National Action Plan

for the Reduction and/or Elimination of Mercury Use inArtisanal and Small-Scale Gold Mining in Mozambique

In accordance with the Minamata Convention on Mercury

October, 2021

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ACRONYMS

AIDS - Acquired Immunodeficiency Syndrome

AMV – African Mining Vision

AOMANE – Association of Artisanal Mining Operators of Naculene

ASG - Artisanal Gold (handmade Gold)

ASM/ASM – Artisanal and Small-Scale Mining

ASMO/ASGM – Artisanal and Small-Scale Gold Mining

Au – Gold

CDS-RN – Sustainable Development Centre for Natural Resources

CEMAM – Census of Artisanal Miners of Mozambique

COCASM – Coordination Committee for Artisanal and Small-Scale Mining

CTV – Terra Viva Centre

DIPREME - Provincial Directorate of Mineral Resources and Energy

DNGM - National Directorate of Geology and Mines

DNM - National Directorate of Mines

DNRN - National Directorate of Registries and Notaries

EMEM – Mozambican Mining Exploration Company

FFM - Mining Development Fund

GEF - Global Environment Facility

GEUS –Denmark's and Greenland's Geological Survey

Hg - Mercury

HIV – Human Immunodeficiency Virus

IGREME – General Inspection of Mining Resources and Energy

IISD - International Institute for Sustainable Development

INAMI – National Institute of Mines

MEF- Ministry of Economy and Finance

MGCAS – Ministry of Gender, Child, and Social Action

MIC - Ministry of Industry and Commerce

MICOA - Ministry of Environmental Coordination

MINEDH – Ministry of Education and Human Development

MINT - Ministry of the Interior

MIREME – Ministry of Mineral Resources and Energy

MISAU – Ministry of Health

MITESS – Ministry of Labour, Employment, and Social Security

MOPHRH – Ministry of Public Works, Housing and Water Resources

Mt - Metical

MT/g - Metical per gram

MTA - Ministry of Land and Environment

MTADER – Ministry of Land, Environment and Rural Development

MTC - Ministry of Transport and Communication

NAP - National Action Plan

NGO – Non-Governmental Organization

OMR - Observatory of the Rural Environment

PMS - Social Mobilisation Plan

PRM- Police of the Republic of Mozambique

SADC – Southern African Development Community

SDAE – District Services for Economic Activities

SIM - Subscriber Identification Module

SOP - Standard Operating Procedures

SPI – Provincial Infrastructure Service

STD - Sexually Transmitted Disease

UGPK – Kimberly Process Management Unit

UN – United Nations

UNIDO – United Nations Industrial Development Organization

WHO – World Health Organization

Executive Summary

Artisanal and small-scale mining (ASM) is a reality throughout the country, and for many Mozambicans living in rural areas, it constitutes an alternative source of income to agriculture. The closure of several mining sitesduring the second half of the 1980s increased substantially the practice of this activity throughout the national territory. If before the 1990s, it was limited to the production of minerals of higher commercial value such as gold and gemstones, today artisanal and small-scale miningcovers a wide range of minerals and rocks, becoming one of the main income-generating activities in rural communities.

The improvement of the social and environmental performance of artisanal and small-scale mining requires government recognition.In 1999,the government organized a national dialogue aimed at strengtheningthis important sector of the economy, studying legal and technical assistance mechanisms for its formalization and growth. The Mining Law 20/2014 introduced for the first time the mining pass for artisanal operators in designated areas.

Decree 31/2015, Regulation of the Mining Law in its Chapter III, Article 98, defines the extensions of the ASM operation areas.

Often ASM activities, especially those related togold mining, result in soil degradation, pollution, and contamination of river waters as well asa reduction in the quality of life of the minersand the surrounding communities due to the use of toxic substances during processing such as mercury.

Mozambique signed the Minamata Convention in 2013, and in June 2017, with financial support from the Global Environment Facility (GEF) through the United Nations Industrial Development Organization (UNIDO), launched the Project for the elaboration of the National Action Plan (NAP) for the Reduction and/or Elimination of MercuryUsein Artisanal and Small-scaleGold Mining (ASGM). The Project aims to address, among many aspects, environmental andpublic health strategies on mercury useofartisanal miners involved in ASGM and theircommunities.

During the NAP project in Mozambique, two active ASM sites were assessed: in Niassa province, Lago district, Cóbue administrative post, Mpapa mine; and in Manica province, Manica district, Machipanda administrative post, Munhena mine. These sites were selected according to the national ASM baseline assessment studies in the country under the auspices of MIREME.

The target group are mercury traders and suppliers, local administrative structure, artisanal miners of primary gold in areas with artisanal and small-scale mining activity.

Strategies for the implementation of the NAP – local multi-sectoral working groups will be established consisting of Provincial Infrastructure Services, local administration, local community leaders and natural resource protection police and body representatives of artisanal miners

Monitoring of activities will be carried out in two levels: (i) Provincial bodies will monitor the development of activities through a routine visit to assess activities and these will be reported to the central bodies. (ii) The central level bodies (MIREME, MISAU, MTA) will carry out regular visits to monitor and evaluate the development of the activity reported by provincial level.

I. Introduction and Background

Artisanal and Small-Scale Mining (ASM) is an integral part of the economy in many developing countries. It is estimated that around40.5million people are directly involved, and another 150 million are dependent on ASM activities globally[1].

The above scenario suggests the significant contribution of ASM to global mineral production. However, ASM in the Southern African region is mainly distinguished as an intensive activity of an informal, illegal, seasonal, migratory,and labour-intensive nature.

Mozambique is signatory to the African Vision for the Mining Sector (AMV) and is in the process of implementing it alongside other African Union Member States. The AMV recognizes the contribution of ASM to local economic development and highlights that responsible mining can only be effective with the development of policies at the local, national, and regional levels, providing benefits to workers, local communities and protecting the environment.

The Yaoundé Vision for ASM, another initiative adopted by African ASM Communities, highlights the need for a participatory development strategy in ASM, with afocus on formalizing the sector and its integration in local and regional plans and strategies for economic development, land use planning, as well as the incorporation of poverty reduction measures.

TheSouthern African Development Community (SADC) states are carefully reviewing their legal framework and specifically recognizing the role of ASM in rural development and poverty reduction. In this context, regional guidance tools for the sector have beendeveloped, with special reference to the “SADC Mining Protocol”,a regional legal instrument valid since February 2000.

The Protocol establishes the strengthening of regional cooperation in several relevant fields, including:

- Harmonization of national and regional policies, strategies, and programmes related to the development and exploitation of mineral resources;
- Facilitation of the development of human and technological capacities;

[1] *https://delvedatabase.org/*

- Encouragement of the private sector participation in the exploration of mineral resources;
- Improvement of availability of public information for the private sector;
- Promotion of Artisanal and Small-Scale Mining (ASM);
- Development and promotion of internationally acceptable health, safety,and environmental protection standards for mining; and
- Promotion of financial mechanisms through microfinancing and conventional banking systems to support the mining sector.

In Mozambique, the artisanal and small-scale gold mining (ASGM) activity enjoyeda great boost during the second half of the 1980s, with the closure of large-scale mining production sites.Someformer workers of the Marropino, Morrua, Muiane in Zambézia Province and gold mines in the Manica Province stimulated by illegal buyers mainly concentrated in the cities of Nampula and Manica, started the informal production of semi-precious stones and gold, as a way to meet basic needs.

This informal activity spread to several areas in Manica, Zambézia and Niassa provincescovering other mineral resources such as tantalite, coal, construction materials (sand, gravel and stone), and with new actors in the production and commercialization that includes local farmers and migrant workers. During the last decade,it is estimated that approximately 100,000 people are directly involved in the artisanal mining sector and around 1,200,000 are dependent.

In the 2000s, several actions targeted towards legalizing and assisting themining sector were taken including:

a) Introduction of the Mining Pass(*Senha Mineira*) in areas designated in the Mining Law of 2002 for the practice of miningactivities;
b) Survey of the situation of the sector in the country;
c) Dissemination of basic artisanal and small-scale mining techniques;
d) Training and institutional support to ASM;
e) Improvement of the forms of organization of ASM practitioners into associations and cooperatives.

<u>Overview of the preparation process</u>

The development of the NAP was participatory and involved several stages, including governance and coordination meetings, fieldwork and consultations.

The **Ministry of Mineral Resources and Energy** (MIREME)as the administrative authority responsible for activities related to ASM in Mozambique was the leading national executing entity for the NAP.

The **Ministry of Land, Environment and Rural Development** (MITADER) as the administrative authority for environmental protection was responsible for the NAP activities covering the establishment of a project coordination mechanism and the dissemination of information among key stakeholders.

The **World Health Organization** (WHO) worked in close coordination and collaboration with the **Ministry of Health** (MISAU) in the health-related activities including an institutional capacity assessment of the health sector and a rapid assessment of the health situation of miners and members of their communities.

Project activities took place on October 20, 2017, in the city of Chimoio, Manica Province., whose opening ceremony was led by His Excellency, Provincial Governor Alberto Mondlane, and on September 18, 2018, in Niassa Province, in the city of Lichinga, was directed by His Excellency Rodrigues Artur Ussene, Permanent Secretary of the Province of Niassa, representing the Governor of the Province (figure 14). Both spoke about the widespread deficient practices in ASGM, the Government's efforts to solve the relative relavent problems, the social and economic relevance of ASM as an important livelihood and employment opportunity and finally, they encouragedthe legislators endorsed the project continuation of the Project. Also present, on the part ofrepresenting INAMI were the National Project Coordinator (Geraldo Valoi), some members of the national technical team, as well as Local Administrative Authorities and part of the Small-Scale Owners from Manica Province.

Following the opening ceremony, seminars were held covering the following topics: (i) aAn overview of ASGM and perspectives on the sector; (ii) Minamata Convention, its background and relevance to Mozambique; and (iii) NAP project - objectives and perspectives.



Figure 14: NAP Launch Seminar in Manica Province (A and B) and Niassa (C and D) (INAMI 2017).

Contact with provincial and local authorities

To integrate the project at district and local levels, the team met with administrators from the districts of Manica, Gondola, and Sussundenga;, Province of Manica, and Lago, and Province of Niassa provinces respectively., Meeting with the respective directors of the District Services for Economics Activities (SDAE), and community leaders in the areas covered by the field survey.

The objectives, targets and strategies of the NAP were developed with stakeholders through:

- Interviews and consultative meetings; and
- National and regional workshops.

II. National Overview

II. 1. Geographical distribution of ASGM

In recent years, Mozambique has seen an increase in the exploitation of mineral resources, especially in the area of artisanal and small-scale gold mining, which has hada direct impact on social, economic and environmental development in the areas where it is taking place.

A considerable part of the Mozambican population lives in precarious conditions, with agriculture being the main source of subsistence. The lackof rainfall, the poor practices used, and the impacts of climate change,have resultedin reduced production and the loss oflivelihoods. High levels of poverty in rural areas, unemployment, lack of opportunities for further educationcombined with the perceived quick gains from mineralextraction, are some of the driving forcesfor the proliferation of artisanal mining in the country. The rural population benefits not only from direct employment, but also from other localopportunities whichASGM generates.

Acartographic survey was conducted in August 2020 as part of the Census of Artisanal Miners in Mozambique (CEMAM). Its main objective was to provide statistical data and spatial location of artisanal mining and it preliminarily identified a total of 1,044 artisanal mining sites throughout the country, out of which 239 are related to gold mining(101 primary mining and 138 alluvial mining) located in the Provinces of Sofala, Manica, Tete, Zambézia, Nampula, Cabo Delgado, and Niassa (figures 1 and 2).

The data from the cartographic survey places Tete Province at the top of ASGMactivities with 116 mining sites, followed by Cabo Delgado with 43 mining sites, leaving behind the provinces with longer gold mining tradition:Manica and Niassa, with 21 and 15 sites, respectively (figure 3).This data will be further updatedduring the Artisanal Miners Census survey to be carried outbetween July and November 2021by MIREME and the National Institute of Mines (INAMI) in collaboration with the National Institute of Statistics (INE).

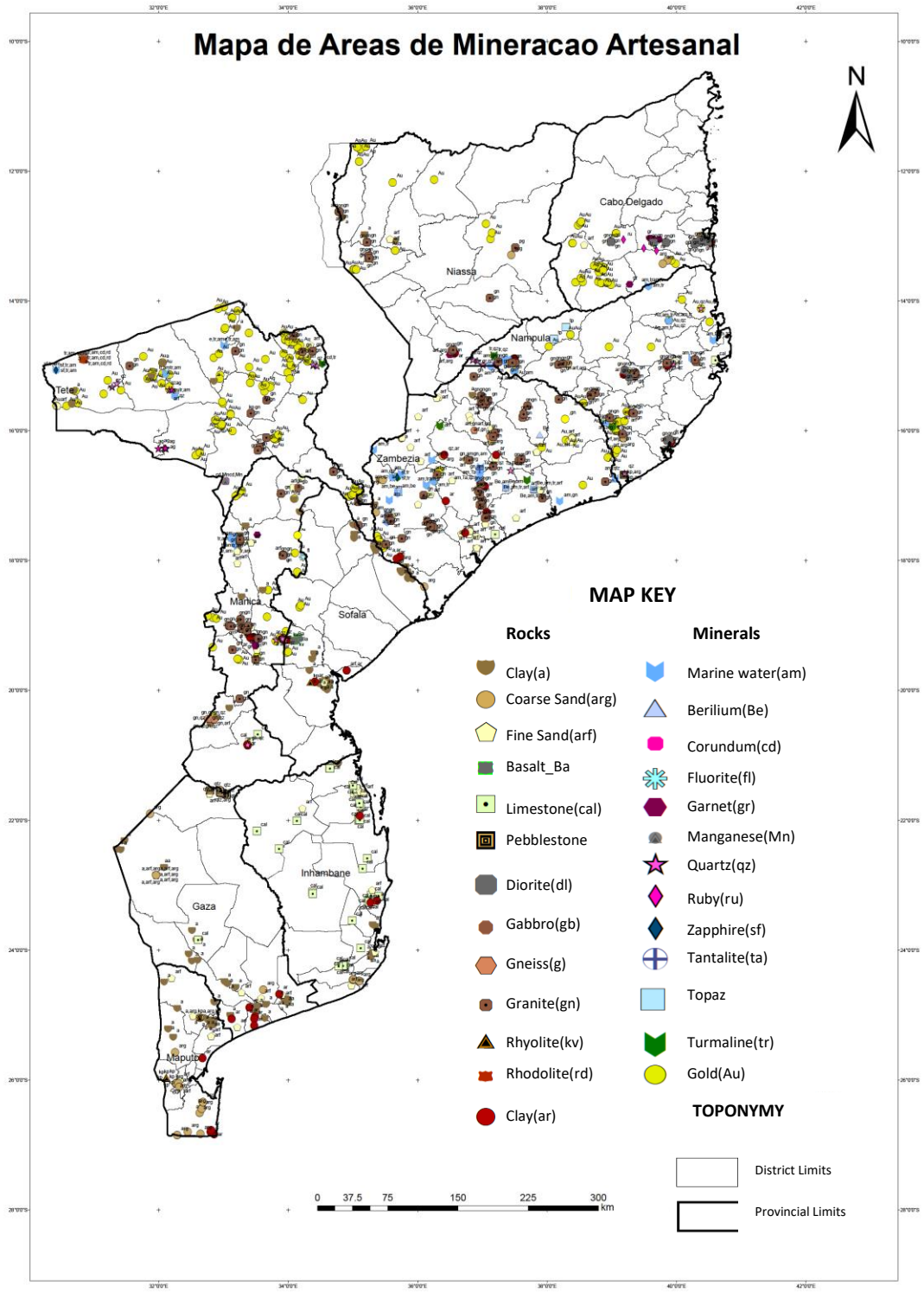

Figure 1: Places of Occurrence of Artisanal Mining in Mozambique (INAMI 2020).

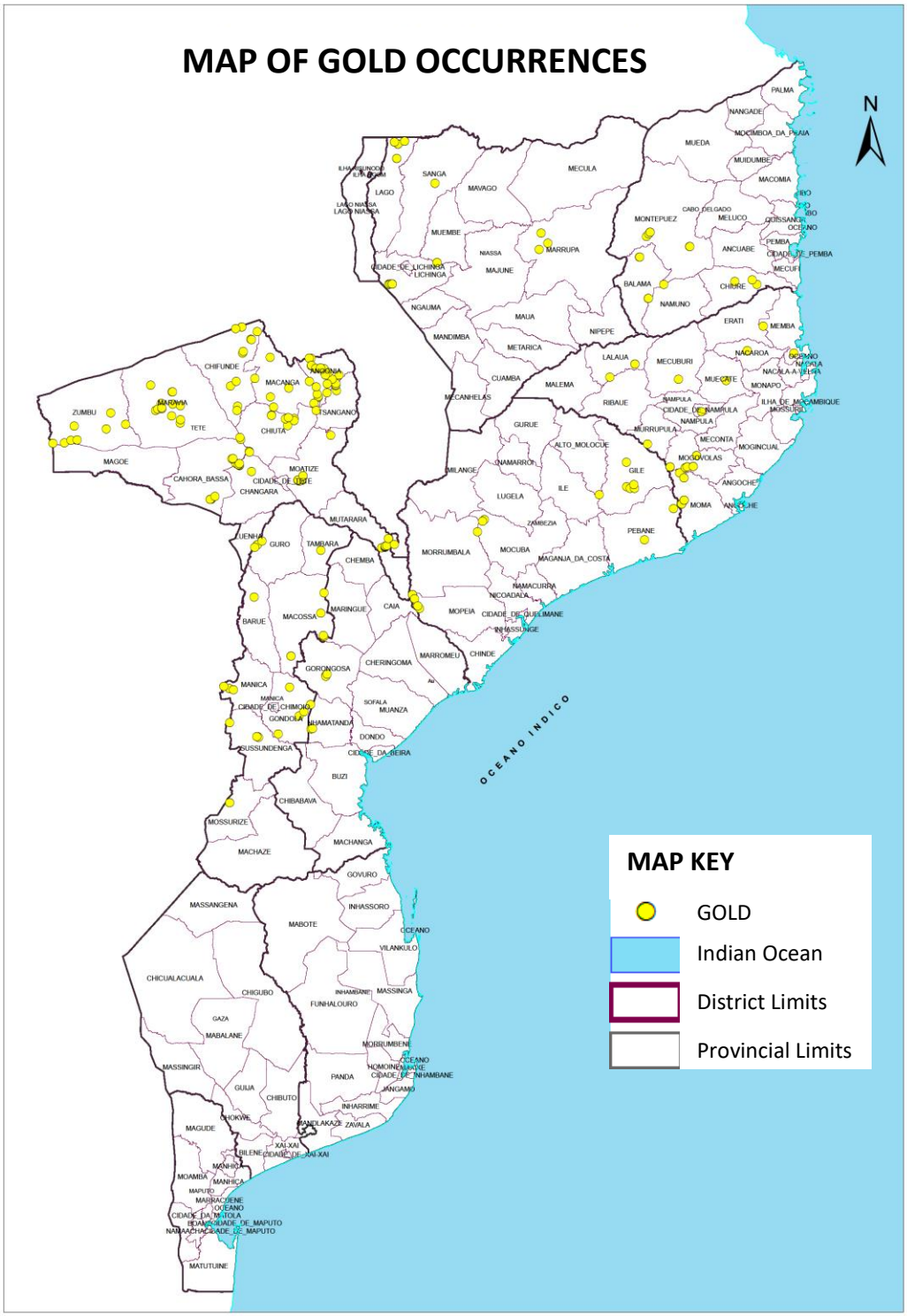

Figure 2: Places of Occurrence of Gold in Artisanal Mining in Mozambique (INAMI 2020)

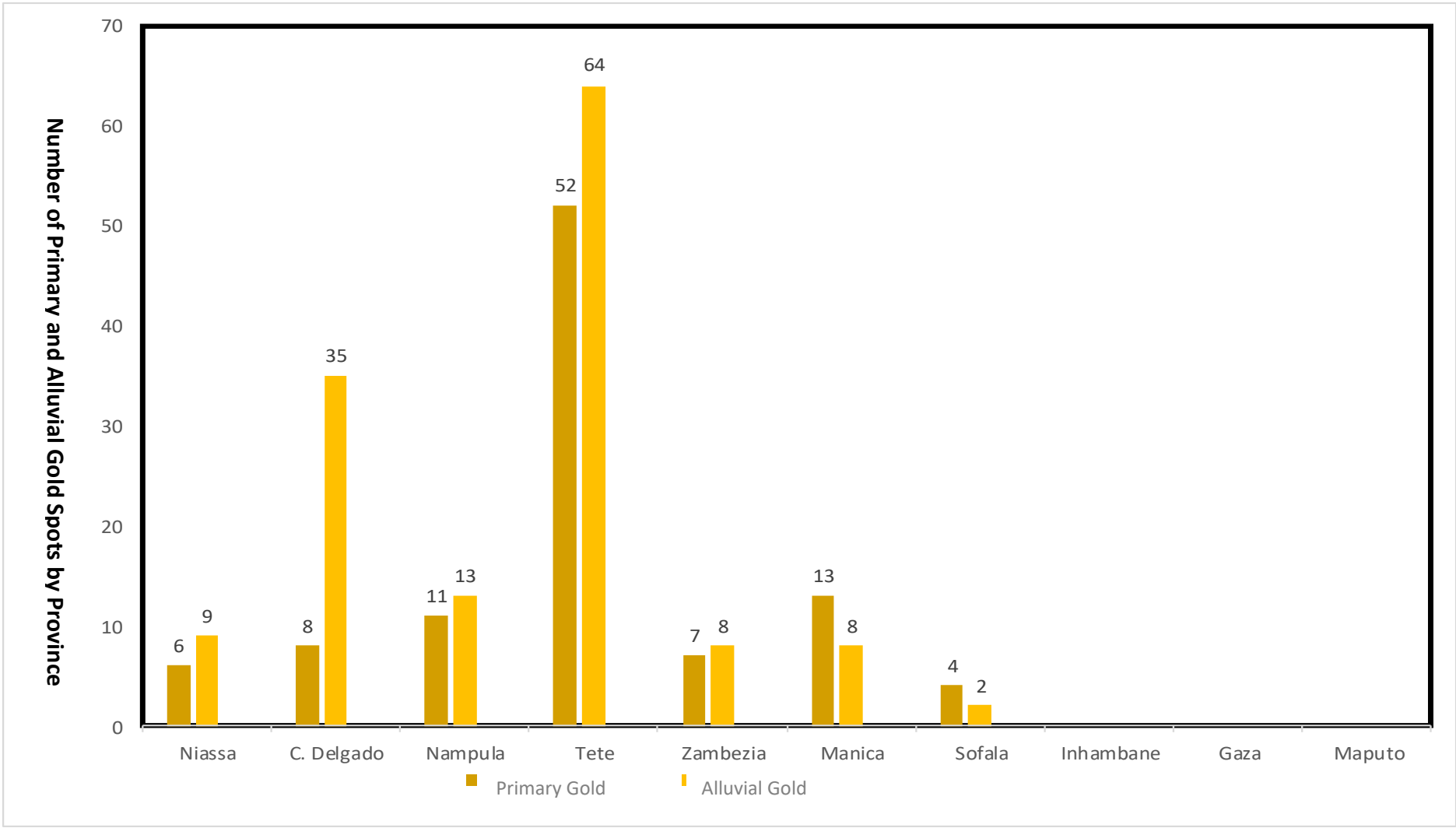

Figure 3: Primary and alluvial Gold Spots at provincial level (INAMI, 2020).

III. 2. Legal and Regulatory Framework

In recognition of the role of ASM in the process of combating poverty, the Government of Mozambique enacted a legal framework that aims to regulate the activities of the mining sector, providing protection for the rights and definition of the obligations of stakeholders in the sustainable use of mineral resources while safeguarding national economic benefits. In effect, the above-mentioned and hereinafter specified legal instruments on ASM are anchored in the provisions of Article 106 of the Constitution, in which the Government of Mozambique recognizesthe contribution of small-scale production to the country'seconomy and support its development:

- Law No. 20/2014, of 18 August, the Mining Law, establishes the general principles on the rights and obligations related to the use of mineral resources;
- Decree No. 31/2015, of 31 December, Regulation of the Law and Mines, defines the rules for prospecting and exploration of minerals, development, mining and processing of mineral resources, as well as geological mapping and development of geological, mining, metallurgical and scientific studies;
- Decree No. 20/2011, of 10 June, Regulation on the Marketing of Mineral Products, applicable to national natural and legal persons; and,
- Decree No. 26/2004, of 20 August, Environmental Regulation of Mining Activities.

The Mining Law (20/2014) establishes that in Mozambique, the mineral resources found in the soil and subsoil, inland waters, territorial sea bed, the exclusive economic zone, and on the continental shelf at the bottom of the sea and the subsoil of the territorial sea bed, are the property of the State. However, any individuals or collective persons, national or foreign, can explore mineral resources in accordance with the requirements established in the mining legislation.

The extraction of mineral resources in the country requires obtaining the respective mining permits, with INAMI being responsible for the issuance ofmining licensing and the guidelines for public and private sector participation in prospecting, exploration, treatment, export and import of mining products.

The Minister of Mineral Resources and Energy (MIREME), exercises the oversight and supervision of the mining concessions.

There are Provincial Infrastructure Services(SPIs)in each provincewhich represent MIREME at the

locallevel.

The Mining Law (20/2014) of August 18 defines seven (7)mining titles and three (3) specific Authorisations, as shown in tables 1 and 2.

Table 1: Mining titles and their validity

Mining Titles	Validity (Years)	Renewal (Years)
Prospecting and Exploration License	5	+ 3
Mining Concession	25	+ 25
Mining Certificate	10	+ 10
Mining Treatment License	25	+ 25
Mining Processing License	25	+ 25
Mining Products Marketing License	5	+ 5
Mining Pass	5	every 5

Table 2: Mining authorisations and respective validity

Authorisations	Validity (Years)
Authorization for the extraction of Mineral Resources for the construction of works of public interest	Variable
Authorization for Geological Surveys	
Authorization for Removal of fossils and archaeological Finds	

The same law also definesareas designated for the awarding of ''mining passes'' which are grantedto individuals or collective persons, constituted among national citizens with legal, technical, and financial capacity, thus allowing them to carry out artisanal mining operations for direct communal benefits.

Another ASMpermitis the ''mining certificate'' which is for individuals or cooperatives, made up of citizens with legal, technical, and financial capacity, allowing them to carry out small-scale mining operations.

The Constitution of the Republic, in its Article 106, justifies the existence of legal instruments that regulate artisanal and small-scale mining in our country, highlighting the following:

- Mining Law No. 20/2014 of August 18, establishes the general principles on the rights and obligations related to the use of mineral resources, including mineral water;
- Decree No. 31/2015 dated December 31, Mining Law and Regulations, establishes the rules for prospecting and exploration of minerals, development, mining and processing of mineral resources, as well as geological mapping and development of geological, metallurgical, and scientific studies;
- Decree No. 20/2011 of June 10, Regulation for the Marketing of Mineral Products, applicable to legal, national individuals or collective associations;
- Decree No. 26/2004 of August 20, Environmental Regulation for Mining Activities;
- Decree No. 25/2015 of November 20, which approves the Regulation on the marketing of diamonds, precious metals, and gemstones;
- Law No. 20/97 of October 1, which approves the Environmental Law and establishes the legal bases of the regime for the protection of the environment, prohibiting the production, deposits on soils and underground, of any toxic substances and contaminants outside the legally established parameters;

Resolution 18/96 of November 26, ratifying the Basel Convention, which classifies Mercury as one of the hazardous wastes.

III. 3. ASM Management Institutional Organization

The management of ASM is distributed in several sub-sectors of subordinate and titled areas within the same Ministry (MIREME)(Table 3):

Table 3: Sectoral Attributions of ASM Management in MIREME

Institution	Roles
National Directorate of Geology and Mines (DNGM)	- Promote, support, monitor and control the use of good techniques and good practices in artisanal and small-scale mining; - Register and propose the creation or extinction of designated mining pass areas; - Promote the formalization and accompaniment of traditional mining activities; - Coordinate with local authorities in order to guarantee their participation in the organization of artisanal mining, as well as reinforce the dissemination of mining legislation and best practices; and - Promote and conduct studies aimed at deepening the knowledge of the social and

	economic aspects linked to small-scale mining.
National Institute of Mines (INAMI)	- Propose policies development for the mining sector and monitor itsimplementation; - Analyze and approve projects includingtechnical and economic studies for the opening of new mines and the rehabilitation and/or closure of mines; - Receive, prepare, organize, and analyze the processes relating to the awarding of mining titles and authorizations, carrying out the acts assigned to it under the Regulations of the Mining Law; - Promote, support and control, in coordination with other institutions, the prospection, exploration and extraction, as well asthe use and exploitation of mineral resources, excluding oil and gas; and, - Promote, support and control small-scale mining, taking into account the minimization of negative impacts of an environmental and social nature resulting from the execution of this activity.
Inspector General of Mineral Resources and Energy (IGREME)	- Ensure control and inspection of compliance with legal, regulatory, and other standards applicable to geological mining operations, as well as technical standards of safety, hygiene, and environmental protection; - Inspect compliance with the mining, closure, safety plans, as well as other technical plans prepared for the execution of geological, mining, geotechnical, extraction and other operations; - Inspect the quality of materials and equipment used in geological and mining activities; - Supervise and inspect transport, storage and utilization systems and mining equipment, explosives, mineral products, as well as mineral processing and beneficiation facilities; - Control the qualities and quantities of mining products extracted to determine the taxes established by law in coordination with other institutions; - Draw up news reports for the purpose of applying sanctions for contravention of applicable legislation; - Investigate accidents, incidents and special events in mining operations; - Inspect the safety systems established in underground and open-pit mines and assess the occupational risks as well as the preventive measures established; and - Inspect the management systems of protective equipment, tests, their operating status, maintenance, storage, certification, and training of workers in safety issues.
Kimberly Process	Manage the technical and administrative procedures for tracking, security and internal

Management Unit (UGPK)	control of diamonds and the sale of precious metals and gems.
Provincial Infrastructure Services (SPI)	Ensure control, monitoring and promotion of bestpractices in artisanal mining at the provincial level.

a) Formalization

ASM takes place across the country involving thousands of Mozambicans. It is an important source of income for rural communities and contributes to local economic development. However, this sector has considerable datagaps lackingstatistical information on its contribution to the country's socio-economic development asit is an artisanal activity and most practitioners are informal, poorly supervised, and often environmentally and socially unsustainable.

Recognizing the importance of the ASM sector for socioeconomic development,MIREME approved in 2018 the Strategy for the Development of ASM, which intends tooperationalisethe :

i) Strengthen mining associations and cooperatives; and,

ii) Implementthe extension services programme.

Under its Five-Year Plan (PQG), the Government has developed activities of transformation of mining associations into cooperatives, resizing designated areas for Mining Passes, disseminated technology, and mining processing techniques along with the Census of Artisanal Miners. Additionally, within this scope, the licensing of certain areas of ASM through public tendering is foreseen, whereby the mining cooperatives will work in partnership with the Mining Concessions.

b) Licensing

Mining licensing in Mozambique follows the principle of **'first come, first served'.**Mining Law 20/2014 of August 18, defines as a direct benefit to the Communities, areas designated for Mining Passes, which are awarded to individuals or collective groups incorporated among nationals having legal, technical, and financial capacity allowing them to carry out artisanal mining operations. Another title benefiting ASM is the Mining Certificate, which is awarded to individuals or collective groups incorporated among nationals having legal, technical, and financial capacity allowing them to carry out small-scale mining operations.

In order to ensure the application of appropriate techniques and technologies for mineral extraction

and processing, the government's strategy for areas of highergeological mining potential is to license the ASM areas through a public tender, with the following expected advantages:

- Licensing of the area to a company with technical and financial capacity that will be able to undertake large-scale mining operations in compliance with mining legislation;
- Generation of revenue for the State, with the payment of taxes and fees due;
- Improved use of the mining product through the use of specialised equipment for this purpose;
- Reduction in smuggling of mineral resources;
- Reduction in the flow of informal work and child labour;and,
- Improved lifestyle within communities.

To avoid future conflicts between the licensed company and its associates or even ASM practitioners, their inclusion in the process must be guaranteed by agreements signed between the company and ASM practitioners.

c) CommercializationNetwork

The requirements for granting a CommercializationLicense are clearly defined in Decree no. 20/2011 dated June 1, 2011. ASM-related officers at the provincial level must have sufficient resources and skills to receive and process applications for Trading Licenses along with up-to-date information on mineral prices as well as value-added mechanisms.

A registration centre should be created for: (i) both formal and informal ASM practitioners; and (ii) licensed and unlicensed buyers and a platform for updating and disseminating mineral prices.

MIREME overall vision focuses on the development of legal, technical, socio-economic, and environmental responsible artisanal and small-scale mining. The Government recognises its role in the development of income creation and the assistance that rests on five pillars represented in the diagram below.

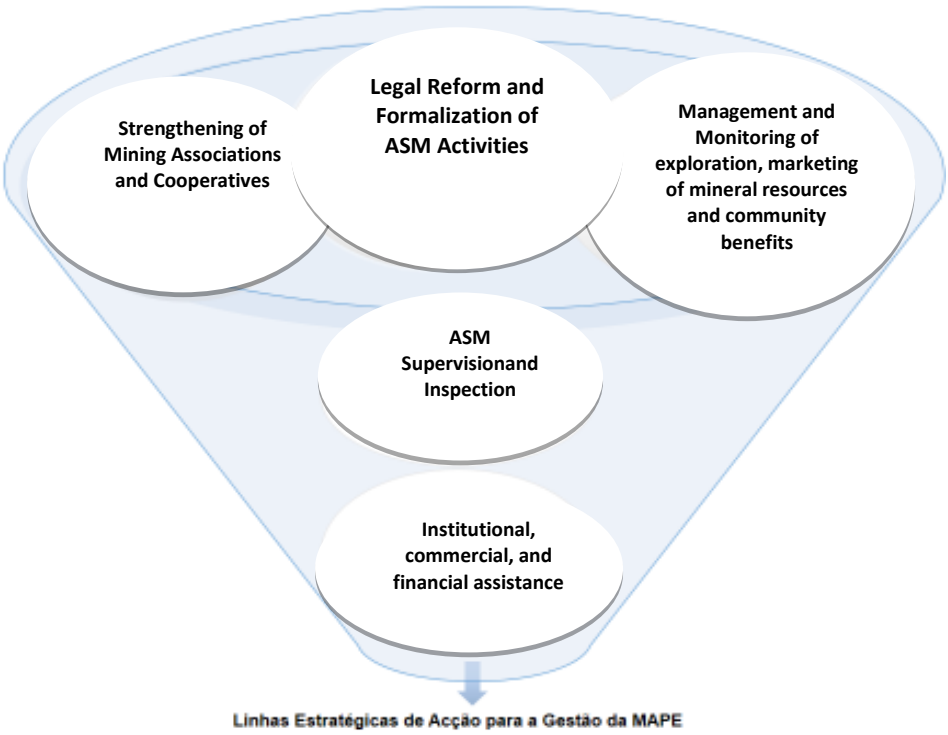

Figure 4: Strategic Action Lines Plans for ASM Management

III. 4. Previous experiences related to ASGM in Mozambique

a) CSA Group Lt / MEPC, Artisanal Mining Baseline Survey, 2003

Objectives

- Support and develop the ASM sector in Mozambique in the context of the existing legal framework;
- Create an enabling environment for the sustainable growth of artisanal miners and mining communities;
- Describe the organizational structures for the mining, processing, and trade of mineral products;
- Assess the economic, environmental and health impacts of ASM on the involvedcommunities; and
- Contribute to the reduction of poverty present in Mozambiquan communities.

Developed Plan of Action

- Promoteand formalize the artisanal and small-scale mining sector, as well as the respective

control and inspection, thus ensuring the production of revenue streams for the State communal budgets;

- Establish a multi-sectoral working group (COCMAPE and relevant NGOs) for a comprehensive and holistic approach ofartisanal and small-scale mining issues;
- Develop clear ASM policies and improve relevant procedures in coordination with SPIs; and
- Establish a recurring training programme with the participation of technicians from MIREME, SPI and COCMAPEin order to discuss issuesrelated to mining.

Recommendations

- Establishment of an Integrated National Programme for Artisanal and Small-scale Mining, including the design of a pilot project in Zambézia Province, aimed at strengthening the sector at national, provincial, and locallevels;
- Review of the current Mining Law and Regulations considering its practical application in the field;
- Development of a more comprehensive government policy on artisanal and small-scale mining by improving the existing regulations;
- Creation of a clear definition of the functions of the central departments and SPIsin the administration of the subsector of Artisanal and Small Scale Mining;
- Establishment of an extensive multi-sectoral working group in order to address ASM rural development issues; and
- Establishment of a comprehensive training programme comprising of MIREME Officials,including experts in artisanal mining, environment, health and safety.The training programme will provide guidance to the miners regarding safety, operational planning, and forms of collective organisation, integration of women, minimization of exposure to malaria, tuberculosis, and HIV/AIDS, as well as a collective and structured approach for financing of sources, capacity building and training opportunities.

Specific Technical Recommendations

- Training to increase gold recovery with equipment such as *batteries, screens and sluice boxes (gutters),* many of which can be manufactured locally thus generating more jobs;
- Provision of adequate equipment through the constitution of a union of producers of small equipment suitable forASM;
- Awareness raising on mining risks, and training in occupational health and safety (OHS), as well as skills enhancement workshops in the field of geological indicators and prospecting

techniques for artisanal miners to identify potential resources; and

- Continuous integration of new discoveries into the local database of provincial and district offices through the allocation of simple recording and evaluation tools.

Social and environmental recommendations

- Train the miners in appropriate miningtechniques, and raise awareness on the practices that reduce water pollution;
- Implement simple measures to prevent common diseases;
- Introduce an appropriate preventive approach by MIREME to avoid the entry and use of mercury in new discovered areas of gold in the Zambézia Province and other parts of the country;
- Train technicians in monitoring and evaluating impacts, preventing long-term degradation, and raising awareness among miners in the adoption of best practices; and
- Introduce simple environmental management tools to minimize their impact.

Specific economic recommendations

Achievingsignificant change within mining communities will require resources, which can be reached through a partnership with bilateral agencies, NGOs anddonors in the context of rural economic development.

- Provision of extension services to miners in a similar way ofagricultural extension services provided in other countries;
- No special production taxes should be leviedon artisanal miners at this stage;
- If taxation is to be introduced, it should be done at the selling stage of mineral products, as the loss of State revenue due to the smuggling of mining production out of Mozambique and the retention of profits outside the countryis not the miners' responsibility;
- Due to tax evasion, the Ministry of Finance and the Ministry of the Interior must be involved in coordination with the MIREME.

b) MIREME – Seminar on "Best Practices forASM in Mozambique", April 2012

Objectives

- Formulate a common approach to artisanal and small-scale mining;
- Exchange of experiences;
- Equip participants with anunderstanding of structuring and developing of artisanal and

small-scale mining activities; and

- Develop a manual of best practices in artisanal and small-scale mining.

Conclusions

- Lack of coordination among governmental institutions that deal with artisanal and small-scale mining, such as MIREME/SPIs, MICOA, and CDS-RN, and local community authorities;
- Improper use of mercury in gold processing;
- ASM results in environmental damage, such as degradation of extensive areas of lands, siltation of rivers, destruction of biodiversity, and others;
- Ineffectiveness of formally registered artisanal mining associations;
- Insufficient dissemination of applicable legislation in the artisanal mining subsector;
- Need for the expansion of the scope of INAMI's actions;
- Need to create a social contract model to facilitate the registration of associations of artisanal and small-scale miners;
- Need to share basic geological information with artisanal and small-scale mining operators;
- Continued inequality among male and female ASM operators in access to mineral resources; and
- Lack of enforcement and monitoring of activities in areas designated to registered artisanal and small-scale mining operators.

Recommendations

- Need to strengthen inter-sectoral coordination;
- Improvement of use of retorts for processing gold-containingmercury;
- Intensification and coordination of awareness-raising activities to mitigate the negative environmental impacts of ASM, as well as the adoption of best mining practices;
- Technical assistance and frequent guidance to artisanal and small-scale miners'associations to help them face the various challenges using local solutions;
- Promotion of the disclosure of mining legislation applicable mainly to the artisanal and small-scale subsector;
- Greater outreach of INAMI's actions through the use of human resources;
- Preparation of a social contract template to facilitate the registration of ASM associations;
- Provision of basic geological information in designated areas subject to a mining pass or any other areas to be allocated for formal and small-scale artisanal mining;
- Awareness raising among the most influential artisanal and small-scale miners for providing

equal opportunities for women in artisanal mining; and

- Regular monitoring and inspections of artisanal mining and small-scale activities.

c) GMSC - Geological Management Services and Consultancy - A Baseline Study of the ASM Sector in Mozambique, 2012[2]

Objectives

- Ensure poverty alleviation and well-being for artisanal and small-scale miners in rural communities;
- Advocate for the implementation of social development programmes aimed at improving living conditions and basic infrastructure around ASM (water, health services, basic nutrition, educationalinfrastructure, etc.);
- Promote the creation of community-based cooperatives;
- On-going formalization of ASM for rural development;
- Create mechanisms to discourage child labour in mining;
- Avoid and mitigateadverse environmental, social, and health impacts of ASM on mining communities; and
- Encourage the creation of markets and related facilities in artisanal and small-scale mining communities.

Developed Activities

- Inter-ministerial coordination on ASM issues (MIREME, MICOA, MISAU, MINT, etc.);
- Equip and support the SPIs for an adequate inter-sectoral coordination at the provincial level in artisanal and small-scale mining, including the liaison with districts;
- Clear definition of the role of the various stakeholders in ASM (INAMI, DNGM, SPI's and others);
- Creation and registration of mining associations and cooperatives;
- Establish access mechanisms;
- Promote extension services dedicated to artisanal and small-scale mining;
- Technical resources training allocated to ASM at MIREME;
- On-going training for ASM operators in various fields; and
- Creation of pilot centres to support Artisanal and Small- Scale Mining.

[2]Denmark's and Greenland's Geological Survey.

Recommendations

- MIREME should lead the inter-ministerial coordination process on artisanal and small-scale mining issues;
- Support from MIREME to SPIs in inter-sectorial coordination at the provincial level;
- Clearly define roles and responsibilities in all interventions around ASM (training, monitoring, etc.);
- Continuous assistance in establishing mining cooperatives along with registration and management support;
- Support ASM and establish contact with related institutions to facilitate the financing of cooperatives;
- Creation of mining extension services for a simple and direct service to artisanal and small-scale mining operators, namely on best mining practices, processing, prospecting and exploration, environmental preservation, etc.;
- Training of technical resources related to artisanal and small-scale mining; and
- Training of ASM operators in their respective existing associations and cooperatives.

***d)* OMR[3]- Artisanal Gold Exploration in Manica, March, 2016**

Objectives

- Identify gold mining operators in Maridza, Manica District;
- Evaluate all theaddedvalue activities in gold mining;
- Analyze the context of gold mining in the area; and
- Analyzethe socio-economic scenario and the impacts gold mining.

Conclusions

- The community is considered as low-income on average, considering the type of housing, access to water and energy, etc.;
- The average monthly income is above the minimum wage established by the Government;
- Lack of planning and use of inappropriate and unsustainable technologies may hinder poverty reduction in the medium and long-term;
- Inadequate approach to mining without governmental inspections;
- Lack of basic infrastructure and services, and no benefits for the Maridze locality;
- Mining area is not rehabilitated, causing accidents such as miners falling in holes left open or

[3]Rural Observatory

poorly sealed; and

- Water contamination contributes to falling agricultural yields and potential health problems in the area.

Recommendations

- Artisanal gold mining or other mineral resources extraction must be thoroughly inspected in order to ensure benefits to miners and reduce its negative socio-economic and environmental impacts;
- Government agencies must be adequately equipped to intervene and monitor mining activities;
- Conflicts and disproportionate or illegitimate actions against ASM communities should not occur neither by the police nor by the community leaders. Instead, appropriate interventions from essential public services (education, health, environment, mineral resources) should prevail;
- Artisanal and small-scale operators should be encouraged to form associations or mining cooperatives to defend their own interestsand rights, improve sharing and/or participation in the value chain and marketing;
- NGOs should act as advocates on behalf of artisanal and small-scale mining communities,with financial support stemming from the Government and mining companies; and
- There must be civil society associations that perform advocacy functions with all the stakeholders involved in this activity acting as a third party, and with the financial support of the State and mining companies.

e) Consultancy Services for the design of a Development Programme Strategy Design for ASM, 2021

Objectives

- Transform associations into mining cooperatives;
- Provide access to professional training;
- Create mining extension services, which include topics such as technical improvement, safety, environment, commercial skills, and market practices;
- Establish mechanisms and tangible benefits, such as improving production rates and returns in ASGM through appropriate technologies and sustainable safety standards;

- Establish practical training mechanisms in appropriate technologies, environmental management practices, and a better understanding of business planning in rural environment;
- Contribute to the establishment of mineral processing facilities, cutting services, and marketing centres in the districts to attract and retain ASM operators in the formal sector;
- Establish mechanisms to facilitate the provision of micro-finance for artisanal and small-scale mining activities; and
- Contribute to the improvement of social infrastructure, such as water supply systems, schools and health centres in rural communities that host artisanal and small-scale mining.

Conclusions

- The number of ASM operators is growing annually due to rural poverty;
- ASM activity has a negative environmental impact across the country, with some forest reserves and national parks affected;
- The transformation of associations into ASM cooperatives is essential to formalize illegal mining;
- The current licensing system is very inefficient and slow to respond to the demand for formalization of mining activities;
- It is necessary to regulate the sale and purchase of minerals through a simplified licensing system established by INAMI, but managed locally through the organization of trade fairs;
- Challenges remain in the field of local mining regulation with police and economic services running parallel systems;
- ASM challenges require a national and integrated response with inter-ministerial collaboration, including the participation of NGOs, to tackle technical, social, environmental, and economic aspects in an integrated manner; and
- ASM issues are not exclusively limited to the domains of mining, as they have a social and rural development dimension.

Recommendations

- Facilitate licensing for artisanal and small-scale mining activities;
- Promote the registration of ASM associations and cooperatives as valid entities and valuable interfaces for interactions with government institutions, in addition to providing support and services;
- Provide technical, managerial and legal assistance to mining associations and cooperatives

to improve their technical, social, and environmental practices;

- Ensure an efficient commercial network for the sale and purchase of minerals, at fair prices, thus contributing to the sustainable and harmonious rural development of communities;
- Monitor and inspect artisanal and small-scale operations to ensure the use of best mining techniques and the adoption of best geological/mining, and environmental practices;
- Establish clear lines of communication among DNGM, INAMI, and SPIs, to identify the needs of local communities and cooperatives; and
- Design guidelines for the registration of associations and cooperatives.

III. 5. Mining data in the provinces of Manica and Niassa

III. 5. 1. Occurrence of gold in the Provinces of Manica and Niassa

a) Province of Manica

The known gold mineralization in the Manica Province is mainly associated with the Archaic Belt of green rocks found only in the southern region of thearea. Two green rock belts extend from Zimbabwe to Mozambique, the Odzi-Mutare-Manica Belt, and the Cronley-Munhinga Belt, which continue into Mozambique for about 25 km in the East West direction (Figure 5). (Lachelt 2014; GTK, 2008).

a.1. Mutare-Manica Green Rock Belt

This belt crosses the northern border of the city of Mutare in Zimbabwe (formerly Umtali) and is known as **the Mutare** (Zimbabwe) **green rock belt** or **the Manica** (Mozambique) **green rock belt.** The older names of *Odzi Gold Belt* and *Umtali Gold Belt*refer to distinct segments of the gold-bearing greenstone belt. Green rocks in the Manica area were the centre of mining activity in Mozambique during the first half of the 20th century and contain substantial known resources of gold, copper, bauxite, and asbestos.

The Mutare-Manica greenrock belt can be subdivided into a NE-SW trending part in the west, referred to as the Odzi segment, and an EW trending part in the east termedthe Mutare segment. The Odzi segment extends from Nyashanu in the SW to Odzi in the NE over a distance of 70-75 km, and its total width is less than 5 km.

The Mutare segment extends over a distance of about 60 km, from Odzi to the east of Manica in Mozambique. Its width varies between 10 and 15 km. A narrow band (1 - 2 km) of ultramafic rocks, surrounded by granitoids, extends EW for about 20 km, south of Mutare, but close to the border

with Mozambique. From a structural point of view, the Mutare segment is a syncline, 5 to 15 km wide that is markedly asymmetrical with a sub-vertical, slightly south-facing flank and a shallow north-diving flank comprising a syncline-anticlinal-syncline succession. The axial trace of the anticline separating the two main synclines follows the BIF (Banded Iron Formations) unit that forms the high ground between the Mbeza and Penhalonga valleys. The Mbeza syncline to the south continues approximately 5 km into Mozambique, where the dip turns west. The Penhalonga north syncline dipping to the east becomes the main folded structure of the greenrock belt in Mozambique. (GTK, 2006).

The Manica Green Rock Belt is subdivided into (bottom to top) Macequece and Vengo formations. The Macequece Formation is mainly composed of ultramafic and mafic meta-volcanic rocks (Figure 6 C-D) with intercalations of banded ferrous and meta-Chert rocks. Serpentinites are common and are accompanied by talc ± chlorite ± tremolite shales. The main lithology of the Vengo Formation isthe north-eastern part of the belt comprising graphitic phyllites and thin intercalated quartzite layers with marble, BIF and ferroginous lithic quartzite. *Metagreywackes* are known only in the southwest as an extension from Zimbabwe. (GTK, 2008).

The lower part of the structural profile consists of green Archaic rocks (basic to ultrabasic rocks, serpentinite, talc-chlorite-carbonate schists, and chlorite-tremolite schists) from the Macequece Formation (Manica Group), and the upper part of the profile is composed of BIF (banded iron ores, itabirite, jaspilite), metasediments (metagreywacke, quartz-chlorite pelite, black schists, quartzite, conglomerate, limestone, agglomerate) from the M'Beza/Vengo Formation (Manica Group). Granite and granite-gneiss form the basement of the Manica Group syncline (or monocline). These archaic rocks are cut by quartz veins, micro-granite intrusions and doleritic dykes (marking NS in Mozambique). Gold mineralisation occurs in all three archaic members (Lachelt 2014).

a.2. Cronley-Munhinga Green Rock Belt

The Cronley-Munhinga Greenstone Belt crosses the Zimbabwe-Mozambique border, and most of the segment is located in Mozambique. The belt occurs south of Lake Chicambo Real on the Revuè River, about 50 km south of the Mutare-Manica green rock belt. It is curvilinear from low hills extending E-N-E below Umkondo Group sediments in the west, to Gairezi Group sediments in the east. The close Cronley-Munhinga sequence (5km to less than 1km wide) has a combined length of the mapped occurrence in Zimbabwe and Mozambique in the order of 35 - 40 km, and is only composed of mafic

and ultramafic metavolcanic and their metasomatic derivatives with some quartzites (GTK, 2008). In Zimbabwe, the belt consists of quartz-sericite-schist and green rocks with serpentinite lenses and an isolated domain of quartz-rich BIF, all attributed to the Upper Bulawayan Supergroup. (GTK, 2006).

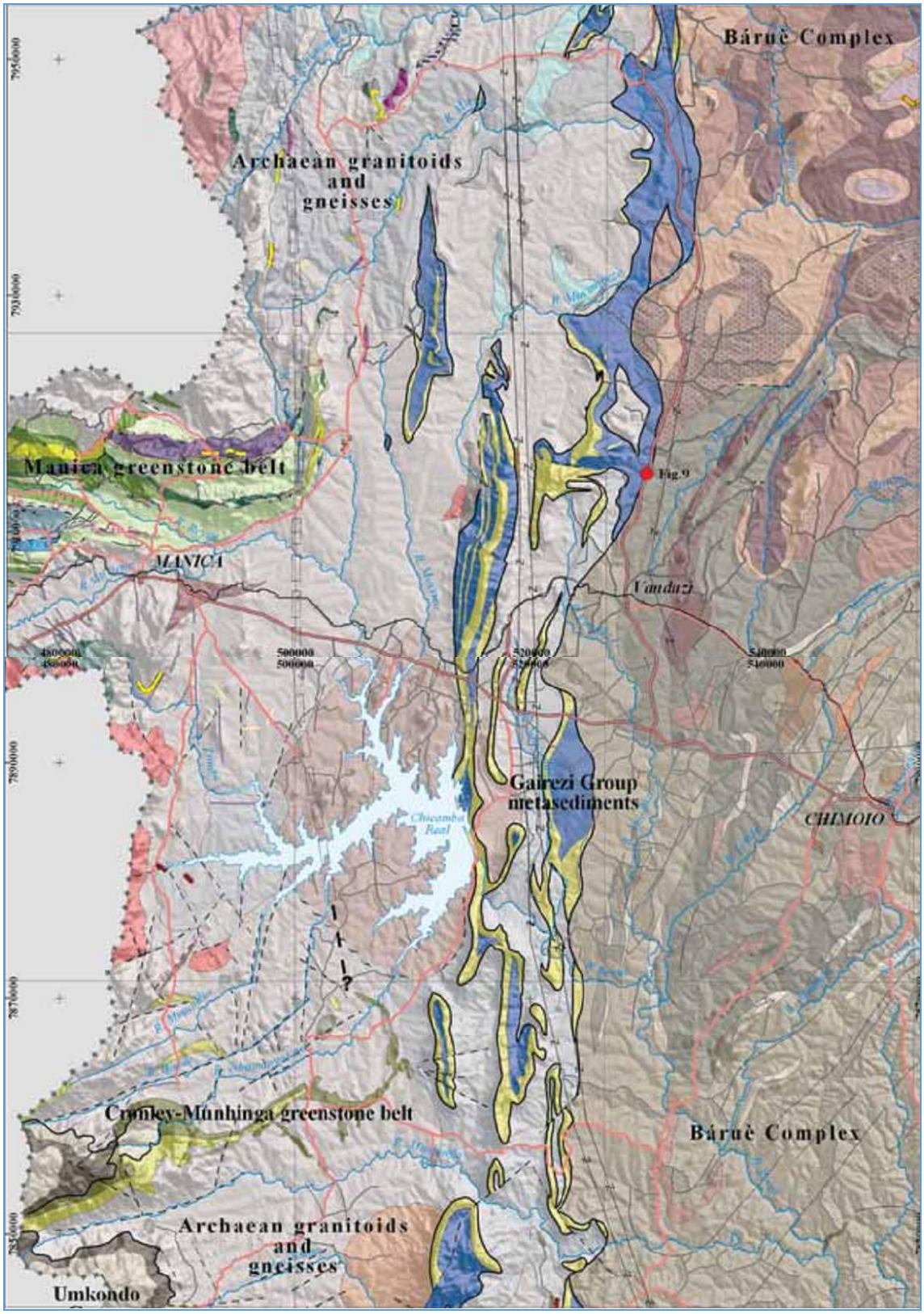

Figure 5: Location of the Odzi-Mutare and Cronley-Munhinga belts (GTK 2008)



Figure 6: (A)- Penhalonga valley; (B) the oldest rock in Mozambique; (C) Ultramafic Komalite from the Macoquece formation; (D) pilow lava from the Mucoquece Formation; (E) metavolcanic rocks from the Mucoquece Formation; (F) Archean gneiss (GTK, 2008)

Gold Mineralizations

In Manica, gold has been mined since prehistoric times. The structure extends across the border between Mozambique and Zimbabwe. In Mozambique it extends east of the border to 32°55'E and in a north-south direction from 18°45'S to 19°15'S (Figure 7).

Sophisticated gold production began in 1888 with alluvium and colluvium exploration. In Bragança, hard rock gold mining began in 1893 followed by mining at *Guy Fawkes* in 1894. Since then, gold mining has been carried out continuously, interrupted by some periods during which mining ceased (Lachelt, 2004).

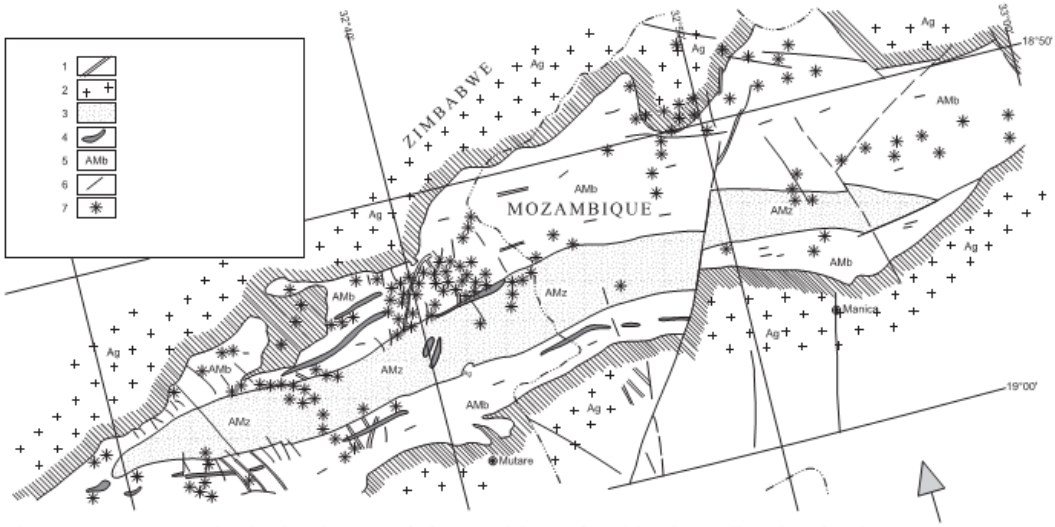

Figure 7.3.2 – Geological scheme of the position of gold mineralisation in the Mutare-Manica Gold Belt (modified from Pnaup, 1987)

1: Dolerite dykes, **2: Granite-gneiss, granodiorites, tonalites;**

3: Metasediments: schists, graywacke, conglomerate;

4: Fe-quartzite, BIF; **5: Metamorphosed basic and ultrabasic lavas (greenstone);**

6: Faults; **7: Gold mineralisations, occurrences, deposits**

Figure 7: Geological scheme of Gold mineralisation in the Mutare-Manica Belt (Pnaup, 1987)

In relation to the total distribution of gold deposits, occurrences and mineralization found in Zimbabwe and Mozambique is (i) 43.6% in green rocks; (ii) 17.0% in serpentinites; (iii) 14.9% in BIF and metasediments, and (iv) 25.5% in granite and Granite-Gnaisse Complex.

<u>Genetic types of gold mineralisation include:</u>

(i) Gold mineralization occurs in quartz-carbonate veins, and stockworks (type of reef) of hydrothermal origin. Examples of this type are the Monarch, Bragança, Cantão, Marianas, Richmond, Estrela, Excelsior, Old Richard, Wednesday, Two Fools, Guy Fawkes, and Damp deposits. This type of mineralisation is predominantly associated with green rock zones. The gold-copper mineralisation from the Mundonguara deposit also belongs to this type;

(ii) Gold, associated with iron and copper sulphides of hydrothermal-metasomatic origin,

predominantly related to BIF. Examples of this type of ore are the Dot's Luck and Try Again deposits; and

(iii) Gold in alluviums and terraces.

The most important ore control factors (metallottes) for gold mineralization are:

- The type of host rocks (green rocks, BIF, metaconglomerate and metaquartzite);
- Contact zones between green rocks and the Granite-Gnaisse Complex; and
- Fracture zones, especially shear zones.

The hydrothermal quartz veins occur predominantly in green, metavolcanic rocks, rarely in serpentinites and granites. They are generally oriented parallel to the metamorphic structure of green rocks, whereas in granite they follow fracturing zones (Hunting, 1988). The veins dip sub-vertically almost without exception and extend from 20–30 m (Chua) to 350 m (Bragança). The mineralisation depth extends to 150-200 m (Guy Fawkes). The grain thickness varies from a few centimetres to 2-3 m. The sulphide content of the veins amounts to 3%, and the mineralisation comprises pyrite and galenite subordinated to arsenopyrite, chalcopyrite and pyrrhotite. The gold grade is generally low. The average grade of mined veins was between 7–15 g/t. gold is also partially included in sulphides (Hunting, 1988).

The gold grade of reefs ranges between 2 and 15 g/t (6.7 g/t on average). In BIF, the gold grade is lower and does not exceed 7g/t. In native BIF,gold occurs in combination with pyrite, magnetite and Cu sulphides. The gold grade of the placers is low and amounts to 0.15–0.50 g/m3 (1.55–3.16 g / t).

Chakrabarti (1983), Obretenov (1977), and Afonso and Marques (1993) distinguished four ore fields:

(i) The Chimezi ore field was estimated to contain 130 230 t of ores at a grade of 9.5 g/t Au over a length of 272 m, an average width of 1.6 m mineralized at a depth 38 m. The ore field includes deposits at Bragança, Richmond, Damp, Dias Pereira, and Marianas;

(ii) The Chua ore field was estimated at 55 700 t of ore, an average Au grade of 6.6 g/t, which extends over an area of 140.5 m long, 0.7 m wide and mineralised to a depth of 43 m. The Cantão, Morrondo, Chua, Old Wednesday, Two Fools, and Excelsior deposits occur within this field;

(iii) The Penhalonga-Revuè ore field was estimated at 372 500 t of ore at an average Au grade

of 5.77 g/t and covers an area of 228 x 15.6 m, mineralised to a depth of 20 m. The ore field includes deposits at Monarch, Dot 's Luck, Try Again, and Fair Bridge; and

(iv) The Mangota ore field was estimated at 92 938 t of ore, a grade of 5.83 g/t Au, and an estimated area of 190 x 5.3 m, mineralised to a depth of 40 m. The Guy Fawkes, Vendetta, and Boa Esperança deposits are the best-known representatives of this ore field.

Total reserves were estimated at 651 368 t of ore to yield 4 321.1 kg of gold (Afonso and Marques, 1993).

b) Province of Niassa

The Niassa Golden Belt is the most important in northern Mozambique and is situated at the eastern end of a SW-NE continental-scale trend lineament defined by the Mwembeshi Shear Zone,and at the southern end of a NW-SE trend lineament defined by the Rukwa shear zone. Primary gold occurs in low-grade quartz veins cutting Neoproterozoic 714 ± 17 Ma (dated by Bjerkgard et al., 2009) metasedimentary sequences associated with mafic dykes and sills in the Txitonga Group. Quartz veins are spatially associated with highly weathered shear zones ranging from a few centimetres to several meters in width and strike predominantly NNE-SSW and almost E-W generally with a dip to NW (Figure 8).



Figure 8: Quartz vein targeted by Gold prospecting excavations (A). Front of primary Gold mining gallery in quartz vein (B). Different generations of quartz veins, one post-deformation (C) and the Oother mineralised syn-kinematics (D), (INAMI 2020).

The maps in figures (9 and 10) show the projection of gold veins and gold occurrences, respectively, whose measurements were obtained mainly in artisanal mining wells. Quartz veins generally truncate shear zone foliation, suggesting that they formed in the brittle stage of deformation, but exhibit the same lateral sliding kinematics and a consistent clockwise rotation of their trend relative to shear zone foliation, suggesting that they were formed in the same stress regimen. Veins 13 appear on an outcrop scale forming large shear arrays of sinistral shear. These shear zones affected magmatic and meta-sedimentary rocks.

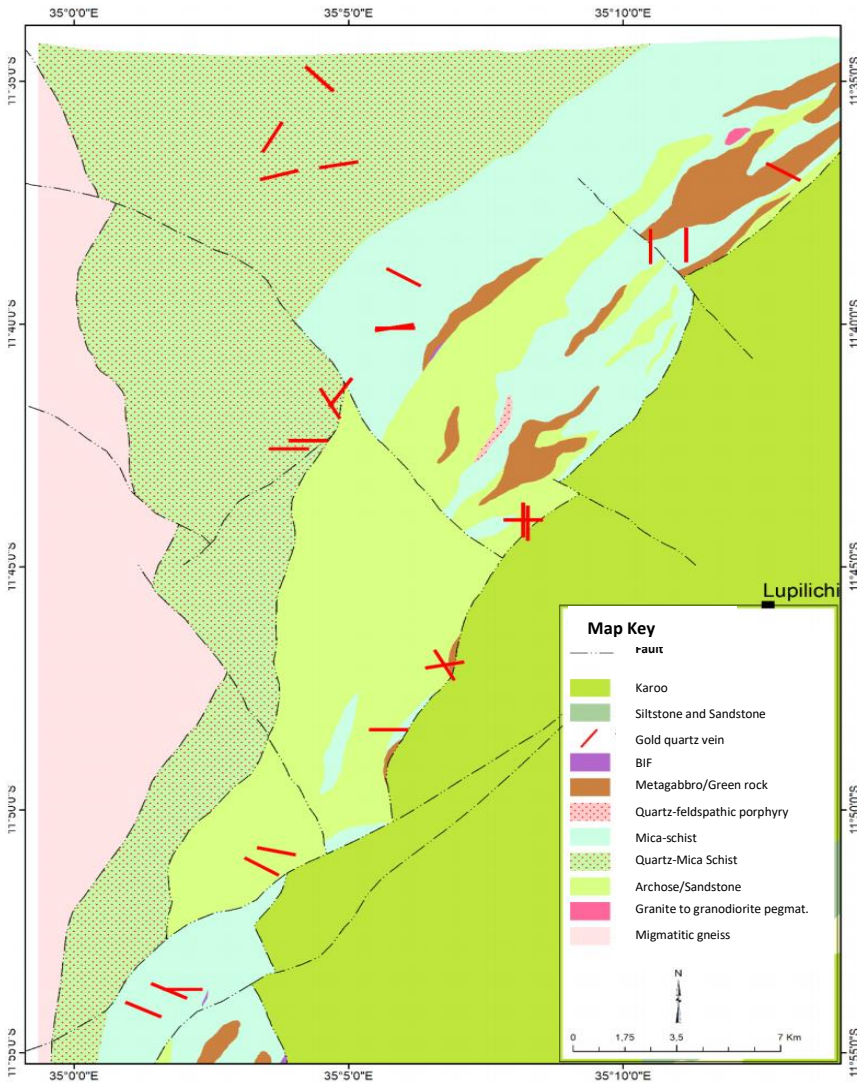

Figure 9: Geological map of NW Niassa highlighting quartz veins with primary goldmineralization (adapted from Nurconsut, 2007).

Bjerkgard et al. (2009) obtained an estimated Pan-African age of 483 ± 72 Ma and an initial 187Os/188Os chondritic ratio of 0.123±0.058 from sulphides, dating the deposition of mineralized quartz veins and linking them to the orogenic evolution of Late Pan- African or Pan-African. The chondritic ratio implies a juvenile source for ore fluids, possibly involving the Neoproterozoic host metagabbro.

The formation of these veins seems to be associated with regional cooling defined by the 40Ar/39Ar ages of biotite and muscovite between 492±4 and 466±2 Ma. Structural observations suggest that the entire Txitonga Group is cut by a suite of greenschist facies, zones of ductile slip shear in an NNE-SSW trend (Fig. 2, Nurconsut, 2007).

Quartz veins with gold probably formed in extensional shear fractures developed during sinistral movement against slipping along the NE-SW trending shear zones. The age, kinematics, and metamorphic degree of these gold-bearing structures are in broad agreement with those of other independently dated sinistral-slide greenschist facies shear zones in the Unango Complex (Bingen et al., 2006; Nurconsut, 2007). Therefore, it is likely that the initial period of mineralization in Txitonga Group is the result of a late Cambrian transcurrent - ordoviciano tectonic event, during the Pan-African orogeny.

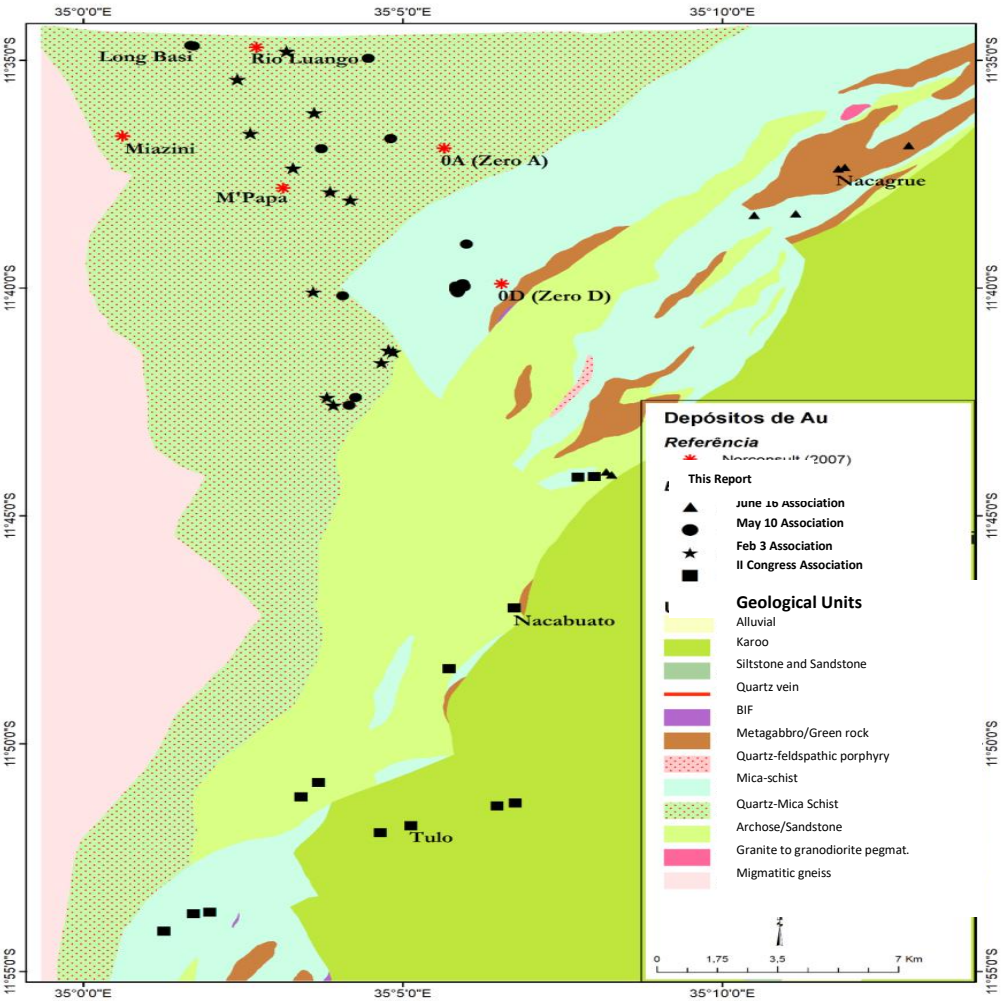

Figure 10: Map of Gold occurrences in the Txitonga Group and location of the main areas of activity of the Associations.

I

III.5.2.Gold mining practices in the Provinces of Manica and Niassa

Extraction is generally carried out using simple manual tools such as picks, shovels, ladders, ropes, hammers, with which miners open the wells and galleries to reach the mineralized ores. Depending on the scale of operation, type of structure, volume and grade of ore found, excavations can be protected by wood . During extraction, and to facilitate rock fragmentation, fire generated by wood fuel is used, and for rock fragmentation and other activities, mallets, pickaxes, tips, and shovels are used.

The ore, as well as the waste material, are manually transported and brought to the surface in bags pulled by ropes by means of cranks, which are sometimes also used to introduce the tunnelling material in the galleries. Communication between the subsoil and the surface is established through hoses, while miners use light bulbs for lighting in underground excavations.

The ore is manually transported to the processing sites, in areas withclose proximitytowater availability (figure 11).

Particularly in Niassa Province, ore can be found at deeper levels requiring some water pumping before and during excavation. The artisanal mining associations visited (*3 de Fevereiro*, *IICongresso e 16 de Junho*) use submersible electric pumps driven by a generator.

The 0D (Zero-D) mine of the '1º de Maio' Association, which has different specificities from the others, is characterised by a high level of the water table, which sometimes reaches before the gold vein, thus making mining operations extremely costly due to the need to pump underground water for 24 hours a day without interruption.

To guarantee the pumping of water in the mining wells, in addition to the floating electro-pumps in each well, the mine has an industrial generator with a capacity of 380 kVA and a daily fuel consumption of 200 litres/day.







Figure 11: Gold extraction process in Manica Province.

III.5.3. Mineral processing in the Manica and Niassa Provinces

a) Mineral processing in the Manica Province

At this stage, the ore is crushed using simple manual instruments, such as pestles and metal rods for subsequent grinding. Grinding is usually done in crank-driven ball mills (figure 12), an operation that can take from 30 to 45 minutes, depending on the nature(hardness) of the ore and or the physical condition of the mill operator.

In some cases, for amalgamation, miners choose to add mercury to the ore in the mill to capture the gold, and then the amalgam is submitted to the burning process to recover the gold, and the mercuryis then released to the environment by evaporation.

Although some ASGM operators claim to be familiar with the use of retorts, the burning of amalgam was never witnessed in the field using this instrument, which prevents the emission of mercuryinto the environment.



Figure 12: Manica Province: (a), (b), (c) ball mills used in ore comminution and (d) mineral concentration flume (INAMI, 2020).

b) Mineral Processing in the Niassa Province

The extracted ore is manually crushed using hammers until reaching the desired average granulometry of 2.5 mm in diameter, passing through a dry ball mill, and then subjected to drying by firewood on metal plates.

Ball mills are driven by motors, which can take 30 to 45 minutes to grind the ore.

The crushed ore is sent or stored for the gravitational concentration process in tables or simple sluice boxes, with gates covered by sisal bags to retain the pre-concentrate. The tailings are subjected to additional processing, which depending on the ore can be done several times.

The recovered pre-concentrate is filtered to obtain the final concentrate in settling tanks, before adding mercury for amalgamation. Powder soap (sodium hydroxide - NaOH) is often added to improve amalgamation.

Mercury is completely mixed by hand into the concentrate and then the amalgam is subjected to the burning process to recover the gold, and the mercuryis then released to the environment by evaporation.



Figure 13: Gold Processing in Niassa Province (INAMI, 2020).

III.5.4. Description of the visited areas

a) Munhena mine and community

The mining community of Munhena is located in the Machipanda Administrative Post, Manica District, Manica Province. It hasa tradition of ASGM activities, which wereinitially practiced only by Mozambicans.

In this mining area, there is currently an organisation of artisanal miners composed of 80 members

predominantly male, all of Mozambican nationality, ten (10) of whom are on the Board of Directors of the Munhena Mining Cooperative.

Members who carry out their activities at the mine sell the produced gold, having6% of all earnings allocated to the cooperative.The technology used in the extraction and processing is rudimentary, similar to the one mentioned above, being currently in the process of migration to mechanized technologies.

b) Mpapa mine and community

The mining community of Mpapa is located in Lupilichi, Lago District, Niassa Province.

In the Mpapa mining area, there are currently two (2)mining associations (*3 de Fevereiro e 1˚ de Maio*) with ninety-six (96) members. Artisanal miners of Mozambican and Tanzanian nationality, all male, carry out extraction and processing activities.

III.5.5. Estimates of the Quantity of Mercury used in ASGM

Preparatory Work

Development of scripts and interview

To estimate the amount of mercury, a questionnaire was developedto assist in the survey of field data collection regarding the origin, costs, quantities used, lost, and recovered of mercury, including aspects related to health and safety of people involved in the activities of ASGM and the surrounding communities, as well as to environmental protection (Annex 3). It should be noted that the questionnaires were draftedin coordination with the Ministry of Land and Environment and Ministry ofHealth.

Acquisition of Equipment for Field Tests

INAMI acquired a set of portable equipment for in situ analysis of water and soil samples, capable of detecting and quantifying heavy metals such as Mercury, arsenic (III), arsenic (total), cadmium, copper, manganese, nickel, lead, and zinc.

The acquired equipment was used in projects to measure the level of environmental contamination by mercury in the soil (portable Metalyser HM4000) and in water (portable MetalometerHM2000

Deluxe) (figure 15).An essential factor in assessing the health and safety exposure of individuals working at ASGM, surrounding communities, and possibly communities living beyond the areas of activity.



Figure 15: Heavy Metal Detection Kits (INAMI 2018)

Training

Training in electrochemical analysis applied to *Trace20* heavy metal testing instruments

Prior to performingthe fieldwork, 18 technicians from MIREME (13 from INAMI, 2 from IGREME, 2 from DNGM, and 1 from MNG) were trained in the capitalof Maputo by Wagtech Projects company in partnership with Trace20 in: (i) use and handling of equipment; (ii) treatment and preparation of samples; and (iii) data processing and analysis.

d2) Training in Mercury quantitative estimates for the ASGM sector

The MIREME technical team responsible for preparing the NAP benefited from a training conducted in the city of Chimoio by the Artisanal Gold Councilon estimates of the quantity of mercury in ASGM.The training included three sessions, one theoretical, one practical in the field in the ASGM occurrence areas in primary rock where the amalgam is produced, and finally a field data evaluation session.

In addition, field training was performed in alluvial and primary ASGM occurrence areas with five technicians from INAMI, 2 technicians from DPREME, 1 technician from SDPI, 2 professors, and it should be noted that some participants in the training came from the Faculties of Medicine and Sciences of Eduardo Mondlane University2 students from the Geology and Chemistry courses at

UEM. UEM is a public higher education institution that has carried out investigations on Mercury contamination for the environment and its potential risks to public health and safety. At the end of the training, all traineesreceived Certificates of Participation.

Field Works

The methodology used consisted of document analysis and field inventory.

a) Document analysis

The document analysis consisted of a bibliographic review of several documents related to ASGM,with contents containinggeneral information on ASGM in Mozambique, socio-economic aspects, national and international legislation, best practices in ASGM, and mercuryassessments in order to obtain holistic overviewof the situation of ASGM in Mozambique and support the drafting andpreparation of the NAP.

b) Field inventory

The Mercury Quantity Estimation aimed to evaluate the methodology used for the amalgamation of the ore, the quantity of mercury used and lost in the environment, thus allowing an assessment of the degree of exposure of miners and surrounding communities to the risk of contamination by mercury. The Inventory consisted of two stages:

b1) First Stage

The first stage of the estimate consisted of the following:

- Weighing the ore to be processed using a spring scale with a capacity of 100kg;
- Weighing of added mercury (ore or in concentrate) using a precision scale with a capacity of 500 g;
- Weighing of the mercury recovered after washing the ore and filtering the concentrate;
- Weighing the amalgam;
- Weighing the sponge after burning;
- Definition of the number ofwashes per week;
- Number of working groups for each mining area; and
- Estimate of the average total mercury lost by each workgroup.

It was possible to determine for each mining community, the mercury ratio (i) used to recover a certain amount of gold and (ii) the percentage released to the environment (lost). With these data, and using the production data provided by the SPIs, the mercury used and lost was estimated.

b2) Second Stage

The second stage of the estimate was carried out only in Manica Province and consisted of the following:

- Collection of surface water samples from rivers;
- Collection of concentrate samples from river beds; and
- Verification of mercury contamination levels by in situ analysis using portable Metalyser equipment from the HM2000 and HM4000 series.

Estimates of the amount of mercury in Manica Province

The estimate of the amount of mercury in Manica Province was made in the districts of (i) Manica – Munhena community; (ii) Gondola - Chicoma mining community; and (iii) Sussundenga – Bandire, and Tsetsera communities.

The data presented below correspond to the field survey carried out in 2017, and it was found that mercury was sold at a price of 500 MT(7.8 USD) per 100 grams.

a.1) Manica District

Munhena Community

In the Locality of Maridze, Administrative Post of Machipanda, there is the *Associação Mineira de Munhena*, made up of 141 founding members, of which 101 are active and employ around 191 seasonal workers, whose number may fluctuate depending on the season and production.

Each gallery can occupy from 4 to 7 workers, including the transport and processing of the ore, which can reach a total of up to 15 people per group. The average daily working hours are from 07:00 to 15:00 and sometimes until 18:00, from Monday to Saturday. During the peak agricultural season (sowing or harvesting) and rainy season, mining activity slows down.

During the baseline study, it was found that the community extracts the ore in 20 wells, of which 9 were abandoned without having been subjected to any rehabilitation and produces an average of 529.2 x 10^{-3} Kg of gold per month, which is equivalent to about 6,350.4 x 10^{-3} Kg of gold per year.

During processing, 486.36 x 10^{-3} Kg of mercury are added per month (5,836.32 x 10^{-3} Kg per year), of which 365.4 x 10^{-3} Kg per month are recovered (4,384.8 x 10^{-3} Kg /year), and 120.96 g of mercury are discharged to the environment per month (1,451.52 x 10^{-3} Kg /year) (see table 4).

a2) Gondola District

Chicoma Community

Chicoma is a community located in Pinanganga, Amatongas Administrative Post, and has about 150 ASGM operators organised in groups of 8 to 10 miners, mostly male.The average daily production of gold per group is 5 grams.

The suppliers of mercury are generally gold buyers, who deliver this produt against a guarantee of exclusivity for its purchase. Mercury is sold at a price of MZN 500 (7.8 USD) per 100g (100 ml). In the Chicoma community, ASGM operators carry out whole ore amalgamation (WOA).

Gold extraction is done by open open-pit excavation, partially carried out in tailing ponds from previous operations, using simple hand tools such as picks and shovels.

Gold is on average sold on-site at a price of 1,100 MT/g (17.1 USD/g) to mining traders, who subsequently resell it in the city of Manica at a price ranging from 2,300 to 2,400 MT/g (36 to 38 USD/g). It is estimated that approximately 150 x 10^{-3} Kg of gold are sold monthly with an average purity of 60% to 75%.

In this community, ASGM operators adopt whole ore amalgamation, where for each batch of 50 kg ore to be processed, 12 x 10^{-3} Kg of mercury are added, of which 4.5 x 10^{-3} Kg are recovered and 7.5 x 10^{-3} Kg are lost to the environment. It was found that in this operation, about 660 x 10^{-3} Kg of mercury are spent on the environment per production group each month, corresponding to 7,920 x 10^{-3} Kg per year.

a3) District of Sussundenga

i) Bandire Mining Community

The Bandire mining Community is located 15 km from the municipality of Sussundenga, and is developed by the Association of *Garimpeiros de Bandire*, ASGM's activity occupies an area of approximately 80 hectares comprising of 380 members, 28 of whom are women, also involving seasonal workers, including children, and non-associated artisanal miners.

The excavation is open-pit, with processing carried out at the extraction site with an average daily

gold production of 6.5 x 10^{-3} Kg, corresponding to an approximate total of 156 x 10^{-3} Kg per month. The daily amount of mercury used to produce amalgam is 1.23 x 10^{-3} Kg, corresponding to 36.9 x 10^{-3} Kg per month, with approximately 158.4 x 10^{-3} Kg /month being lost to the environment, leading to an estimated annual loss of 1,900.8 x 10^{-3} Kg of mercury, see table 4.

Gold buyers supply the mercury on credit against a guarantee of exclusivity in gold sales. The price of mercury is 500 MZN(7.8 USD) per 100 g. Bandire Gold is about 98% pure and is sold locally at a price of 2,000 MT/g (31.25 USD/g), and is later resold by mining traders in the city of Manica at a price ranging from 2,300 to 2,400 MT/g (36 to 38 USD/g).

ii) Tsetsera Community

Tsetsera is part of the Muhoa Administrative Post and is located on the outskirts of Sembezia, just 15 km from the District capital, Sussundenga.

ASGM operators are organised in an association, subdivided into 33 groups of 3 to 10 members. Gold is produced at a rate of 49.29 x 10^{-3} Kg per day, making up 345.24 x 10^{-3} Kg per week (1,381.26 g/month). Gold buyers pay locally 2,000 MT /g (31 USD), which is 70-80% pure. Regional buyers pay from 2,230 to 2,400 MT/g (35 to 38 USD)of gold in the city of Manica.

Mercury, which is sold for 500 MT(7.8 USD) per 100 g, is supplied by gold buyers on credit with the condition that the mining community sells the gold exclusively to the mercury suppliers. 10.55 x 10^{-3} Kg of mercury are added, of which 2.52 x 10^{-3} Kg is discharged into the environment. An estimate of 332.64 x 10^{-3} Kg of mercury is emitted into the environment every month in Tsetsera, totalling the equivalent of 3,326.4 x 10^{-3} Kg per year, see table 4.

Table 4: Estimate of the amount of mercury lost in the environment in Manica

Site of collection	Operator No.	Group No.	Number of Washes per week	Quantity of added Mercury (10^{-3} Kg) /group	Hg lost per group (10^{-3} Kg)	Mercury lost (10^{-3} Kg)		
				daily		daily	monthly	Yearly
Munhena	141	21	3	1.93	0.48	10.08	120.96	1,451.52
Chicoma	150	11	2	12	7.5	82.5	660	7920
bandir	380	33	1	1.23	1,2	39.6	158.4	1,900,8
Tsetsera	380	33	1	10.55	2.52	83.16	332.64	3,326.4
Total	**1,051**	**98**	**7**	**25.71**	**11.7**	**215.34**	**1,272**	**14,598.72**

Table 5: Annual estimate of Gold and Hg emissions for the period 2018 to 2020

Site	Field Data					2018			2019			2020		
	Quant. of Mercury Added (10^{-3} Kg)	Hg Lost (10^{-3} Kg)	Au produced per day (10^{-3} Kg)	Hg/Au	Hg lost/Hg recovered	Au produced (SPI source) (10^{-3} Kg)	Hg Added (10^{-3} Kg)	Hg lost (10^{-3} Kg)	Au produced (10^{-3} Kg)	Hg Added (10^{-3} Kg)	Hg Lost (10^{-3} Kg)	Au produced, (10^{-3} Kg)	Hg Added (10^{-3} Kg)	Hg Lost (10^{-3} Kg)
Bandire	1.23	1.2	1.25	0.98	0.98	22,295	21,938	21,403	19,043	18,738	18,281	15,438	15,191	14,821
Tsetsera	10.55	2.52	0.86	12.27	0.24	382	4,685	1,119	402	4,932	1,178	383	4,692	1,121
Total	**11.78**	**3.72**	**2.11**	**13.25**	**1.21**	**22,677**	**26,623**	**22,522**	**19,445**	**23,670**	**19,459**	**15,821**	**19,883**	**15,941**

a) Stage 2 - Analysis of mercury concentration in the rivers of Manica

A total of 8 surface water samples and of 7 concentrates were collected from the Revué, Chua and Mussambuzi river beds in Manica Province, indicated in tables 6 and 7, and projected in figures 16, 17, and 18. The data were compared to the World Health Organisation (WHO) standard that establishes the maximum permitted mercury value of 0.1 µg/L (0.001 mg/L) for bodies of water.

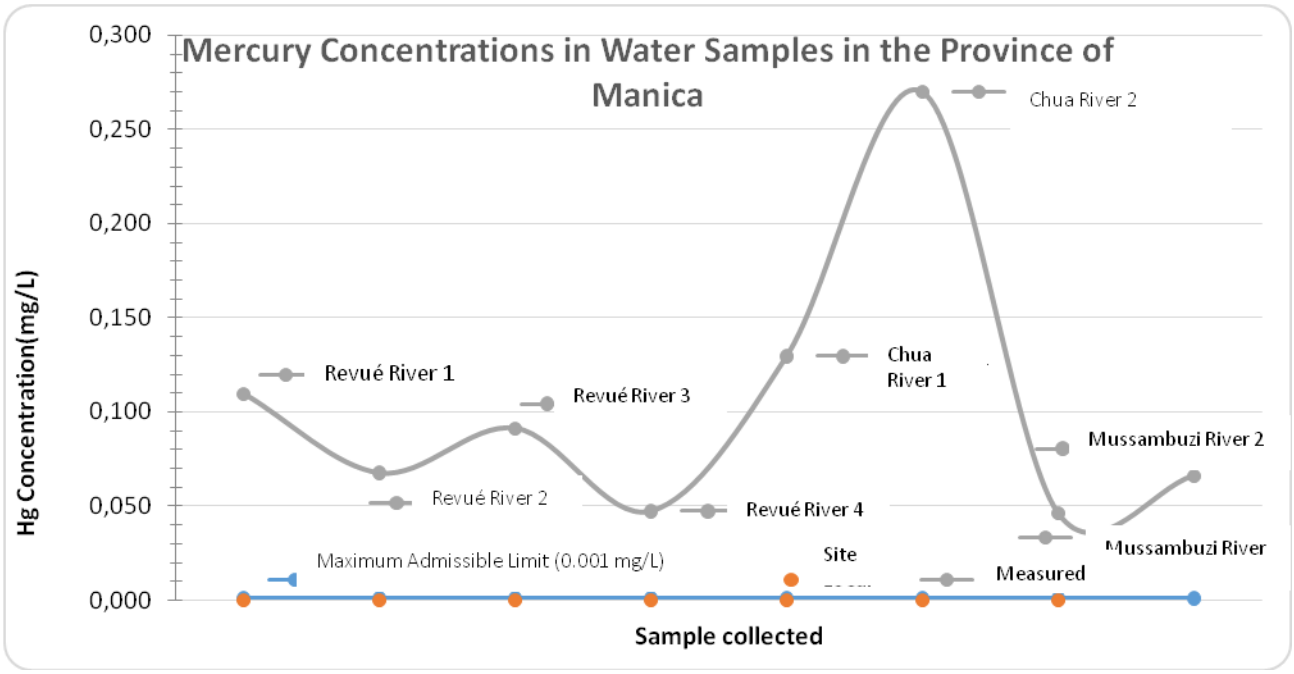

Figure 16: Mercury concentrations in water samples in Manica province

Table 6: Results of the analyses of water samples collected from rivers in Manica Province

Study area	Sampling Points	Hg concentration (mg/L)	WHO Standard (mg/L)
Revué River	1	0.10935	0.001
	2	0.06736	
	3	0.09111	
	4	0.04715	
Chiuta River	5	0.12939	
	6	0.2697	

Mussambuzi River	7	0.04615	
	8	0.06588	

The above results authenticates that all the studied rivers present concerningconcentrations of mercury since, in all samples the concentration of mercury exceeded the maximum value allowed by the WHO. The highest concentrations of mercury were recorded in the Chua River with values ranging from 0.13to 0.27mg/L followed by the Revué and Mussambuzi rivers with mercury concentrations ranging from 0.05to 0.11, and 0.05to 0.07mg/L, respectively, as shown in the graph below:

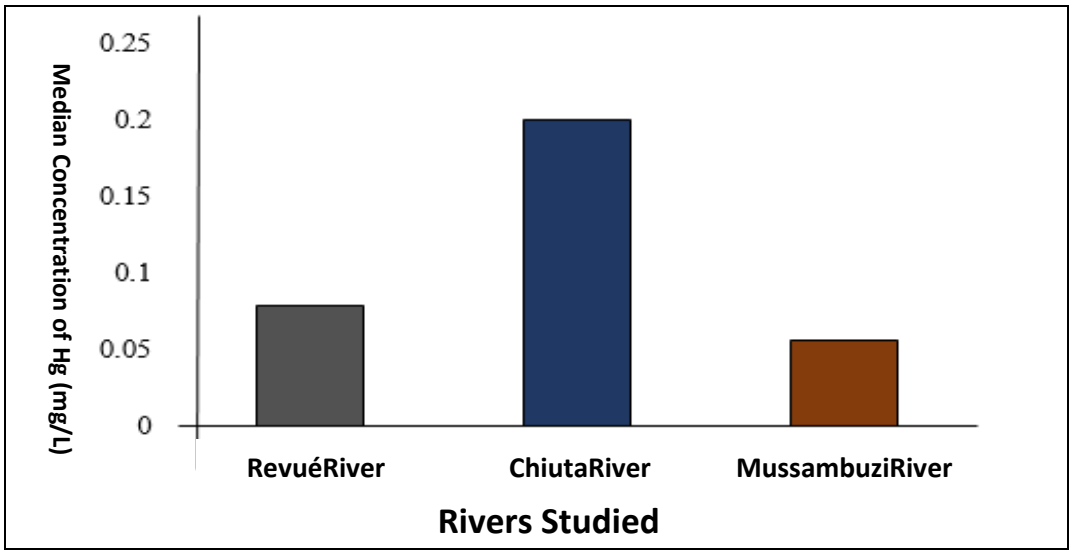

Figure 17: Results of the analyses of water samples collected from rivers in Manica Province

In addition to confirming the existence of considerable levels of mercury in rivers, the results demonstrated that there is a significant contribution of mercuryby artisanal gold mining in rivers. The high toxicity of this element in the water is because it bio-accumulates, taking into account that fishing is one of the main subsistenceactivities of local communities and they rely upon river water for consumption and other household activities. These results alert us that communities surrounding the study areas are in health danger due to high levels of exposure to mercury.

Table 6 shows the results of the analyses of soil samples that indicate the presence of mercury in all samples; however, it is important to emphasise that, based on the values presented, the concentrations of mercury detected in the soils are not alarming sincemercury values detected in all samples are below the standards established by WHO. Although they are below the permitted standards, these values should not be overlooked because, mercury and mercury containing substancesaccumulates,and subsequently poses

hazardous impacts both on human health, and the environment.

Table 7: Mercury concentration in river bottom concentrates

Study area	Sampling Points	Hg concentration (mg/kg)	WHO Standard (mg/kg)
Revué River	1	0.12686	1
	2	0.11276	
	3	0.01469	
	4	0.10519	
	5	0.15441	
Chiuta River	6	0.08626	
Mussambuzi River	7	0.12411	

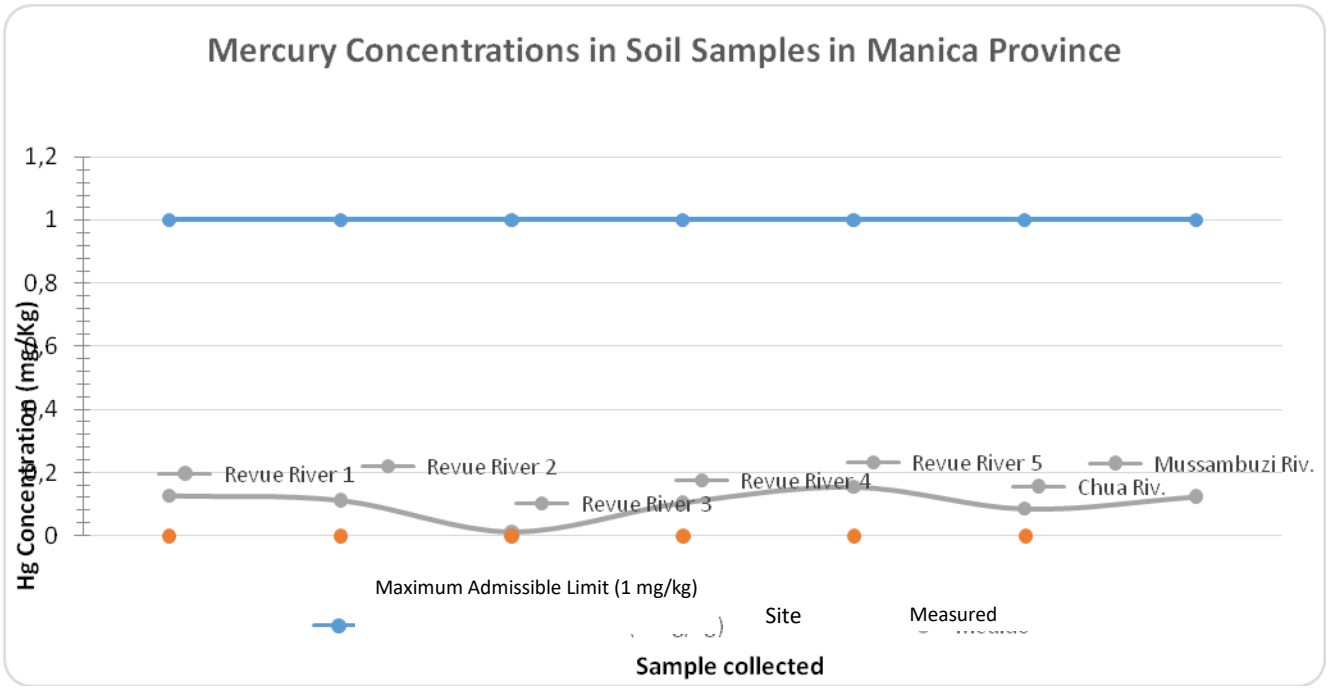

Figure 18: Mercury concentrations in soil samples in Manica province

Estimate of the amount of mercury in Niassa Province

The estimate of the amount of mercury in Niassa Province was made at the Administrative Post of Lunho, Lago district.The data presented below correspond to the field survey carried out in 2018, and it

ascertained that mercury was marketed at a price of 500 MT (7.8 USD) per 100 g.

Tulo Mining Community

In the Tulo mining community there is a Mining Association called the *II Congresso*, with 110 operators, organised into 19 working groups.

The average daily production of gold is 24x 10^{-3}Kg, corresponding to a total of 720 x 10^{-3}Kgper month. In the processing of gold, approximately 36 x 10^{-3}Kg of mercury are added per group daily for each batch of ore processed, from which 33.8 x 10^{-3}Kg are recovered. About 167.2 x 10^{-3}Kg of mercury are released into the environment every month, corresponding to 2,006.4 x 10^{-3}Kg per year.

In Tulo, more mercury was added during the procedure without weighing, resulting in a gain of mercury from the soil and water. The result of evaporated mercury looks perfectly normal. Using just the amount of mercury evaporated, the resulting mercury to gold (Hg:Au) ratio is 1:11, which would be slightly higher in normal procedures.

Nacagurué Mining Community

In the mining community of Nacagurué there is a Mining Association called *16 de Junho*, comprising of 160 ASGM operators subdivided into 28 groups. During the amalgamation process, each group uses 9.5 g of mercury for each batch of ore, from which 8.34 x 10^{-3}Kg are recovered and 1.16 x 10^{-3}Kg per day are lost to the environment. It was found that in this operation, about 389.76 x 10^{-3}Kg of mercury is emitted monthly to the environment, corresponding to 4 677.1 x 10^{-3}Kg per year.

Gold is sold at the extraction site at 1900 MT (30 USD)/g to mining traders, who resell it in the city of Niassa at a price ranging from 2400-2500 MT (38-39 USD)/g. The mine produces an average of about 900 x 10^{-3}Kg of gold per month with a purity of 93%.

The test resulting from the Hg:Au ratio is less than 1:0.82, which is hardly normal. Repetitive testing certainly tended to a ratio greater than 1. The skill and dedication of the washer is very important, as is the fact that the rejects are reprocessed, thus moving the ratio to different values.

Mpapa mining Community

The Mpapa mining association called *1˚ de Maio,* contains 120 operators organised into 7 groups. In this community, operators add 43.3 x 10^{-3}Kg of mercury to each batch of ore, of which 38.9 x 10^{-3}Kg is recovered and 4.4 x 10^{-3}Kg is lost to the environment. Monthly, 123.2 x 10^{-3}Kg of mercury are released into the environment, corresponding to 2,478.4 per year. The monthly production is 800 x 10^{-3}Kg, which is equivalent to 9,600 x 10^{-3}Kg per year, and each gram is sold to buyers at 1900 MT/g.

In Mpapa, the Hg:Au ratio obtained in the only test witnessed by the team was 3.49, a very high indicator, considering the approximate balance of ASGM operators referring the annual amount of Mercury used. It is true that a momentary lapse of the worker performing the processing can lead to the abnormal loss of only small fractions of Mercury in use. Table 8 shows the estimate of the amount of mercury emitted to the environment in the mining areas of the District of Lago.

Table 8: Estimate of the amount of Hg emitted to the environment in Niassa

Site of collection	**No. Op.**	**Group No.**	**Number of Washings per week**	**Quantity of added Mercury (10^{-3}Kg)/roup**	**Hg lost by group(x 10^{-3}Kg)**	**Mercury lost(x 10^{-3}Kg)**		
				daily		**daily**	**monthly**	**Yearly**
Tulo	110	19	1	36	2.2	41.8	167.2	2006,4
Nacagurué	160	28	3	9.5	1.16	32.48	389.76	4677.1
Mpapa	120	7	1	43.3	4.4	30.8	123.2	2 478.4
Total	**390**	**54**	**5**	**88.8**	**7 7 6**	**105.08**	**2 668.96**	**9 161.9 2**

Table 9: Annual Gold production by association in the years 2018 to 2020

Local	Field Data					2018			2019			2020		
Quantity of added Hg	Lost Hg(10^{-3} Kg)	Au produced per day (10^{-3} Kg)	Hg/Au	Lost Hg/Recovered Hg(10^{-3} Kg)	Au produced(10^{-3} Kg)	Added Hg (10^{-3} Kg)	Lost Hg (10^{-3} Kg)	Au produced (10^{-3} Kg)	Added Hg (10^{-3} Kg)	Lost Hg (10^{-3} Kg)	Au produced (10^{-3} Kg)	Added Hg (10^{-3} Kg)	Lost Hg (10^{-3} Kg)	
Tulo	36	2.2	1.26	28.50	0.06	14,600	416,100	25,428	15,469	440,867	26,942	10,513	299,629	18,311
Nacagurué	9.5	1.16	1.07	8.87	0.12	16,200	143,640	17,539	27,108	240,358	29,349	5,688	50,434	6,158
Mpapa	43.3	4.4	3.81	11.36	0.10	22,960	260,936	26,515	11,898	135,219	13,740	10,884	123,695	12,569
Total	**88.80**	**7.76**	**6.14**	**48.73**	**0.28**	**53,760**	**820,676**	**69,483**	**54,475**	**816,443**	**70,031**	**27,085**	**473,758**	**37,038**

III. 5.6. Economics

The mining associations have well-structured cost control and budget, as well as the distribution of benefits, taking into consideration each member's role and contribution, the ownership of machinery and inputs, the need support members without production and membership fees.

In addition to the members of the mining associations, there are collaborators, with occasional employment status, who perform all kind of functions along the value chain, in Exchange of cash payment or production sharing.

The production-sharing schemetakes place before the concentration and extraction of gold. Employees tend to give preference to this type of reward for their work, betting on an eventual event of luck.

Some of the costs incurred in gold production are as follows (per bag of ore):

- Transport from Mine - 100.00 MT(1,56USD);
- Manual Crushing - 80.00 MT(1,25USD);
- Ore Drying - 20.00 MT(0,3USD);
- Ore Grinding - 300.00 MT(4,69USD);
- Transportation to washing station - 20.00 MT(0,3USD);
- Washing (panning) - 100.00 MT (1,56USD)
-

The required petrol consumption is 20 litres for every 30 bags of weathered rock and 25 bags of fresh rock. The petrol is supplied from Lichinga.

As in many communities are in the vicinity of the border, it is common to have dual currency trading in some ASGM camps. In all artisanal gold mining communities in the Lake district, the shilling, Tanzanian currency is valid with a common (market) exchange rate.

III.5.7. Mercury trade and supply

In terms of mercury regulations, the 2006 Regulation on Technical and Health Security in Geology and Mining Activities bans the use of mercury in artisanal mining operations or any other noxious substances used for gold processing (Art. 225). Additionally, the Ministry of Environment is mandated to implement international conventions regarding hazardous substances. Both the Ministry of Land, Environment and Rural Development and the different municipalities of Mozambique are mandated to do inspections of chemicals substances.

However, despite the ban on mercury trade for ASGM, the business is still booming. According to the World Bank, informal miners obtain mercury via small mercury sellers or through gold buyers, who are often unregistered, with the latter being the most common means. When purchasing mercury, the ASGM miners pay around $2 for 22g, which amounts to approximately $100 per kg. On the other hand, when dealing with gold buyers, establish a production agreement with the miners where they are contracted to sell their gold to private buyers in exchange for free-of-charge mercury alongside working tools such as hoes, picks, shovels, buckets, basins, bags.

The provenance of mercury used by artisanal miners in ASGM areas is generally unknown.Data from the field survey conducted show that there is a discreet distribution network of mercury to artisanal and informal gold miners from neighbouring countries such as Tanzania, Malawi, Zimbabwe and South Africa.

III.5.8. Socioeconomic and socio-demographic aspects

Until 2019,artisanal mining in the country had never been a statistical matter to measure the number of people involved in the activities, socio-demographic characteristics, income and production costs in the value chain, and the contribution of this activity to the local and regional economies.

MIREME in partnership with INE is carrying out the Census of Artisanal Miners in Mozambique (CEMAM), which shouldcollect statistical and location data of artisanal mining in the country, in order to provide information on the number of artisanal miners existing in the country, its location, predominant age groups, origins and nationalities, type of activity of people involved in mining processes, environmental aspects associated with the activity, form of organisation of mining communities, and their contribution to local socio-economic development.

Artisanal and small-scale mining activities have the following socio-economic advantages and disadvantages:

Advantages:

- Source of employment in rural areas;
- Source of income complementary to agriculture or other secondary activities;
- Discourages rural-urban migration of the population from mining areas;
- Source of occupation for young people unable to continue their studies; and
- Contributes to rural poverty reduction.

Disadvantages:

- Presentssocial, environmental and public health challenges;
- Difficult to control by the State due to its informal, unregulated, and migratory nature;

- Low tax contribution;
- Presents precarious conditions of mining hygiene and safety;
- Promotes illegality in mining and commercialization;
- Encourages illegal immigration; and
- Weak organisation of miners in associations or small companies.

III.5.9. Environmental information

Despite recognizing the economic potential of artisanal and small-scale mining, the Government considers the pollution of rivers, itssedimentation, the contamination of the environment by mercury, and the destruction of nature as matters of alarming emergency.

This practice has crucially degraded the water quality of rivers and caused soil erosion. From the baseline survey, it was verified that there have not yet been any alarming concentrations of mercury in Mozambique's waters, and its use represents, primarily a danger to the health of the artisanal miners themselves.

a) Mercury's environmental impacts on ASGM

The most accessible gold is usually found loosely in alluvial streams. It is this type of gold that is most explored in Mozambique, using baths in rivers, and artisanal miners concentrate the largest particles of gold. During the gold extraction process, riverine vegetation is destroyed, and erosion and soil impoverishmentoccurs.

In reference to agriculture, thereis disturbance of aquatic flora and fauna and the pollution of river waters, thus affecting the entire river ecosystem as it deprives it of light. When primary or colluviumgold is explored, rocks and soil are excavated and also through river basins, thus separating gold from the lighter particles. Suspended sediment loads block light in rivers. When this situation lasts for a long time, all the plants and algae that inhabit them die, consequently, the fauna that depends on them disappear. Where loads settle, the depth of rivers and lakes is drastically affected, consequently modifying riverbeds and reducing the usefulness of reservoirs.

The main environmental problems caused by the use of mercury in ASGM and Mozambique are:

- Pollution of river waters, especially the Revué, Zambuzi, Chua, Namacuarara, Madzi, Púngue and Gairedzi rivers, in Manica Province; (figure 19)
- Silting of rivers and streams;
- Erosion of land, mainly in mountainous areas (figure 20);
- Degradation of land for agriculture as most mines are located on agrarian properties; and
- Existence of large cracks and holes, as artisanal miners do not landfill abandoned mines.

The problems mentioned above are already affecting agricultural and livestock activities (mainly agriculturalirrigation), fishing activities, as well as fauna and flora in general.



Figure 19: Pollution of rivers by the practice of artisanal mining in Ouro



Figure 20: Erosion and silting of soils in the district of Manica (INAMI, 2018)

III.5.10. Health Information

The inhalation of mercury vapours is the leadingcause of contamination for people who work with this element.

Once in the lungs, the metal undergoes the oxidation process and becomes soluble substances in the blood, consequently causing the inhibition of oxygen. In the case of acute intoxication, acute renal failure, gastric and oesophageal erosion or perforation, and cardiovascular collapse can occur, which can often lead to death.

Inevitably, whilst artisanal miners use mercury, part of the mercuryis released to river waters. In water, mercury in metallic form is barelysoluble and does not pose many risks to public health, but bacteria and airbornecontact transform it into methyl-mercury, which is highly soluble and very toxic.

The risks are high for people who regularly consume fish and/or other aquatic animals, in particular carnivores, as this substance bio-accumulates in food products such as microorganisms and small animals such as insects and crustaceans, fish, birds, and mammals. The highest concentrations are found in large carnivores and their parasites.

Overall, the risk is even greater for people who handle mercury constantly: miners, gold sellers and buyers, and people living in closevicinity toareas where amalgam burning takes place.

Prolonged exposure to all forms of mercury causes chronic illness. Symptoms predominantly result from central nervous system toxicity to the central nervous system and include tremors, personality changes, Parkinson's, renal failure, cognitive impairment of speech and vision, dementia and others. Symptoms of illnesses caused by mercury contamination are felt after several years (approximately 20 to 35 years) after exposure to vapours or as a result of accumulation through the food chain. Asthe impactsare irreversible, prevention and early treatment are extremely important.

Exhaled air samples were taken from miners in Munhena, Manica Province, and it was found that the average level of mercury in their lungs was 8.23 µg/m³. Some amalgam burners had mercury levels above 50 µg/m³, 50 times higher than the WHO acceptable levels for public exposure to mercury

emissions(Dondeyne et al., 2007).

In mining areas, there is also a great risk of transmission of HIV/AIDS and other sexually transmitted diseases. The stagnation of water in abandoned mines creates conditions for the increase of diseases such as malaria, cholera, diarrhoea, tuberculosis, etc. Sincethe mines do not have adequate safety and health conditions, there is an increase in occupational risks and accidents. It is also noted the frequent occurrence of accidents due to landslides in mines, causing burials, injuries, fractures and, in some cases, leading to death.

The problemsassociated with health in Mozambique'sASGMare increasingly worrisome, as there is negligence and ignorance on the part of communities involved in mining combined with a lack of financial conditions and difficulties in accessing health posts in the localities (Marrufo et al., 2020).

During the NAP project, several interviews with ASGM miners in Niassa Province on aspects related to health were conducted and concluded that:

- Miners do not seek health care as often as required;
- Some miners prefer to seek out to ancestral medicine practitioners;
- Modern medicine is sought mainly in cases of flu, back pain, malaria, etc.;
- For accidents and serious injuries, the best health services are located in neighbouring Tanzania;
- The behaviour of not seeking health care may be related to the associated costs;
- Tanzania's health services are generally more expensive;
- A considerable proportion of miners are reluctant to seek health care because this means losing time from work and therefore losing the day's income; and
- The area of health services is cross-border and services do not seem to discriminate against non-locals.

The WHO is helping to combat mercury poisoning and other health risks related to ASGM by strengthening the national health systems, developing training manuals for health professionals, helping to establish national chemical observatories and reaching out to a regional network of contaminationcontrol centres.

IV. National Objectives and Reduction Targets

ASGM in Mozambique has registered exponential growth in recent years, thus contributing to the

employment and income of the people involved, mainly in rural areas. However, this practice is characterised by informality, low compliance with laws and regulations and low application of environmental, health and safety procedures at work. The informality of this sector reduces the benefits for the country's economy and consequentlyimpactsthe generation of State revenue and subsistence of families.

Environmental and health issues in the ASM sector were the main highlights during the the national baseline overview of the use of mercury in ASGM. Lack of environmental protection was noted, leading to contamination of water, air and soil in and around the mines.The health sector lacks capacities in detecting, diagnosing and treating mercury poisoning cases. In addition, the country does not have laboratories to test mercury-contaminated samples. These and other circumstances are detrimental and affect miners and the surrounding communities.

Technically viable, affordable, and efficient technology solutions are the main options to support artisanal and small-scale miners to decrease and/or eliminate the use of mercury during the processing of gold.

The Mozambican Government, through the National Directorate of Geology and Mines and the National Institute of Mines (INAMI), institutions under the Ministry of Mineral Resources and Energy (MIREME) have been assisting ASM practitioners in general for their formalisation and subsequent regularization and dissemination of good practicesof mining licenses.

Tables 10, 11, and 12 show the summary of the work carried out in the period from 2015 to March 2021. Figure 21 illustrates some activities carried out in the context of awareness and dissemination of good practices, with emphasis on the use of activation systems, construction, and handling of gutters (sluice boxes).

Table 10: Distribution of ASM Associations/Cooperatives

Formalisation			
Province	**Associations/Cooperatives of artisanal miners**		
	forGold	**Other Minerals**	**Total**
Maputo	-	6	6
Gaza	-	4	4
Inhambane	-	6	6
Manica	4	2	6

Sophala	-	1	1
Zambezia	5	12	17
Tete	1	-	1
Nampula	3	7	10
Cabo Delgado	13	10	23
Niassa	4	3	7
Grand total	30	51	81

Table 11: Dissemination of good extraction and processing practices carried out in ASM

Dissemination of good extraction and processing practices					
Year	for Gold	Other Minerals	Number of beneficiary miners		
			Women	Men	Total
2015	5	1	132	268	400
2016	1	0	18	39	57
2017	6	8	96	279	375
2018	12	13	226	748	977
2019	7	10	86	367	453
2020	4	2	39	272	311
2021	5	7	58	302	360
Grand total	**40**	**41**	**658**	**2 275**	**2 933**

Table 12: Geological survey areas carried out in support of ASGM

Geological survey in support of ASGM		
Province	Gold	Total
Maputo	-	-
Gaza	-	-
Inhambane	-	-
Manica	9	9
Sophala	-	-
Zambezia	1	1
Tete	1	1
Nampula	-	-

Cabo Delgado	2	1
Grand total	13	13



Figure 21: (A and B) - Implementation of activation systems; (C) - Mining security through the construction of containment systems; (D) - Construction and handling of sluice boxes (INAMI, 2020)

INAMI has built a mining technology laboratorycurrently in the equipping stage (Figure 22) that will carry out research and development studies of gold processing flowsheets (crushing, grinding, granulometric testing, gravity concentration, centrifugal concentration, flotation tests and leaching) specific to gold recovery operations, including monitoring of environmental issues, to further improve the performance of artisanal and small-scale mining operations.



Figure 22: Mining Technology Laboratory

Objectives and Targets

The main goal of the National Action Plan is to implement actions that guarantee the reduction and/or elimination of mercury use in ASGM, safeguarding the environment and all living beings.

During the baseline, the amount of emissions and releases of mercury in the ASM sector in Mozambique for the studied areas was determined very high in soil sample, and similar scenarios are believed to occur in other 94 areas yet to be studied. Aligned with that its expected by 2030 to reduce mercury usage in ASGM by 80% according to table bellow:

Table 13: National targets for the reduction of mercury use and discharges in ASGM

National targets for the reduction of mercury use and discharges in ASGM				
Types of action	Targeting (identified sites)	Short term (2022 – 2023)	Medium term (2024 – 2026)	Long term (2027 – 2030)
Control of mercury use in in primary deposits	Niassa province (6) Cabo Delgado province (8) Nampula (11) Tete province (52) Zambezia (7) Manica province (13) Sofala province(4)	10% reduction in mercury use	50% reduction in mercury use	80% reduction in mercury use

Technological adoption and improvements that foster the mercury-free production of gold in primary deposits	Niassa province (6) Cabo Delgado province (8) Nampula (11) Tete province (52) Zambezia (7) Manica province (13) Sofala province(4)	15% of gold production is mercury-free	50% of gold production is mercury-free	85% of gold production is mercury-free

Improvements should be made around the following lines:

- Reduce the emissions and releases and the risks of mercury exposure and environmental pollution caused by ASGM, ensuring the complete conversion from the harmful technologies and practices used for the extraction and processing of gold and banning the illegal trade and use of mercury;
- Progress on the formalization of the ASM sector to ensure better conditions for the miners, greater control of the activity and tax collection for the state;
- Create a legal and regulatory framework that facilitates the practice of this activity and commercialization of the mineral resources;
- Build and strengthen the institutional capacity regarding mercury through the development of a mercury trade tracking system, detection and analysis of mercury samples, and regional cooperation regarding mercury trade;
- Implement a public health strategy on exposure, diagnosis and treatment of complications related to mercury use in ASM by analysing public health concerns in the mining sector, which will facilitate villages in being aware of the health effects of mercury, diagnosis and treatment of mercury exposure;
- Prevent exposure of vulnerable communities in and around mines to mercury emissions and releases;
- Disseminate and promote the use of alternative and responsible technologies in the extraction and processing of gold in artisanal and small-scale mining;
- Develop, raise awareness and enforce occupational safety and health standards; and
- Develop a strategic environmental management plan.

V. Implementation Strategies

V.1. Actions to eliminate worst practices inASGM

Objectives	Strategy	Intervention Actions/Activities	Expected results	Implementation Level	Responsible Authority	Implementation Partner
1 Reduce emissions and risks of exposure to mercury by the ASGM sector in the amount of 70% by 2030	**1. 1. Actions to eliminate worst practices (as required by point 1(b) of Annex C of the Minamata Convention)**	**1.1.1. Elimination of ore amalgamation**				
		1.1.1.1. Improve the ASM regulatory framework	- Creation of guidance measures on the use and commercialisation of mercury	National	MIREME	MTA MIC MINT MISAU
		1.1.1.2. Development and production of communication materials to illustrate the dangers of the mercuryamalgamation process and its impacts	- Reduction of emissions and exposure to mercuryin ASGM activities - Increased knowledge on alternative methods to gold processing - Reduction of exposure of ASGM miners to mercuryemissions - Reduction of environmental contamination by mercury	National	MIREME	SPI MTA
		1.1.1.3. Conducting awareness programmes on the use of mercury and its dangers	- Greater knowledge about the dangers of mercuryfor public health and the environment - Promote the use of mercury-free techniques and technology and processing of gold	National	MIREME	SPI MTA MISAU

			- Adoption of safety and health measures in the use of mercury			
		1.1.1.4. Conducting demonstrations on alternative methods to the use of mercury	- Greater adoptionof mercury-free processing technologies - Improved skills in using and handling mercury-free technologies	National	MIREME	SPI MTA MISAU
		1.1.1.5. Creation of a direct communication platform between ASGM miners and mining equipment suppliers	- Availability and ease of access to mercury-free technologies - Adoption of mercury- free techniques and technologies	National	MIREME	SPI MIC MCT Universities
		1.1.1.6. Create guidelines on responsiblegoldmining and processing	- Guidance on the processing of gold without the use of mercury - Adoption of mercury- free techniques and technologies - Reduction or elimination of mercury in gold processing	National	MIREME	COCASM SPI
		1.1.2. Elimination of open-circuit amalgam burning				
		1.1.2.1. Facilitate access to tools / mercury containment technologies in ASGM	- Reduce or eliminate emissions and exposure to mercuryin the ASGM sector	National	MIREME	SPI MIC MCT Universities

V 2. Steps to facilitate formalization or regulation of the ASGM sector (as required by point 1 (c) of Annex C of the Minamata Convention)

Objectives	Strategy	Intervention Actions/Activities	Expected results	Implementation Level	Responsible Authority	Implementation Partner
2. Improve the formalization process of the ASGM sector by 2025	**2.1: Steps to facilitate formalisation or regulation of the ASGM sector (as required by point 1 (c) of Annex C of the Minamata Convention)**	**2.1.1 Support the development of the ASM Strategy Implementation Plan**				
		2.1.1.1ASM regulation	- Simplify the licensing process forartisanal miners	National	MIREME	SPI DNRN
		2.1.1.2 Regulation of the commercializationof mineral products	- Simplify the commercializationprocess	National	MIREME	SPI
		2.1.1.3. Create partnerships with the private sector for support in the formalizing of ASGM	- Formalize ASM - Improve the value chain in ASGM - Improve the marketing cycle	National	MIREME	MIC CTA Other economic associations
		2.1.1.4. Capacity-building and institutional alignment of ASM intervening sectors	- Develop organizational structures and development programmes for ASM - Strengthen the involvement of the inter-ministerial committee for the coordination of artisanal and small-scale mining (COCMAPE) in ASM	National	MIREME	COCMAPE

			activities			
		2.1.1.5. Intensify ASM formalization	- Creation of associations and cooperatives of artisanal miners	National	MIREME	DNRN SPI
		2.1.1.6. Dissemination of mining techniques and mercury-free processing in ASGM areas	–Reducing emissions and exposure of mercury in the areas of ASGM - Massification of the use of mercury- free techniques and technologies - Reduction of the exposure of ASGM miners to mercury - Reduction of environmental contamination by mercury	National	MIREME	SPI MTA
		2.1.1.7. Train public and private vocational institutions in the geological-mining area in responsiblemethods for extracting and processing gold	- Vocational institutions with the capacity to train in responsiblemercury-free methods	National	MIREME	MTA
		2.1.1.8. Promote the mining extension services programme	- Technical Assistance Facility - Ease of monitoring and follow-up on ASGM activities	National	MIREME	SPI
		2.1.2. Update qualitative and quantitative data on ASGM				
		2.1.2.1. Conduct qualitative	- Update database on the use of	National	MIREME	SPI

			ASGM surveys	mercury			INE
			2.1.2.2.				
Objectives		**Strategy**	**Intervention Actions/Activities**	**Expected results**	**Implementation Level**	**Responsible Authority**	**Implementation Partner**
3. Reduce level of	**3.1**		Update data on the estimate of Mercury amounts used in ASGM	- Levels of concentration and emission of Hg are known at the national level	National	MIREME	SPI
			3.1.1. Identifymercury-free techniques and technologies for the processing of gold in ASGM				

V.3 Strategies to promote the reduction of emissions and risks of exposure to mercury

mercuryexposure and emissions by the year 2025	**Promote the reduction of emissions and exposure to mercury (as required by point 1 (e) of Annex C of the Minamata Convention**	**3.1.1.1.** Identify mercury-free techniques and technologies	- Identifymercury- free gold processing techniques and technologies	National	MIREME	SPI
		3.1.1.2. Promote the production of closed-circuit amalgam burning equipment using local materials	- Ease of access to closed-circuit amalgam burning equipment - Reduction of mercuryemissionsand exposure to mercury - Reduce amount of residues containing mercuryinto theenvironment - Reduce the risk of contamination by inhalation of mercury	National	MIREME	SPI
		3.1.2. Support the use of mercury-free technologies				
		3.1.2.1. Train ASGM miners in mercury emission containment techniques and technologies	- Empower ASGM miners on the application of mercury waste containment and emission techniques and technologies - Reducemercuryemissioneffluents in ASGM areas	National	MIREME	SPI

		3.1.2.2. Create a mechanism of interaction between mining cooperatives and financial institutions	- Create conditions for access to financing by ASM - Increased capacity to acquire responsiblemercury-free techniques and technologies	National	MIREME	SPI

V.4. Strategies for managing trade and smuggling of Mercury and its compounds in Mozambique

It is assumed that in Mozambique,mercury reaches ASGM sites through foreign informal traders, who at the same time buy goldfrom miners. In addition, mercury can also be diverted from the sectors where it is used such as dental amalgams and mercury-added products (i.e., thermometers, laboratory equipment).

- **Survey of mercury supply and tradeflows**

Mercury supply and trade flows in the ASGM sector will be investigatedand will target both legal and illegal sources of mercury imports, including likely points of entry and distribution networks within the country. In order to obtain better information and directly involve the ASGM stakeholders, a participatory approach will be adopted during the research period, and the study will be carried out with the participation of COCMAPE.

- **Establishment and capacity-building of an inter-ministerial committee monitoring mechanism**

The Inter-ministerial Committee (COCMAPE) will be in charge of monitoring the supply and trade of mercury in the ASGM sector. To enable the committee to effectively carry out this activity, technicians will be trained on mercury's characteristics and health impacts.Procedures for documenting, tracking, and verifying mercury trade under Article 3 of the Minamata Convention (Supply and Trade of Mercury) will be established.

- **Involvement of laboratories and other users of mercury to avoid their diversion to ASGM**

As part of the monitoring, COCMAPE will organise several meetings with laboratories, importers, and producers of mercury-added products (such as thermometers, batteries, and fluorescent lamps) in order to obtain their support to ensure that the mercury that is used in its products and processes is not diverted to ASGM.

- **Training of customs officials in monitoring and supervision of illegal mercury trade**

Customs officials will be trained in supervisionof the illegal trade of mercury since they play a major role in inhibiting the illegal trade in gold comingfrom ASGM.

VI 5. Strategies for participation and transfer of information among all interested parties in the implementation and continuous development of the National Action Plan

It is important to establish practical mechanisms for interaction between the various stakeholders involved in the ASGM activities in order to actively participate and exchange in the execution of activities undertaken by the different national and local institutions for the implementation of this National Action Plan.

The following table describes the intervention measures:

Table 13: Functions of COCMAPE Sectors

N ª	Institutions	Organic Sectors	Activities
1	MIREME	DNGM	Coordinate all COCMAPE activities.
		IGREME	Intensify inspection and monitoring actions in ASGM areas. Ensure direct contact among operators (miner, trader, and other partners) in advising on the dangers of using mercury.
		INAMI	Train operators and miners in responsiblemercury- free extraction and processing technologies; and Promote, support,accompany,and control the use of good practices in ASGM.
		UGPK	Tracking and recording of goldproduction in areas of ASGM processing that use mercury.
2	MORPRH		Intervene in the management of water resources in ASGM areas and disseminate probable impacts of mercuryin water courses.
3	MISAU		Ensure monitoring of public health problems associated with the use of mercuryin ASGM.
4	MTA		Promote environmental management in ASGM areas to maximise the control of harmful practices and minimize environmental impacts related to the use of mercury.
5	MINT -MEF		Control the illegal commercializationof mercury.
6	MGCAS		Disseminate child protection policies and programmes in ASM activities, taking into account the dangers of using mercury.
7	MITESS		Reduce occupational health problems related to the use of

		mercury in ASM activities.
8	MINEDH	Develop initiatives aimed at encouraging children not to use mercuryand to abandon mining activities.

V. 6. Public Health Programme on mercuryexposure to miners and mining communities

The public health programme is crucial for the implementation of the NAP, as mining and surrounding communities are vulnerable to mercury exposure and other health effects. This programme will clarify roles and responsibilities based on national and international best practices in mercury management policies, considering the strengthening of the health system and coordination of COCMAPE cross-sectoral activities related to the ASGM sector. For its effectiveness, this broader and stronger health system will take into account the following activities:

- Establish a mechanism to facilitate health sector engagement and collaboration with other relevant stakeholders in ASGM;
- Include simple protocols on prevention, diagnosis and treatment of disease caused by mercury as part of heavy metal programmes;
- Develop Standard Operating Procedures (SOP) to support engagement and response to ASGM-related health issues;
- SOPs includeguidelines related to administering first aid treatment in case of poisoning by mercury or other health problems related to ASGM activities; and
- Implement guidelines for first aid volunteers of community health care in remote ASGMareas and who do not have quick access to health clinics.

Provide ASGM communities with basic health services

As a final component of the public health programme, various actions will be taken to provide ASGM communities with health services as part of the provision of on-going support:

- Conduct basicoccupational health and safety training. This training will have components on identifying and addressinghealth risk related to ASGM, use of appropriate personal protection equipment and other more general health, sanitation and safety considerations of importance in rural areas of Mozambique (for example, malaria, STDs, cholera, etc.); and
- Provideessential safety equipment to mitigate health risks, includingthe provision of personal

protective equipment such as gloves, masks, helmets, as well as first aid kits for miners.

The public health programme has the following expected outcomes:

a) Reduction of health problems in ASGM activities through the adoption of safer mining practices by miners;
b) Effectively addressinghealth-specific issues in ASGM with existing programmes and initiatives;
c) Collection of health data in the ASGM sector;
d) Training of health personnel on health risks associated with the ASGM activity; and
e) Strengthening the health system in coordination with the Inter-Ministerial Committee (COCMAPE).

V. 7. Strategies to prevent exposure of vulnerable populations, particularly children and women of childbearing age, to mercury used in ASGM.

Objectives	Strategy	Intervention Actions/Activities	Expected results	Implementation Level	Responsible Authority	Implementation Partner
7. Reduce the exposure of vulnerable populationstomercury used in the ASGM sector by 2025	**7.1. Prevent exposure of vulnerable populations, particularly children, women of childbearing age, pregnant women, and mothers nursing, by mercury used in ASGM (as required by paragraph 1 (i) of the Annex C of the Minamata Convention)**	**7.1.1. Conduct community programmes to emphasise risks and vulnerability in relation to the use of mercury**				
		7.1.1.1. Create awareness and socialization programmes along vulnerable mining communities	- Increased knowledge about risks, mitigation methods, and alternatives to the use of mercury - Reduction of exposure levels to mercury -Develop miners' skills in mining practices that reduce the exposure of vulnerable populations to mercury	National	MIREME	DNGM MTA MISAU
		7.1.1.2. Develop documentaries, pamphlets, and informative leaflets about the dangers of mercury to human health and the environment, for display in ASGM areas.	- Increased knowledge about risks,mitigation methods, and alternatives to the use of mercury - Reduction of exposure levels to mercury	National	MIREME	DNGM MTA MISAU

		7.1.1. 3. Facilitate local ASGM exchange in relation to the transfer of knowledge and technology-related practices free from mercury	- Increased adoption of mercury-free technologies	National	MIREME	DNGM MGCAS
		7.1.2. Strengthen the application of legislation regarding the participation of child labour in ASGM activities				
		7.1.2.1 Strengthen the application of existing labour laws	- Reduction of child labour in ASGM activities	National	MIREME	MITESS MIGCAS MISAU
		7.1.2.2 Strengthen the national action plan to combat the worst forms of child labour in ASGM	- Reduction in the participation of child labour in ASGM activities	National	MIREME	MITESS MGCAS MISAU
		7.1.2.3 Perform regular inspections to ensure legislative enforcement	- Reduction in the number of children involved in ASGM	National	MIREME	MITESS MIGCAS MISAU
		7.1.2.4. Conduct awareness-creation programmes of children who practice ASGM as to return	- Reduction in the number children participating in ASGM - Increase in the number of children going to school at the expense of	National	MINEDH	MINEDH MIGCAS MISAU

		them to schools	ASGM			

V. 8. Strategies to provide information to artisanal and small-scale miners and to affected communities

Objectives	Strategy	Intervention Actions/Activities	Expected results	Implementation Level	Responsible Authority	Implementation Partner
8. Intensify awareness in the use of mercury in ASGM and its impacts	**8.1) Provide information to artisanal and small-scale miners and communities (as required by point 1 (j) Annex C of the Minamata Convention**	**8.1.1 Develop CommunicationProgrammes**				
		8.1.1.1. Develop awareness programmes on the use of mercury in ASGM along with its impacts	- Mining Communities made aware of the dangers of using mercury and its impacts	National	MTA	MIREME MISAU
		8.1.1.2. Organize events to spread messages about the dangers of using mercuryin gold mining	- Increase public knowledge and wide dissemination of information about mercury and its impacts - Increase adoption of best practices	National	MTA	MIREME MISAU
		8.1.2. Document and disseminate information on the use of mercury and its impacts				
		8.1.2.1. Produce and translate into local languages information and educational material on the effects of mercury on public health and the	- Increased public knowledge and wide dissemination of information about mercury and its dangers - Increased adoption of better mining practices	National	MISAU MTA	MIREME

		environment				
		8.1.3. Implement and disseminate information on the use of mercury and its impacts				
		8.1.3.1. Hold meetings with miners to disseminate information about the effects of mercury on human health and the environment, including best practices	- Massify knowledge about mercury and its impacts at the community level	National	MISAU MTA	MIREME
		8.1.3.2. Establish partnerships with social communication organisations to socialise messages about the dangers of using mercury and their impacts	- Maximise the dissemination of the effects of mercury	National	MTA MISAU	MIREME media
		8.1.3.3. Conduct training for extension workers and district technicians on the effects of mercury on human health and the environment	- Sustainability in ASGM activities	National	MISAU MTA	MIREME
		8.1.3.4. Develop mechanisms for information sharing between artisanal miners and stakeholders	- Ease of communication and creation of partnerships between miners and stakeholders	National	MIREME	MISAU MTA MITESS
		8.1.3.5. Create partnerships for sharingASGM information and	- Creation of institutional capacity in the ASGM area	National	MIREME	MISAU

		experiences				MTA

V. 9. Strategies for instituting market-based mechanisms to promote reduced use of mercury

Market-based mechanisms provide financial support and reduce costs through the adoption of alternative technologies to mercury that enable its transition to responsibletechnologies. On the other hand, these market-based mechanisms are needed to make the affordability and use of mercury too expensive. This will require subsidising alternative mercury- free technologies to make them cheaper and more accessible.

Objectives	Strategy	Intervention Actions/Activities	Expected results	Implementation Level	Responsible Authority	Implementation Partner
9. Develop market-based mechanisms for reduced use of mercury by 2025	**9.1. Implement market-based mechanisms to promote reduction in the use of mercury (as in section 2 of Annex C of the Minamata Convention)**	**9.1.1. Establish incentives for the use of alternative methods to mercuryin ASGM operations**				
		9.1.1.1. ASGM regulations	- Establish incentives for the use of alternative methods to mercury in ASGM operations - Establish incentives for refineries that use gold processed without mercury - Establish incentives for holders of commercial licenses for gold processed without	National	MIREME	SPI MEF

			mercury			
		9.1.1.2. Create mechanisms to secure lines of credit for ASGM miners under the condition of zero use of mercury in the processing of gold	- Adoption of technologies free of mercury - Reduction of mercury emissions and their impacts	National	MIREME	MEF
		9.1.2. Establishing market standards to determine gold processed without mercury				
		9.1.2.1. Certificate of origin of gold issued mentioning processing with or without mercury	- Reduced use of mercuryin ASGM - Increase in the value of gold processed with mercury-free methods	National	MIREME	MEF
		9.1.2.2. Monitor and inspect ASGM local and border points where the mercury trade is done	- Reduced use of mercuryin ASGM	National	MIREME	MINT MEF

VI. Work Plan

Strategy	Intervention Actions/Activity	Priorities	Activity leadership	Timeline					Funding source	Expected results	Indicator	Activity cost (USD)
				22	23	24	25	26				
Actions to eliminate worst practices (as required by point	Improve the ASM regulatory framework	Short Deadline	MIREME						Government, and Implementing Partners	- Creation of guiding measures on the use and commercialisation of Hg.	Approved specific ASM regulation	**125 000**
	Development and production of communication materials to illustrate the dangers of the Hg amalgamation process and its impacts	Short Deadline	MIREME						Government, Implementing Partners	- Reduction of emissions and exposure to Hg in ASGMactivities; - Greater knowledge about alternative methods inGold processing; - Reduction of exposure of ASGM miners to Hg emissions; - Reduction of environmental contamination by Hg.	Number of communication materials produced and disseminated	**190 000**
	Conducting awareness programmes on the use of	Long-term	MIREME						Government, Implementing	- Greater knowledge about the dangers of Hg	Number of awareness programmes carried	**70 000**

1(b) of Annex C of the Minamata Convention	Mercury and its dangers								Partners	for public health and the environment; - Promote the use of Hg-free techniques and technologies inGold processing; - Adoption of safety and health measures in the use of Mercury.	out in ASGM areas	

	Produce guiding guides on the sustainable processing of Gold	Short Deadline	MIREME						Government, Implementing Partners	- Guidance on the processing of Gold without the use of Hg; - Adoption of Hg-free techniques and technologies; - Reduction or elimination of Hg in Au processing.	Number of guides produced and broadcast	**80 000**
	Conducting demonstrations on alternative methods to the use of Hg	Long-term	MIREME						Implementation Partners	–Massive use of Hg-free processing technologies; - Improved skills in using and handling Hg-free technologies.	Number of demonstrations performed	**390 000**
	Creation of a direct communications platform between ASGM miners and	Short Deadline	MIREME						Government, Implementing Partners	- Availability and ease of access to Hg-free technologies;	An operationalised communications platform	

	mining equipment suppliers.									- Adoption of Hg-free techniques and technologies.		**22 500**
	Facilitate access to Mercury containment tools/technologies in ASGM	Short Deadline	MIREME						Government, Implementing Partners	- Reduced or eliminated emissions and exposure to Hg in the ASGM sector.	Number of implemented technologies	**22 500**
Steps to facilitate formalisation or regulation of the ASGM sector (as required by point 1 (c) of Annex C of the Minamata Convention)	Regulation of the ASM[1] sector	Short Deadline	MIREME						Government, Implementing Partners	- Simplify the Licensing process for Artisanal Miners.	Approved specific ASM regulation	-------
	Regulation of the sale of mineral products under the Kimberley process, precious metals, and gemstones [2]	Short Deadline	MIREME						Government, Implementing Partners	- Simplify the marketing process.	Regulation for the marketing of mineral products under the Kimberley process, updated precious metals, and gemstones	-------
	Create partnerships with the private sector to support the formalisation of ASGM	Medium and Long-term	MIREME						Government, Implementing Partners	- Formalisation of ASGM; - Improve the value chain in ASGM; - Improve the marketing circuit; -Increase in revenue for the State.	Number of partnerships created	**6 500**
	Strengthening and institutional alignment of the sectors involved in ASM	Short Deadline	MIREME						Implementation Partners	- Develop organisational structures and development programmemes for ASM;	Aligned inter-sectoral interaction in the management of ASM	**280 000**

										- Reinforce the committee's commitment; inter-ministerial coordination of artisanal and small-scale mining (COCMAPE) in ASM activities.		
	Intensify the formalisation of ASM	Long-term	MIREME						Implementation Partners	- Creation of associations and cooperatives of Artisanal Miners.	Number of cooperatives created	**172 500**

	Dissemination of Mercury-free mining processing techniques and technologies in ASGM areas.	Long-term	MIREME						Government, Implementing Partners	–Reduction of Mercury emissions and exposure in ASGM areas; - Massification of the use of Hg-free techniques and technologies; - Reduction of exposure of ASGM miners to Mercury;	Number of disseminations of techniques and technologies carried out	**160 500**

										- Reduction of environmental contamination by Mercury.		
	Train public and private vocational institutions in the geological-mining area in sustainable methods of extracting and processing Gold	Long-term	MIREME						Implementation Partners	- Vocational institutions with the capacity to train in Mercury-free sustainable methods.	Number of qualified institutions trained	**90 000**
	Promote the mining extension services programme	Long-term	MIREME						Government, Implementing Partners	- Ease of technical assistance; - Ease of monitoring and following up on ASGMactivities.	Number of programmes promoted	**310 000**
	Update data on Hg levels in ASGM	Long-term	MIREME						Government, Implementing Partners	- Know the levels of concentrations and emissions of Hg at the national level.	Number of updates performed	**270 000**
	Conduct qualitative surveys on ASGM	Long-term	MIREME						Government, Implementing Partners	- Update the database on the use of Hg.	Number of inquiries carried out	**150 000**
	Identify Mercury-free techniques and technologies	Short-term	MIREME						Government, Implementing Partners	- Hg- free Gold processing techniques and technologies	Number of techniques and technologies identified	**26 750**

										identified.		
Promote the reduction of emissions and exposure to Mercury (as required by point 1 (e) of Annex C of the Minamata Convention	Promote the production of closed-circuit amalgam burning equipment using local material.	Short-term	MIREME						Government, Implementing Partners	- Ease of access to closed-circuit amalgam burning equipment; - Reduction of emissions and exposure to Hg; - Reduced amount of waste containing Hg in nature; - Reduced risk of contamination by inhalation of Hg.	Number of equipment promoted	**47 500**
	Train ASGM miners in techniques and technologies to contain Mercury emissions	Short-term	MIREME						Government, Implementing Partners	- ASGM miners trained on the application of techniques and technologies to contain Mercury emissions and effluents; - Reduced Hg effluent emissions in ASGM areas.	Number of trained miners	**172,000**
	Create an interaction mechanism between	Long-term	MIREME						Government, Implementing	- Create conditions for access to	Number of loans granted	

	mining cooperatives and financial institutions								Partners	financing in ASGM; – High capacity for acquisition of sustainable and Hg-free techniques and technologies.		**25 000**
Trade management and for smuggling of Mercury and its compounds inMozambique	Survey of Mercurysupply and marketing circuit	Long-term	MIREME						Government, Implementing Partners	- Mercury supply and marketing circuit identified.	Number of circuits identified	**125 000**
	Operationalise the activities of the inter-ministerial committee	Short-term	MIREME						Government, Implementing Partners	- Document, track and verify trade	Functional Inter-Ministerial Committee	**117 000**
	Involvement of laboratories and other users of Mercury to avoid their diversion to ASGM	Short-term	MIREME						Government, Implementing Partners	- Ensure that Mercury used by laboratories in their products and processes is not diverted to ASGM.	- Reduced availability of Hg from laboratories and other users	**15 000**
	Training of customs technicians in the monitoring and inspection of illegal Mercury trade	Short-term	MIREME						Government, Implementing Partners	- Training of customs officials in supervising the illegal trade of Mercury.	Number of trained customs technicians	**125 000**
Participation and transfer of information among all stakeholders in the	Establish inter-sectoral interaction mechanisms for the variousASGM stakeholders	Long-term	MIREME MISAU						Government, Implementing Partners	- Intensify ASGMinspection, supervision, and monitoring activities.	Established inter-sector interaction mechanisms	**110 000**

implementation and on-going development of the National Action Plan											
Public Health Programme on Mercury Exposure of Miners and Mining Communities	Develop a public health programme in ASGM communities	Short-term	MISAU						Government, Implementing Partners	- Develop simple protocols for the prevention, diagnosis, and treatment of Mercury as part of heavy metal programmes; - Implement health care guidelines in ASGM.	Public health programme developed and operated	**130 000**
	Carry out awareness and dissemination programmes with vulnerable mining communities	Long-term							Government, Implementing Partners	- Increased knowledge about risks and methods of mitigation and alternatives to the use of Mercury. - Reduction of exposure levels to Mercury; -Develop miners' skills in mining practices that reduce	Number of awareness and dissemination programmes carried out	**60 000**

										the exposure of vulnerable populations to Mercury.		
Prevent exposure of vulnerable populations, particularly children and women of childbearing age, to Mercury used in ASM	Develop documentaries and produce pamphlets and information leaflets on the dangers of Mercury to human health and the environment, to be displayed in ASGM areas.	Short-term	MIREME						Government, Implementing Partners	- Increased knowledge about risks and methods of mitigation and alternatives to the use of Mercury; - Reduction of exposure levels to Mercury.	Documentaries, pamphlets, and leaflets produced	**115 000**
	Establish partnerships for the transfer of Mercury-free technologies in ASGM	Long-term	MIREME						Implementation Partners	- Massification ofMercury-free technologies.	Number of partnerships established	**125 000**
	Strengthen the application of labour legislation	Medium and Long-term	MIREME						Government, Implementing Partners	- Reduction of child labour in ASGM's activities.	Enhanced Labour Legislation	**42 500**
	Strengthen the national action plan to combat the worst forms of child labour in ASGM	Short-term	MIREME						Government, Implementing Partners	- Reduction in the participation of child labour in ASGM activities.	Reduced child labourin ASGM	**78 000**
	Carry out regular	Short-term	MIREME						Government,	- Reduction in the	Number of	

	inspection to ensure the applicability of legislation								Implementing Partners	number of children involved in ASGM.	inspections performed	**100,000**
	Conduct awareness programmes for children who practice ASGM for their return to schools	Short-term	MINEDH						Government, Implementing Partners	- Reduction in the number of children participating in ASGM; - Increase in the number of children going to school at the expense of ASGM.	Number of awareness programmes carried out	**55 000**
Provide information to artisanal and small-scale miners and communities (as required by point 1(j) of Annex C of the Minamata Convention	Develop awareness programmes on the use of Mercuryin ASGM and its impacts	Short-term	MISAU MTA						Government, Implementing Partners	- Mining communities made aware of the dangers of using Hg and its impacts.	Number of awareness programmes carried out	**47 500**
	Produce and translate into local languages information and educational materials on the effects of Mercury on public health and the environment	Short-term	MIREME						Government, Implementing Partners	- Increased public knowledge and wide dissemination of information about Mercury and its dangers; - Increased adoption of better mining practices.	Number of educational informational materials produced and translated	**130 000**
	Establish partnerships with local media to	Short-term	MIREME						Government, Implementing		Number of partnerships	

	spread messages about the dangers of Hg use and its impacts								Partners	- Maximise disclosure about the effects of Mercury.	established	**22 500**
	Conduct training for extension workers and district technicians on the effects of Mercury on human health and the environment	Medium and Long-term	MIREME						Government, Implementing Partners	Sustainability in ASGMactivities.	Number of trainings carried out	**176 000**
	Create partnerships for sharing of information and experiences inASGM	Medium and Long-term	MIREME						Government, Implementing Partners	Creation of institutional capacity in the area of ASGM.	Number of partnerships created	**41 000**

	Regulation of ASGM[1]	Short-term	MEF					Government, Implementing Partners	- Establish incentives for the use of alternative methods to Mercury in ASGM operations; - Establish incentives for refineries that use Gold processed without Mercury; - Establish incentives for holders of	Regulations produced	----------

										commercialisation licenses for Gold processed without Mercury.		
Institute market-based mechanisms to promote the reduced use of Mercury (as per point 2 of Annex C of the Minamata Convention)	Create mechanisms to secure lines of credit for ASGM miners under the condition of zero use of Mercury in the processing of Gold	Short-term	MIREME						Government, Implementing Partners	- Adoption of Mercury-free technologies; - Reduction of Mercury emissions and their impacts.	Number of loans granted	**11 500**
	Certificate of origin of Gold issued mentioning the processing with or without Hg	Medium and Long-term	MIREME						Government, Implementing Partners	- Reduced use of Mercury inASGM; - Increased value of Gold processed with Mercury-free methods.	Number of certificates issued	**122 000**
	Monitor and inspect ASGM sites and border points where Mercury trade takes place	Long-term	MIREME						Government, Implementing Partners	- Reduced use of Mercuryin ASGM; - Reduction of child labour.	Number of ASGM sites monitored and inspected	**90 000**
Total cost of the plan: (USD)												**4 448 250**

VII. Implementation Steps

The National Action Plan will be implementedin four (4) years and will result in the following:

- Curtailing of illegal gold mining and use of mercury in artisanal and small-scale mining operations. ASGM will be better organised and better able to manage and reduce the negative impacts of mining on the environment and human health;

- ASGM operators will be empoweredwith knowledge and understanding of the need and importance of environmental protection, occupational safety and health, and protection against pollution, exposures, and hazards will be increased;

- There will be more openness for the participation of non-governmental organisations, citizens, and business entities in policy development, decision-making, and policy implementation for the development of small-scale and artisanal gold mining;

- Improved and increased capacity of vulnerable groups, including children and women, especially pregnant women, to protect themselves and their families from potential risks of mercury;

- Improved formalization of employment in mining operations, thus contributing to the livelihood of citizens,whichwill have positive impacts on the composition of budget revenue and well-being of communities;

- With the development of responsible artisanal gold mining and elimination of inadequate and out-dated technology harmful to human health and the environment, it will be in a position to bring more significanteconomic and health benefits; and

- Increased awareness of artisanal and small-scale miners concerning the environment, protection, and legal aspects of environmental protection. This will result in a reduction in crime against the environment, and in budgetary expenditures for its remediation.

VIII. Evaluation Mechanism

The main function of the Coordination Committee for Artisanal and Small-Scale Mining (COCMAPE) is to supervise and ensure the harmony and coordination of activities for the formalization of artisanal mining, enable responsible practices in the artisanal and small-scale mining sector, and ensure the sustainability and continuity of the implementation of the NAP.

The final implementation of the NAP evaluation mechanism, in accordance with the Minamata Convention, will take place in 2030.

This sectiondescribes the evaluation mechanism and the indicators that will be used to monitor and evaluate the progress of the NAP implementation in accordance with the work plan presented in section VI.

Strategy	Indicators	Targets	Means of verification	Agency Responsible	Competence/responsibility
Reduce emissions and risks related to mercury exposure and worst practices	Number of areas that adhered to sustainable/improved and alternative methods to mercury	Artisanal gold miners	Monitoring and evaluation of mercury concentration on ASGM areas	MTA	General monitoring of the Minamata Convention implementation. Validate the implementation report of the NAP in coordination with stakeholders. Monitoring of compliance with NAP strategies
Formalization of artisanal and small-scale mining	Number of formalized artisanal miners	Artisanal gold miners	Mining licence issued	MIREME	Monitoring and evaluation of the strategy for formalization/regularization of miners Monitoring and evaluation of the strategy for the reduction of illegal mining Promote mercury free technologies in ASGM areas Intensify monitoring actions in ASGM areas
Control of illegal trade and transport of mercury and its compounds	Reduction of mercury use in previously identified areas	Mercury traders and suppliers Artisanal gold miners	Regulary inspection on target ASGM areas	MIC MINT	. Control of illegal trade and use of mercury and mercury compound
Public health programme	Number of trained personnel in the detection and prevention	Community members, local authority,	Capacity bulding	MISAU	Monitoring and evaluation of the public health programme in ASGM.

	of diseases related to contamination by mercury	artisanal gold miners			
Strategy on child labour in ASGM activities	Number of child labour participation in ASGM	Parents, community members, local author, artisanal gold miners	Raise awareness	MGCAS	Monitoring and disseminate child protection policies and programmes in ASGM activities.

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X. Analysis of Mercury Amounts

Knowledge gaps

The study of the mercuryquantity baseline estimates identified existing knowledge gaps and made the following recommendations:

- Carry out a National Mercury Inventory in ASGM considering the results of the study in the provinces of Manica and Niassa;
- Identify and categorize the relevant sources of mercury discharges in ASGM areas;
- Regulate the use and management of mercury in ASGM in Mozambique;
- Improve inspection and monitoring capacity in ASGM areas;
- Intensify the use of mercury-free gold processing techniques and technologies;
- Exchange successful experiences in eliminating the use of mercury in ASGM; and
- Strengthen the inter-ministerial committee on the elimination of mercuryin ASGM.

XI. Annexes

Annex I: Composition of the working group

Name	Position	Agency
Adriano Sênvano	National Coordinator	INAMI
Zaquir Issufo	Team Leader	INAMI
Horácio Belengueze	Internal Collaborator	INAMI
Alberto Fernando Manuel	Internal Collaborator	INAMI
António Cumbane	Internal Collaborator	INAMI
Carlos Marove	Internal Collaborator	INAMI
Vânia Amâncio Chihepe	Internal Collaborator	INAMI
Wilson Mujovo	Internal Collaborator	DNGM
Mateus Alfândega	Internal Collaborator	DNGM

Annex II. Field data survey assistance questionnaire regarding the use of mercury

Annex III. NAP Disclosure Leaflet

Annex IV. Report of the Bank of Mozambique on Artisanal Mining

[1] Denmark's and Greenland's Geological Survey

[2] Rural Environment Observatory