de ouro, Califórnia, USA, cerca de 1860



Stang Water Monitor Cannon
<https://youtu.be/y2Gooe32A>

Monitores hidráulicos modernos em Yukon, Canadá, 2021

Kalimantan, Indonesia (Aluvião Seco de Ouro)



Laos (Aluvião)



Dragas no Rio Madeira, Brasil (Aluvião)

Fonte: Manchete, 1993



BBC Documentary
The Price of Gold
1993

Brasil (Coluvião)



Como Melhorar as Práticas de Extração de Ouro em Mineração Artesanal

1. É preciso entender que a recuperação de ouro na mineração artesanal **raramente é superior a 30%**
2. É preciso entender que melhores práticas exigem investimentos e conhecimento
3. É preciso entender que não é processando mais material que se vai produzir mais... **É preciso produzir com mais eficiência**
4. Existem métodos para melhorar as práticas

Ouro Não Precisa Estar Liberado para Ser Concentrado

- Mas ouro necessita estar **LIBERADO** para ser amalgamado



- Esta partícula (com 10% de ouro) pode ser concentrada mas **não pode ser amalgamada**



- Mas o ouro **EXPOSTO** pode ser lixiviado por cianeto, por exemplo

Outros Conceitos Básicos

1. Amalgamação é o **pior** método de recuperar ouro
2. Amalgamação de **TODO** o minério **é ineficiente** e aumenta a perda de mercúrio e a perda de ouro
3. Se for usar mercúrio: use somente nos concentrados
4. Concentração: existem muito métodos gravíticos (para ouro maior que 0,1 mm) e flotação para ouro mais fino

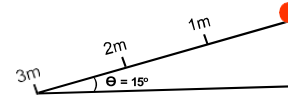
Calhas (cobra fumando) Devem Ser Estudadas antes de Usá-las

1. Inclinação varia entre 10 e 15°. Para ouro fino, se usa 5° mas nesses casos muito concentrado se acumulala
2. Calhas maiores que 2 m são inúteis
3. Carpetes para ouro fino são melhores
4. Densidade de polpa = 10-20% em peso de sólidos
5. Descarga de concentrados depende da recuperação e do teor de ouro no concentrado

Inclinação da Calha Deve Ser Estudada

- Calhas não precisam ser longas. Velocidade da polpa (água + minério) aumenta com a distância

$v(1m) = 1,9 \text{ m/s}$
 $v(2m) = 2,7 \text{ m/s}$
 $v(3m) = 3,3 \text{ m/s}$
 $v(4m) = 3,8 \text{ m/s}$



Partículas finas de ouro são concentradas onde a velocidade é mais baixa = NO INICIO

Se for Usar as Calhas Concentradoras

- Use as calhas em zig-zag para quebrar a velocidade do fluxo de água



Brasil
Photo: Hermann Wotruba



Suriname

Carpetes



Brazil
Photo: Hermann Wotruba

- Calhas rifladas são para ouro grosso (criam turbulência)
- Carpetes são melhores que os rifles e concentram ouro médio e algum ouro fino (0.1 - 0.5 mm)
- Pode ter rifles no começo da calha e carpete no resto
- Turbulencia deve ser evitada

Carpetes

- Carpetes devem estar bem presos na calha



Carpete sem o Fundo

- Carpetes sem o fundo de borracha são fáceis de limpar

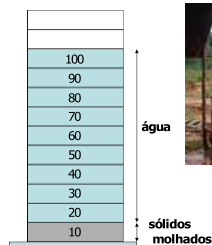


US\$ 2-7/m²

<https://www.youtube.com/watch?v=1LmNY4mV58Q>
<https://www.youtube.com/watch?v=WyswDA66MQ>
<https://laivubless.en.made-in-china.com/product/pv4OgwGhbrW/China-Vinyl-Loop-Mats-No-Backing-Sluice-Mat-Gold-Mining-Carpet.html>

Densidade de Polpa na Calha

- A polpa não deve ter mais que 20% de sólidos em peso
- Em volume, **não** deve ser maior que **10% da garrafa**



Quando Devemos parar o Trabalho e Limpar as Calhas

- Isto depende de cada minério e tem que ser estudado
- Se parar **mais frequentemente** para retirar os concentrados terá **mais recuperação de ouro** mas terá **muito concentrado**
- Se **demorar a limpar** a calha, terá um **concentrado rico**, mas a **recuperação de ouro é baixa**... muito foi perdido
- Tem gente que limpa calhas a cada 5 horas, outros a cada 8 horas e outros a cada semana

Centrifugas

- Muito melhores que calhas
- Icon 150: Preço no Canada = US\$ 5000
- 2 tonnes/h de solidos
- 30% solidos
- 2 HP
- Tamanho máximo de partícula = 2 mm
- Água de contra pressão = 30 L/min
- G = 120 to 150 (1100 rpm)
- 0,5-1 kg de concentrado por ciclo
- O Icon 350 tem capacidade de 15 tonnes por hora



Icon 150

Que Fazer para Extrair o Ouro de um Concentrado

- Se for de depósito aluvionar: ouro está livre, é só bater o concentrado e fundir (algumas pessoas usam amalgamação)
- Se for depósito de barranco (coluvionar ou eluvionar) o ouro no concentrado pode não estar liberado, logo amalgamação só será parcialmente efetiva
- Tem que moer antes, retirar as bolas e amalgamar ou cianetar



Using Gas Tanks as Ball Mills



Moçambique

Não pode colocar mercúrio no moinho de bolas pois será pulverizado

Usando Barril de Amalgamação

- Concentrado depois de moído é amalgamado
- Uma parte de Hg para 100 partes de concentrado, 45 min

Jarra de vidro (3 L)
Indonésia

Usando Barril de Amalgamação



Brasil

Feito por Edmundo Veiga

Amalgamação de TODO Minério em Placas de Cobre

O mercúrio das placas é removido e vai com os rejeitos



Venezuela



Brasil

Amalgamação de TODO Minério em Placas de Cobre

Verificando com água se o amálgama foi formado

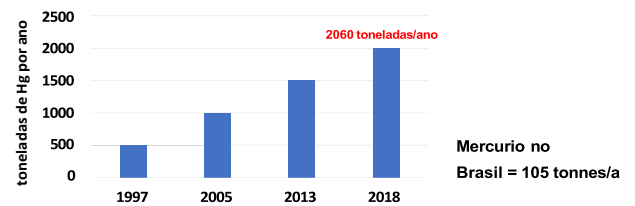


Raspando a superfície da placa para retirar o amálgama



Venezuela

Descarga Mundial Anual de Mercúrio ao Meio Ambiente por Mineiros Artesanais de Ouro



Veiga, 1997, Swain et al., 2007, UNEP, 2013, UNEP 2018

Amalgamação de Concentrados

Concentrando o ouro, a massa de material a ser amalgamado é muito menor (menos de 10%)

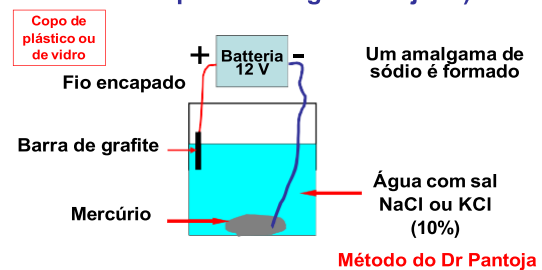


Moinho Chileno no Equador



Moinho Chileno na Colombia

Ativando Hg antes da amalgamação (aumenta a coalescência = reduz esfarinhamento do Hg = menos perda de Hg com rejeito)



Fio de cobre encapado

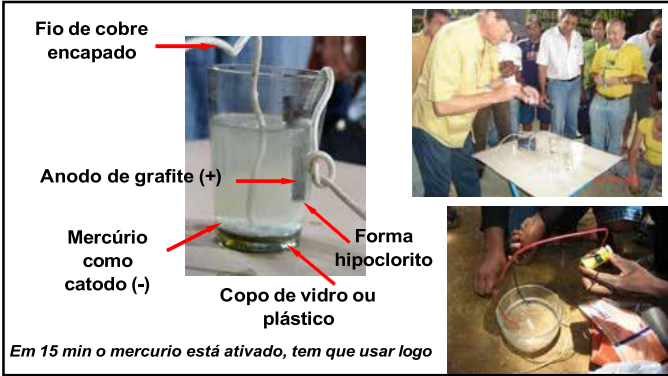
Anodo de grafite (+)

Mercúrio como catodo (-)

Forma hipoclorito

Copo de vidro ou plástico

Em 15 min o mercúrio está ativado, tem que usar logo



Reduzindo% Hg no amálgama de 40% (compressão manual) a 20% (centrifuga)

Tubo de PVC

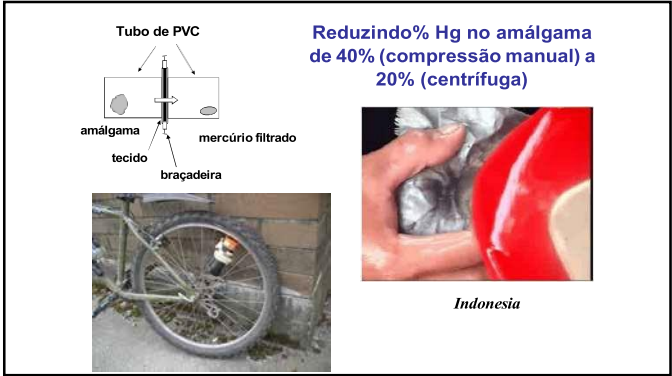
amálgama

mercúrio filtrado

tecido

braçadeira

Indonesia



Filtrando o Amálgama

Centrifugação Manual

Brasil

Feito por Edmundo Veiga



Mineiro Queima Seu Amálgama...

... e chama seus amigos e familiares para ver como a cor do amálgama muda de prateada para dourada

Cambodia
Foto: Tom Murphy

60% Au, 40% Hg



Queimando Amálgama

Todos compostos de Hg evaporam a temperaturas acima de 460 °C

Indonesia



**Estou protegido !!!
Eu uso minha camisa como máscara**

Indonesia
Photo CETEM





Retorta de Tigelas



A tigela de cobertura não necessita ser de vidro

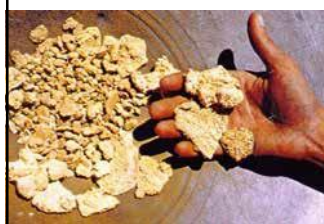
Tigela de aço esmaltado esfria mais rápido

Areia molhada aqui

Fogareiro a querosene

Moçambique

Casas Compradoras de Ouro nas Cidades



Brasil

Compram dos mineiros: ouro retornado (*doré*) com 2 a 5% Hg ou amálgamas com 40 a 50% Hg



60% Au,
40% Hg



Colômbia

Na Colômbia as casas compradoras queimam amálgamas nas cidades

Capelas para Casas Compradoras de Ouro



>98% de abatimento de Hg
~US\$ 65

35 casas em Galangan, Indonésia fizeram esta capela



Kalimantan, Indonésia

Capelas para Casas Compradoras de Ouro



Indonésia

Substituindo Mercúrio por Cianetação Intensiva de Concentrados

- Cianetação de concentrados em moinhos de bolas
- Baixo investimento
- Cianeto de sódio com Oxiclean (ou Vanish): 21% H_2O_2 (acelera o processo de cianetação mas cuidado que pode destruir o cianeto)



Equador

Resultados do tratamento de concentrados (após 8 horas)

(testes de campo no Equador)

- Amalgamação de 2/3 de concentrado gravítico recuperou 26% do ouro (feito pelos mineiros artesanais)
- A cianetação de 1/3 do concentrado em “moinho de bolas” recuperou 95% do ouro
- Esta demonstração é a chave para convencer os mineiros a mudarem seus métodos poluentes

Substituindo Mercúrio por Cianetação Intensiva de Concentrados

Lixiviação de concentrados em moinhos de bolas



Brasil



Cápsula de carvão ativado ou de aparas de zinco.
97% de ouro extraído em 12 horas

Substituindo Mercúrio por Cianetação Intensiva de Concentrados

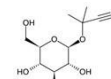


98% ouro extraído em 8 horas
10 g/L NaCN and 0.5 g/L H₂O₂



Uso de Mandioca Brava para Dissolver Ouro

- O principal componente tóxico da mandioca é a linamarina, um glicosídeo cianogênico que forma HCN quando hidrolisa
- A mandioca que comemos tem 20 mg de cianeto por kg de mandioca
- A mandioca amarga contém > 1000 mg de cianeto / kg
- Os resultados preliminares no laboratório da UBC resultaram em 50-60% de recuperação de ouro de concentrado



Resultados dos Treinamentos

- 39 boas plantas construídas na Colômbia com base nos projetos que os mineiros aprenderam
- Mais de 50 boas plantas no Equador



Colombia

Boas Plantas de Processo



Equador

- Uma boa planta de processamento de ouro completa, custa da ordem de US\$ 30 a 40 mil por tonelada por dia a ser processada
- Exemplo, uma planta para processar 10 tpd pode custar US\$ 400 000

Co-existência É a Melhor Opção

- Mineiros artesanais **MINERAM**, companhia **PROCESSA**
- Mineiros **vendem** o minério a companhia que paga pelo teor do ouro contido (40, 50, 60, 70% do valor do ouro que está no minério a ser vendido – análise química)
- Com isto o mineiro ganha mais e não tem investimentos nem custos de operação... Nem usa mercúrio também
- Várias companhias e mineiros no Peru, Colombia, Nicarágua, Costa Rica já adotam esta metodologia

Conclusão

- Existem técnicas simples que os mineiros artesanais podem usar para melhorarem suas produções
- Mercúrio é ineficiente pois só amalgama ouro liberado
- Amalgamação de concentrados pode melhorar
- Venda de minério ou concentrados a companhias para extrair o ouro por processos químicos (cianetação ou outros) é a melhor solução técnica e econômica para os mineiros artesanais

“O crime que cometemos é ter nascido com ouro aos nossos pés e ter que morrer de fome”

Um minerio artesanal

Temos que Mudar Isto

Obrigado



Ghana

Projeto ASGM - Sustentabilidade em Peixoto

Visão Geral do Conceito de Coexistência

Giorgio de Tomi
05 de maio de 2021

Apoio e organização:



Conteúdo

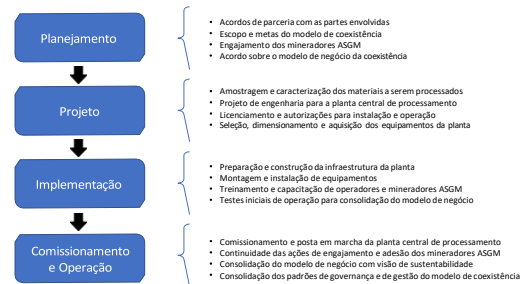
- Porque um modelo de coexistência?
- Abordagem proposta
- Exemplo de Modelo de Coexistência
- Próximos passos para a COOGAVEPE

Porque um modelo de coexistência?

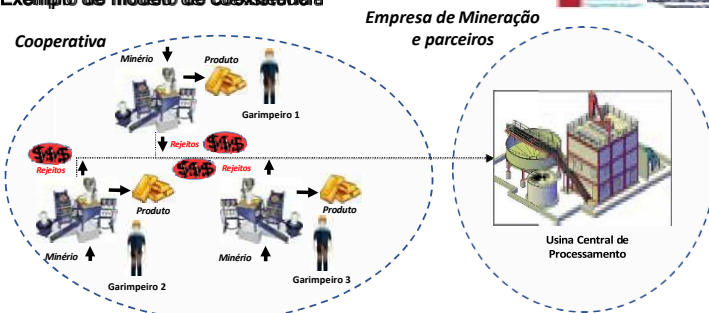
- O conceito de **coexistência** é um modelo de negócio entre **entidades ASGM** e uma ou mais empresas de **mineração convencional**.
- Há diversas modalidades de coexistência para o setor de ASGM. No entanto, o foco em geral é geral o **aumento da recuperação de ouro** utilizando tecnologias limpas, o aprimoramento do **gerenciamento de rejeitos** e o controle de **impactos ambientais** da operação em conjunto.
- As metas de um modelo de coexistência normalmente incluem: (a) reduzir a contaminação por **mercúrio**; (b) reduzir os impactos ambientais da operação e (c) fortalecer os benefícios para as comunidades por meio da **formalização**.
- Um modelo de coexistência adequado pode promover **boas práticas, tecnologias limpas, gestão ambiental, treinamento e suporte técnico**.
- **Diferente arranjos de coexistência** estão sendo utilizados com **sucesso** pelo setor de ASGM em diversos países, incluindo Colômbia, Nicarágua, Filipinas e Mali, entre outros, conforme relatado por **Veiga e Fadina (2020)***.

(*) Fonte:
M. M. Veiga & O. Fadina (2020). A review of the failed attempts to curb mercury use at artisanal gold mines and a proposed solution. The Extractive Industries and Society 7 (2020) 1135–1146
<https://www.sciencedirect.com/journal/the-extractive-industries-and-society/pii/S2214780X20300093>

Abordagem proposta



Exemplo de modelo de coexistência



Obrigado

Giorgio de Tomi
05 de maio de 2021







Coexistência de Mineiros Artesanais com Companhias de Mineração




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 University of British Columbia
Norman B. Kevill Institute of Mining Engineering

Projetos que Participei desde 1980



Que Soluções Já Foram Tentadas para Melhorar as Minerações Artesanais no Mundo

Várias abordagens foram tentadas nos últimos 40 anos:

- Ambiental e de Saúde
- Formalização - Legalização
- Capacitação Tecnológica
- Outros????

Resultados Destas Abordagens

- Mineiros artesanais não leem artigos científicos nem acreditam mais em cientistas nem em imprensa (escândalos)
- Formalização = legalização + melhores práticas
- Poquíssimas áreas disponíveis para os mineiros artesanais trabalharem...maioria nas mãos de companhias ou especuladores
- Burocracia para formalizar é imensa e os artesanais não conseguem cumprir com os regulamentos
- Demonstrações de tecnologias no campo não são sustentáveis Projetos não têm continuidade

Solução para os Mineiros Artesanais

- Para que um mineiro artesanal informal possa ser um pequeno mineiro responsável é preciso:

Assistência Técnica e Investimento

Isto não é micro-crédito

Abordagem da Coexistência

Justificativa

- Empresas processadoras prestam assistência aos mineiros nas minas e processam o minério vendido por eles
- Nenhum investimento ou custos operacionais para mineiros
- Mineiros recebem mais \$ (mais pelo conteúdo Au)
- Mercúrio ou cianeto não são utilizados por mineiros
- Mineiros não precisam obter licenças ambientais (usam subcontratos)
- Isso já está funcionando no Peru, Colômbia, Nicarágua, Costa Rica e está crescendo.

Modelos de Coexistência

- Companhia processadora deixa os mineiros artesanais trabalharem em suas concessões... outras não têm concessões, só plantas processadoras
- Companhia compra o **minério** dos artesanais pagando de 40 a 70% do ouro contido e processa o minério em uma planta grande
- Companhia faz uma planta de processo pequena junto com os artesanais e divide as despesas e o lucro
- Companhia compra somente **rejeitos** dos artesanais

Exemplos de Coexistência

- Dynacor, Peru
- Compram minério desde 2006, 330 t/dia
- 6000 mineiros artesanais envolvidos
- O preço é pago dependendo do teor de ouro no minério e da facilidade de extrair-lo
- Fazem testes em um dia para determinar em que tabela de preço eles pagam



Exemplos de Coexistência



- Bonanza Gold, Nicaragua
- Em 2013 Mineros S.A. adquiriu da HEMCO a mina Bonanza e planta de 2500 tpd
- Existem também 2 plantas de 120 t/dia dedicadas a 1678 mineiros artesanais trabalhando em 3% das concessões da empresa
- Mineiros dividem os custos operacionais com a companhia
- Bonanza compra minério também de outros locais

<https://mineros.com.co/es/Sostenibilidad/Gesti%C3%B3n-Ambiental>



Exemplos de Coexistência

- Rio Nechí, Colombia (473 km²)
- Em 2020 Mineros S.A. produziu 2,4 t de ouro aluvionar
- Mineram teores de 0,09 g/m³ de Au
- Deixam mineiros artesanais dragarem atrás das suas dragas e em locais onde as grandes dragas não chegam
- Artesanais usam calhas com carpete e levam os carpetes para serem processados em terra pela empresa = 98% de recuperação de ouro sem mercurio



Exemplos de Coexistência



Dragas de Mineros S.A. no Rio Nechí, Colombia



5 dragas de caçamba e 9 de sucção
total cerca de 20 milhões de t/dia

<https://www.youtube.com/watch?v=FFbJDbBZMts>



Exemplos de Coexistência



Dragas de Mineros S.A.
no Rio Nechí, Colombia

<https://www.youtube.com/watch?v=FFbJDbBZMts>



Mineros *por el bienestar de todos* **Exemplos de Coexistência**


Draga de Mineros S.A. no Rio Nechí, Colombia




- Cada caçamba leva 250 a 590 toneladas por hora
- 100 caçambas por draga

<https://www.youtube.com/watch?v=0DQaWY3R710> <https://www.gelkos.com/en/news/technology-solutions/inline-pressure-jigging-hydrocyclones.html> [new-gravity-recovery-equipment-in-minerals](https://www.gelkos.com/en/news/technology-solutions/inline-pressure-jigging-hydrocyclones.html)

Mineros *por el bienestar de todos* **Exemplos de Coexistência**



Dragas de Artesanais no Rio Nechí, Colombia

- Mineiros artesanais trabalham nas concessões de Mineros S.A. com áreas <10 ha cada grupo
- São ajudados pela companhia
- Companhia compra o ouro e paga 80% do preço internacional do ouro no dia
- Áreas são rehabilitadas e terreno dado aos mineiros

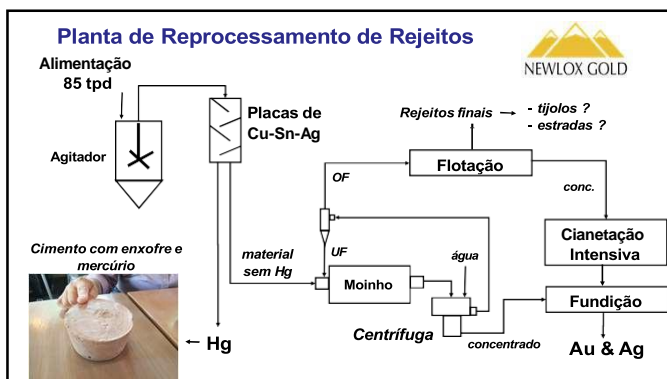
<https://www.ogm.nl.co/weblog/en-el-2021-la-fuerza-publica-continua-operaciones-de-rehabilitacion-en-el-rio-nechi> legal-en

ZiJin **CONTINENTAL GOLD** **Exemplos de Coexistência**

- Continental Gold, Colombia
- A companhia estabeleceu contratos de operação com os artesanais em suas concessões
- Em 2019, mineiros venderam 3000 t de minério para serem processados na planta industrial da companhia
- Dividem o carregamento de minério em 3 partes que, após trituração e homogeneização, são analisadas
- Mineiros analisam uma parte e outra fica guardada
- Pagam de 40 a 65% do ouro contido

NEWLOX GOLD **Exemplos de Coexistência**

- Newlox Gold, Costa Rica
- Compram desde 2014, 85 t/dia de rejeitos contaminados por Hg dos artesanais na Costa Rica
- Removem o Hg, remoem, retiram o ouro por gravimetria, flotação e cianetação de concentrados
- Estão terminando uma segunda planta de 150 tpd trabalhando junto com a cooperativa de artesanais



Planta de Reprocessamento de Rejeitos



Custo de uma Planta de Processamento

- O custo de uma planta de processamento de ouro é maior que o custo de lavra (60% processo & 40% lavra)
- Uma planta completa processando 50 tpd (toneladas por dia) com gravimetria + flotação + cianetação + tratamento de rejeitos + escritórios + laboratórios + provedores de energia e água + construção, etc., custa entre US\$ 30000 e 40000 por tonelada processada por dia ou 1,5 a 2 milhões de dólares

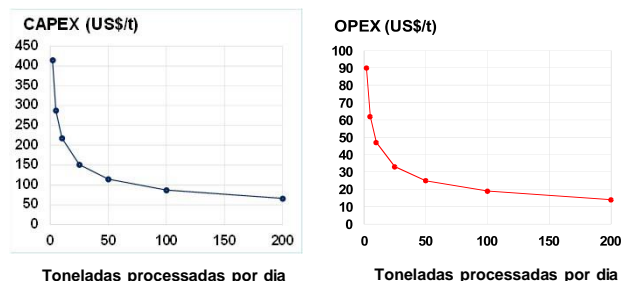
Custo de Uma Planta de Processo

Processando diariamente (tpd)	CAPEX, US\$	OPEX, US\$/a	CAPEX (US\$/tpa)	OPEX (US\$/tpa)
200	3,946,266	855,091	66	14
100	2,603,565	564,150	87	19
50	1,717,712	372,200	115	25
25	1,133,267	245,560	151	33
10	653,986	141,708	218	47
5	431,470	93,492	288	62
2	248,993	53,953	415	90

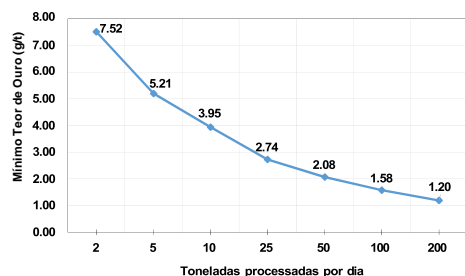
tpd = toneladas por dia, tpa = toneladas por ano, 300 dias trabalhados por ano

CAPEX 50 tpd = \$ 34000/ tonelada processada por dia
CAPEX 10 tpd = \$ 65400/ tonelada processada por dia

Custo de Uma Planta de Processo



Teor Mínimo de Ouro para Dar Retorno \$



Planta (10 tpd):

- Britador
- Moinho de bolas
- Hidrociclone
- Peneiras
- Centrífuga
- Flotação
- Cianetação
- Eletrólise
- Refino
- Barragem de rejeitos



Equador

Planta Piloto (exemplo do Equador), 10 tpd



Equador

Boas Plantas no Equador



Boas Plantas no Equador



Abordagem da Coexistência

Resultados

- É o único processo de formalização, despoluição e desburocratização de mineiros artesanais que está funcionando no mundo... e crescendo
- É o único processo que traz mais dinheiro ao mineiro artesanal sem que ele precise investir
- É o único processo que elimina a exposição do mineiro e comunidades ao mercúrio e cianeto
- É o único processo que permite a introdução de lixivantes alternativos para o ouro
- É o único processo que garante venda legítima do ouro

Etapas para Implementar um Sistema de Coexistência de Mineiros Artesanais com uma Companhia de Mineração



O Que É Preciso para Começar um Sistema de Coexistência

- **Avaliar:** Fazer um balanço de ouro nos processos existentes e mostrar aos mineiros quanto ouro eles estão atualmente recuperando e perdendo. Para isso, saber **teores e volumes** de minérios e rejeitos para uma planta mínima de 50 tpd. Fazer testes de processamento para saber se o minério é refratário
- **Educar:** Cursos, palestras e questionários para os mineiros para que eles entendam bem os custos de processo, quanto eles hoje recuperam do ouro, quais são as limitações que eles têm em termos de conhecimento e dinheiro e as vantagens da coexistência

O Que É Preciso para Começar um Sistema de Coexistência

- **Organizar:** Conhecer quem na Coop estaria interessado através de consultas. Verificar juridicamente como a coexistência poderia ser feita com a Coop e qual a proposta de interesse de ambos os lados: Coop e companhia. Estabelecer plano de negócio. Obter OK das partes e dos cooperados.
- **Formalizar:** Formalizar o processo de coexistencia garantindo minimo de 50 tpd de minerio ou rejeito com avaliação previa de teores e de tipo de minério

O Que É Preciso para Começar um Sistema de Coexistência

- **Divulgar:** Conhecer como irá funcionar o processo e divulgar com detalhes aos cooperados. Mostrar todos os pontos de decisão, como os teores de ouro serão calculados, assistência técnica que a companhia pode dar aos cooperados, preços , tempo de pagamento aos mineiros, transparência, venda de ouro, investimentos que serão feitos

Projeto ASGM - Sustentabilidade em Peixoto

Síntese dos Resultados

Giorgio de Tomi e Carlos Henrique Xavier Araújo

11 de maio de 2021

Apoio e organização:



Objetivos do projeto

- Entender os desafios socioambientais da COOGAVEPE:
 - Comércio do ouro produzido pelos cooperados
 - Igualdade de gênero nas atividades da cooperativa
 - Redução e eliminação do uso de mercúrio
- Propor um modelo de operação que permita enfrentar esses desafios
- Comunicar e compartilhar essa visão com cooperados e comunidade, incorporando percepções e expectativas de todos



Abordagem utilizada

- As entrevistas foram feitas via **telefone** e via **formulário online com perguntas de múltipla escolha** disponibilizado para os cooperados pelo WhatsApp.
- Cerca de **300 pessoas** tiveram acesso ao questionário.
- Todos** os participantes deram o **consentimento** para participar **espontaneamente** do levantamento.
- Devido às medidas preventivas relacionadas à **pandemia da Covid-19**, não foram realizados trabalho de campo presenciais.
- Para a discussão dos temas e disseminação dos resultados, foram organizados **três webinários** e uma seção de **treinamento técnico** para os garimpeiros e a comunidade local.

Coleta de dados

- A região de estudo foi o município de **Peixoto de Azevedo** (estado do Mato Grosso)
- Período de coleta dos dados: **Abril de 2021**
- Total de entrevistados: **58 pessoas**
- Foco do estudo: **Cooperados da COOGAVEPE**



Figura 1: Localização

Síntese dos Principais Resultados



Dados sociodemográficos dos entrevistados

86% são homens e **14%** são mulheres. A maioria dos entrevistados tem cargo de relevância nas atividades do garimpo, sendo **45%** gestores, **21%** donos de máquinas e **17%** donos de máquinas.

64% dos participantes responderam que não trocariam o garimpo por outro tipo de atividade.

Família e moradia



Em média, cada entrevistado **sustenta pelo menos 3 dependentes**. **66%** responderam que moram em casa própria e passam alguns dias no alojamento do garimpo. **Operadores de máquina e ajudantes em geral** foram os que responderam que moram somente no alojamento do garimpo.

Regime de trabalho



A participação nos lucros via acordo verbal ainda é a principal forma de remuneração (**40%**).

Por outro lado, **19%** responderam que trabalham com contrato reconhecido em cartório. **38%** responderam que trabalham por conta própria no garimpo.

Síntese dos Principais Resultados

Função da Cooperativa na visão dos entrevistados



As respostas mais citadas foram: **1º) Regularizar a atividade de garimpo;** **2º) Prestar assistência técnica;** **3º) Comercializar o ouro.** As menos citadas foram: para facilitar o **acesso ao crédito** em instituições financeiras e para ajudar na **compra de equipamentos**.

Métodos de lavra e beneficiamento



O método de lavra predominante é em frentes de lavra denominadas **"baixão" (57% das respostas)**. **36%** dos participantes responderam que trabalham com draga (em curso d'água).

Comercialização



Outro dado relevante do estudo é que as compras de ouro desempenham um papel fundamental na organização da econômica em Peixoto de Azevedo. A maioria dos entrevistados responderam que vendem o ouro produzido para alguma compra representante de DTVM (**98% das respostas**).

Síntese dos Principais Resultados



Igualdade de oportunidades para mulheres

Os entrevistados indicaram que as mulheres pode contribuir no garimpo como **assistente administrativo**, com 79% das respostas, seguido da **administração (logística, compra de materiais)** com 69%, e em terceiro um empate entre a **operação de máquinas** e **postos de comercialização** do ouro, ambos com 52%.

Coexistência em Peixoto de Azevedo



45% dos entrevistados que se ter mais anuência para os garimpeiros trabalharem seria melhor. Sobre a possibilidade de uma mineradora comprar o minério produzido, houve uma variação media entre os que tem interesse em saber mais e dos que ainda não tem uma opinião formada.



Métodos limpo e sustentável para recuperação do minério de ouro

62% responderam que estão abertos e interessados em experimentar um método limpo e sustentável para recuperação do ouro. **36%** gostariam de saber mais sobre o assunto.

Quais as principais lições?



- A Cooperativa deve oferecer mais serviços, para não ser identificada apenas como um meio de legalização da atividade. A legalização é uma meta importante, mas a Cooperativa pode também, por exemplo, promover a compra coletiva de insumos e a transformação mineral, que pode ser potencializada pela coexistência.
- Foi constatado o predomínio de relações informais de trabalho;
- É necessário aprimorar os métodos de recuperação de ouro sem a utilização do mercúrio, investindo em formação e novas tecnologias;
- Os garimpeiros estão abertos a novos métodos, tecnologias e conhecimentos.
- Os garimpeiros querem e desejam permanecer na atividade, pois se identificam com o garimpo.
- Há espaço e abertura para mais mulheres nos garimpos. Porém, são necessárias iniciativas de sensibilização e treinamento.

Projeto ASGM - Sustentabilidade em Peixoto



COGAVEPE no Século XXI

- Mineração responsável**
- Atuação sustentável**
- Alinhada com a Agenda 2030**

Financiamento:



Implementação:

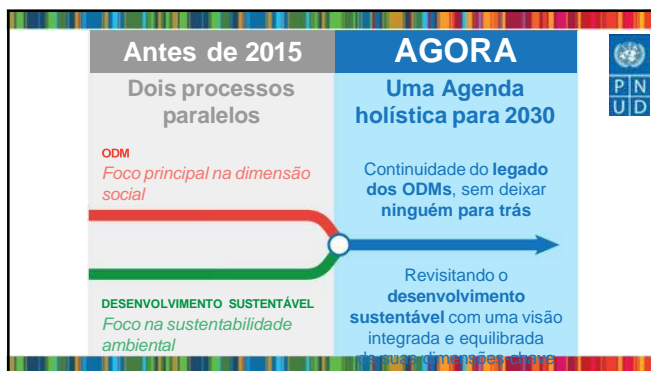


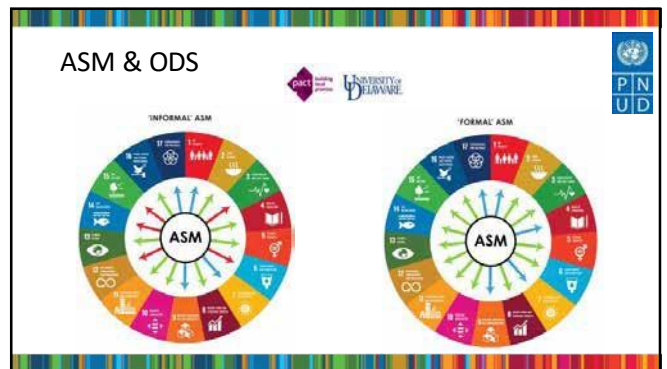
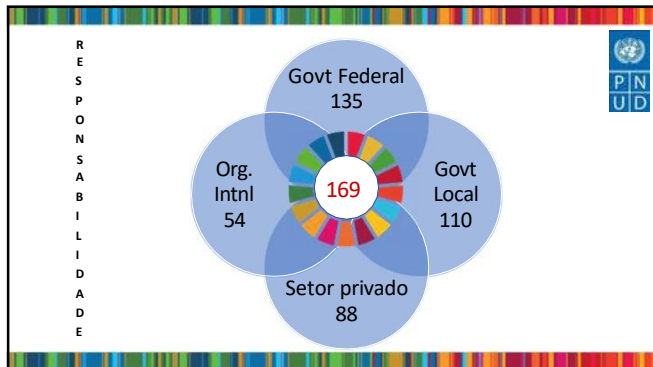
Apoio e organização:



Agenda 2030 e Objetivos de Desenvolvimento Sustentável

Ieva Lazareviciute
Assessora de Desenvolvimento Territorial
PNUD Brasil





Mais info ?

- Site do PNUD e Plataforma Agenda 2030 (<http://www.agenda2030.org.br/>)
- Site do IBGE (<https://odsbrazil.gov.br/>)
- Atlas de Desenvolvimento Humano (<http://www.atlasbrasil.org.br/#home>)
- International Futures (http://www.ifc.edu/ifs/frm_MainMenu.aspx)
- Atlas Mineração e ODS (<https://www.br.undp.org/content/brasil/pt/home/library/br-mapasando-os-objetivos-de-desenvolvimento-sustentavel.html>)
- RMF (https://www.responsibleminingfoundation.org/app/upload/CLSI_Mining_and_SOGs_P1_Sept2020.pdf)
- OCB – Cursos (<https://www.capacita.coop.br/sescoop/subscribe/login>):
 - Introdução à Agenda 2030
 - Cooperativismo e Agenda Mundial de Desenvolvimento Sustentável

capacitacoop

PNUD



APPENDIX F: Summary overview of the training session

ASGM Project - Sustainability in Peixoto

Short course: Practical application of the co-existence model in ASGM.

Lecturers Prof. Marcello Veiga and Prof. Giorgio de Tomi

Date 05/05/2021

Participants: 13 participants, 2 women and 11 men.

Summary

The ASGM Project short course - Sustainability in Peixoto took place on May 5, 2021, at 6:00 pm - 8:00 pm Brasília time. The event was attended by 13 people, including 3 members of the cooperative's management (president, geologist, and mining engineer), 4 artisanal mine owners, 4 ASGM project team members. Also participating were the president of the Artisanal Miners Cooperative of Moraes Almeida and Transgarimpeira (COOPERTRANS) from Pará state and the mining engineer representing the Mining Cooperative of Lourenço's Artisanal Miners (COOGAL) of Amapá state.

In the beginning, Prof. Tomi thanked the participants for their availability in accepting the invitation to participate in this event that was planned together with the COOGAVEPE team. He recalled the motivations for the event realization. The first idea of the short-course was to present the concept of what "Coexistence in Peixoto de Azevedo" would be. However, during the interaction of the project team with the president of COOGAVEPE and the geologist responsible, it was commented that they are organizing financially to implement a mini test plant to recover alluvial gold without adding mercury. According to the geologist, the greatest difficulty would be to identify which equipment can have greater efficiency which the cooperative will be able to show and prove to cooperative members.

After meetings, it was decided by a common agreement that the focus of the minicourse would be to present which practical aspects for a coexistence model in Peixoto de Azevedo.

Emílio Miguel, COOGAVEPE's geologist said that they chose to invite fewer people. He said that it is difficult for artisanal miners to participate effectively in this type of event. The justification was that between April/May begins the dry season and the beginning of alluvial work,

and it is difficult for the artisanal miners to program themselves because of the unforeseen events, and also because they cannot adapt to using the internet.



Prof. Marcello began his presentation by addressing solutions that have already been tried to improve artisanal mining around the world and the results of these approaches. Then he went into the concept of the coexistence approach with examples in Peru, Nicaragua, Colombia and Costa Rica.

After this first part of the presentation, the participants commented that the artisanal miner or entrepreneur knows that there are techniques and equipment that improve gold recovery and the non-use of mercury, but they don't waste time and money doing something that they don't see in practice. President Solange Barbosa, commented that this is common in the Peixoto de Azevedo region, they always copy something from someone who is doing something different and showing results. Geologist Emilio commented that two examples of this that came out of Peixoto are the mechanized auger drilling with a recovery of the sampled material adapted on a tractor for drilling alluvial soil up to 20m deep and the 8" dredge, which is equivalent to two 6" dredges. These two examples above were fundamental for the development of more areas for mining.

Then, Prof. Marcello started the second part of the minicourse showing examples of reclamation plans, what are the associated costs, and the steps to implement a system of coexistence of artisanal miners with a mining company. Ms. Solange asked if these partnerships, between mining companies and artisanal miners and/or cooperates and/or cooperatives, are to benefit the raw material or the mining waste. Prof. Veiga finished by commenting that coexistence usually starts with tailings reprocessing. This is the easiest way to convince artisanal miners that they have low gold recovery and that they should sell the raw ore to earn more.

In the Q&A, Prof. Tomi commented on the need to do a metallurgical balance of COOGAVEPE's mining fronts. Prof. Marcello Veiga complemented that this is to verify how much gold is recovered and how much is lost. With this information it is possible to move forward. It was discussed the next steps that the ASGM project would have and what COOGAVEPE could do. At this first moment, it was agreed that the cooperative will organize itself to implement a laboratory for characterization and chemical analysis. Mrs. Solange Barbosa, president of the cooperative stressed that there is already a purchased area with enough space for the construction of the laboratory and the small processing plant.

APPENDIX G: Conceptual co-existence model for Peixoto









Project ASGM Sustainability in Peixoto

Visão Geral do Conceito de Coexistência

Giorgio de Tomi
05 de maio de 2021

Apoio e organização:



Conteúdo



- Porque um modelo de coexistência?
- Abordagem proposta
- Exemplo de Modelo de Coexistência
- Próximos passos para a COOGAVEPE

Porque um modelo de coexistência?

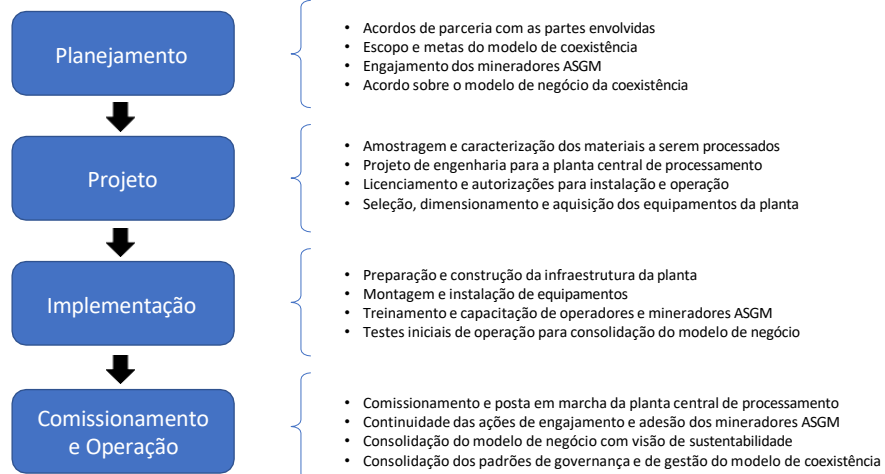


- O conceito de **coexistência** é um modelo de negócio entre **entidades ASGM** e uma ou mais empresas de **mineração convencional**.
- Há diversas modalidades de coexistência para o setor de ASGM. No entanto, o foco em geral é geral **o aumento da recuperação de ouro** utilizando tecnologias limpas, o aprimoramento do **gerenciamento de rejeitos** e o controle de **impactos ambientais** da operação em conjunto.
- As metas de um modelo de coexistência normalmente incluem: (a) reduzir a contaminação por **mercúrio**; (b) reduzir os impactos ambientais da operação e (c) fortalecer os benefícios para as comunidades por meio da **formalização**.
- Um modelo de coexistência adequado pode promover **boas práticas, tecnologias limpas, gestão ambiental, treinamento e suporte técnico**.
- **Diferente arranjos de coexistência** estão sendo utilizados com **sucesso** pelo setor de ASGM em diversos países, incluindo Colômbia, Nicarágua, Filipinas e Mali, entre outros, conforme relatado por **Veiga e Fadina (2020)***.

(*) Fonte:

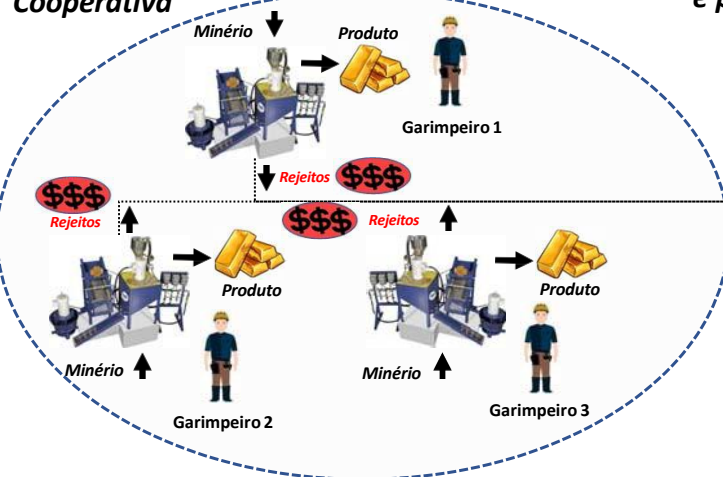
M. M. Veiga & O. Fadina (2020). A review of the failed attempts to curb mercury use at artisanal gold mines and a proposed solution. *The Extractive Industries and Society* 7 (2020) 1135–1146
<https://www.sciencedirect.com/science/article/abs/pii/S2214790X20302033>

Abordagem proposta

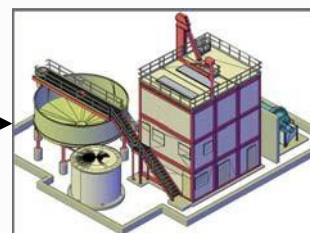


Exemplo de modelo de coexistência

Cooperativa



Empresa de Mineração e parceiros



Usina Central de Processamento

Obrigado

Giorgio de Tomi
05 de maio de 2021