

## **UNIDO'S POSITION**

### **STRATEGY OF THE ORGANIZATION TO ACHIEVE SUSTAINABILITY IN PROJECTS RELATED TO MERCURY POLLUTION OF INTERNATIONAL WATERS CAUSED BY SMALL-SCALE GOLD MINING**

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Artisanal mining which is sometimes used synonymously with small-scale mining means different things to different people. There is no universal definition of what constitutes an artisanal or small-scale mine. In general, artisanal mining is used to refer to those mining activities carried out by individuals, families, and/or adhoc groups (some form of co-operatives) of indigenous people, the majority of which have no technical skills and lack adequate working tools. Although the term “artisanal mining” is used in some countries, e.g., Zimbabwe, to refer to illegal alluvial gold mining activities, it is used in others to refer to those activities that are carried out without following conventional mining engineering norms. As such a good number of artisanal miners in countries like Brazil, Indonesia and Tanzania are licensed and there are policy drives to get all mining activities licensed as a way of transforming them into organized small-scale mining activities. Although there have been improvements by various countries in recognizing artisanal mining as a significant economic activity, the promulgation of legal frameworks that are conducive to this sector remains elusive.

Despite these activities being individually small, their combined economic and social impacts are substantial for the economies of many developing countries. Globally, it is estimated that up to 12% of metallic minerals, 31% industrial minerals, 20% coal, 10% diamonds and 75% of gemstones production come from small-scale mining operations. In individual countries the economic

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benefits are even higher. For example, whereas in Brazil activities of *garimpeiros* are estimated to produce 50% of the country's total gold production averaging around 60 tons, it is estimated that in both Tanzania and Zimbabwe artisanal miners have the capacity to produce 10 tonnes of gold per year. On average, it is estimated that artisanal miners in Indonesia and Laos have annual gold production of nearly 50 and 0.5 tonnes respectively. Although statistics are hard to establish, estimates show that in Sudan where artisanal gold mining is relatively limited, 10 tonnes of gold have been produced over the last thirty years (1970 to 1999). These activities provide considerable employment especially in the rural areas and thus contribute substantially to poverty alleviation. It was estimated in 1993 by the International Labour Organization, (ILO), that out of the 30 million mineworkers throughout the world, 6 million were engaged in artisanal mining in developing countries. Given the fact that rural poverty is prevalent in most developing countries, artisanal mining has room to contribute fully to economic and social development. It is now widely accepted by large mining companies that artisanal miners are one of the most important tools for finding sizeable gold deposits. Artisanal mining also allows the exploitation of marginal reserves that would otherwise be classified as uneconomical.

Although artisanal mining has shown some positive contributions, it has also suffered negative conceptualization as a misnomer to mineral sector development by host Governments. Whereas some countries choose to ignore the existence of such activities, others lack adequate legal frameworks to regulate them. As a result, the activities are carried out illegally thus denying the host Governments the badly needed revenues. Even in countries that have enacted legal and regulatory frameworks for controlling such activities, the lack of adequate resources limits the capacity to institute them effectively. The combination of this and the lack of technical know-how and financial means make it difficult for miners

to invest in appropriate technology. Mining and processing activities are carried out by manual means or through application of locally improvised but inefficient equipment and tools. As a result, the activities have become synonymous to negative environmental impacts, inefficiency, lack of adherence to health and safety standards, and activities that have negative social impacts. The uncontrolled use of mercury as a cheap means for recovering gold is now threatening the health of miners and members of communities far away from mining areas. Most of the negative factors tend to reinforce one another resulting in a vicious circle that is difficult to break. For example, the lack of regulatory mechanisms means that Governments lose the much-needed revenue that in turn makes it impossible to provide adequate control due to lack of resources. The lack of, technical know-how, access to credit facilities, and technical support coupled with poor organizational structures means that miners are unable to invest in technology and hence cannot improve their working methods. This results in negative environmental impacts, low productivity and hence earnings and the vicious circle continue.

In many gold producing countries, women are major participants in artisanal mining activities. In Laos it is estimated that almost 80% of all artisanal gold panners are women. In Zimbabwe, the majority of the 350,000 estimated artisanal miners are in gold digging and panning with 50% comprising of women and children. In Tanzania, 26% of all 600,000 artisanal miners are estimated to be women most of which mine gold and gemstones. In Sudan it is estimated that 35% and 10% of the miners consist of women and children in the Southern Blue Nile and Eastern Bayuda Desert regions respectively. Despite these impressive figures, the number of women miners with mineral rights is still limited. In other words the majority of women operators are still in the illegal miners category. Direct entry into mining production activities is often determined by taboo,

socio-cultural factors, financial and economic capacity, technology and organizational aspects.

### **ARTISANAL GOLD MINING ACTIVITIES IN INTERNATIONAL WATERBODIES**

Recently a new project has been approved by the Global Environment Facility (GEF) for UNIDO execution in six countries (GLO/01/G34). The selection of countries participating in this project was done based on the intensity of mercury based artisanal gold extraction activities and their impacts on water bodies of global significance. In the South American region, the Amazon Basin is the largest drainage system in the world with an area of about 6.0 million square kilometres. The Amazon River has a total length of 6400 kilometres, which is slightly shorter than the Nile. Stretching almost 2760 kilometres from north to south at its widest point, the Basin occupies a great part of Brazil and Peru, significant parts of Columbia, Ecuador and Bolivia and a small area of Venezuela. Almost two-thirds of the Amazon's main streams and by far the largest portion of its Basin are within Brazil. More than two thirds of the Basin is covered by an immense Amazon Rain Forest which represents about half of the Earth's remaining rain forest and constitutes the largest reserve of biological resources. At the peak of the gold rush in the 1980s, it was estimated that nearly 1.0 million people were directly involved in the activities, with 400,000 of those being in the Tapajos area alone. Available figures show that nearly 1,000 tonnes of mercury were dumped into the Amazon Basin during the 1980s and nearly 130 tonnes are currently dumped annually.

Within the participating countries of the African Region, the significant International Waterbodies include the Nile River system, Lake Victoria and the Zambezi River system. The Nile River system is composed of the Blue Nile (Abbai) River that originates from Lake Tana and the White Nile that rises from Lake Victoria. Sudan

occupies a major part of the River Nile basin. Along its course (6825 km), the Nile drains from the Equator up to the Mediterranean coast in Egypt. Areawise, the Nile basin represents one tenth of the African continent. Mining along the Nile covers nearly 2,000 km<sup>2</sup> in the Southern Blue Nile region with mine workings developed in old river terraces along the riverbanks and its tributaries at the foothills of the Ethiopian highlands. It is estimated that nearly 120,000 people are engaged in these activities. On the other hand, Lake Victoria which has an area of more than 70,000 km<sup>2</sup> is Africa's largest lake and second largest in the world only to North America's Lake Superior. The Lake, which is surrounded by one of the most highly populated areas in the world and is shared by Tanzania (51% of the Lake area), Uganda (43%) and Kenya (6%), is a source of employment for nearly 30 million people. The Lake Victoria Goldfields which cover almost 200,000 km<sup>2</sup> are estimated to employ nearly 300,000 people and produce nearly 70% of the country's total gold production. Nearly 12 tonnes of mercury are released annually to the environment in Tanzania alone. More than 50% of artisanal gold panning activities in Zimbabwe are carried out within the Zambezi River system (more than 2400 kilometres are panned) and its tributaries. The Zambezi flows along the northern and Southern borders of Zimbabwe and Zambia respectively before cutting across central Mozambique on its way to the Indian Ocean. There are about 350,000 gold panners in the country with as many as 300 panners concentrated in every kilometre of the widely panned sections of the Zambezi River system and releasing nearly 12 tonnes of mercury annually to the environment.

River Mekong in Laos and River Kahayan in Central Kalimantan, Indonesia are the significant International Waterbodies within the Asian participating countries. The River Mekong which is about 4,500 kilometres long and is a life-stay for almost 50 million people and their cultures sets out at the Qinghai plateau in Western China before flowing into Laos, Myanmar, Thailand, Cambodia and Vietnam. Although the upper portions of the river are characterized

by turbulence, the lower Mekong is more placid, and the annual flooding supports a biologically diverse ecosystem. In Laos, alluvial mining activities are carried out as seasonal activities during the dry non-agricultural season mainly by dredging on the River Mekong and its tributaries. Up to 3,000 miners have been found at any one time working on River Mekong. The Kahayan River, is the largest river in Central Kalimantan and drains directly into the Java sea and thus with effects to Singapore, the Islands of Sumatra, Java, Bali and others. Most activities are based on alluvial operations within the river systems with a few mining hard rock gold veins. However, even those in hard rock mining transport the ore to the rivers for processing. The Kahayan River in Central Kalimantan and the Tapian River in North Sulawesi are known to have a high concentration of miners per kilometre length. It has been reported that more than 2,000 illegal miners would converge on single mining site following a reported gold recovery. In Indonesia where artisanal gold mining activities are carried out either through village cooperative units or through illegal operations and are found in the provinces of West and Central Java, Sumatra, Central and East Kalimantan, North Sulawesi and others, nearly 180 tonnes of mercury are released to the environment annually.

#### **NEGATIVE ENVIRONMENTAL IMPACTS DUE TO ARTISANAL GOLD MINING**

Artisanal gold mining activities within the participating countries under review show negative environmental impacts that tend to overshadow their positive contributions. Mining is carried out either by pitting in both hard rock and in old riverbed alluvium or by dredging existing riverbeds all of which generate substantial amounts of rubble. Whereas pits in abandoned areas are dangerous to people and animals, the mined rubble blanket the top fertile soil and thus lead to loss of grazing and agricultural land. The exposed mined areas

are susceptible to accelerated erosion from both wind scour and surface runoffs and may lead to Acid Mine Drainage. Piles of tailings most of which contain toxic chemicals, e.g., mercury, are directly washed into rivers resulting to siltation and water pollution problems. Pools of stagnant water left behind during washing and abandoned flooded pits turn into breeding grounds for Malaria spreading mosquitoes. Poor sanitation from mining camps, hydrocarbons from machinery, uncontrolled use of explosives and others, add to pollution of surface and ground water systems.

During the preparatory phase of this project, it was revealed that mercury is directly released into rivers and lakes during panning of the alluvial ore or washing of the hard rock-based ore within the waterbodies. The key concerns here are the direct release of mercury into the waterbodies, its accumulation and subsequent methylation to organo-mercury and hence transfer into the food chain through the aquatic ecosystem. The transformation of inorganic mercury to an organo-metallic compound, methyl mercury, is the most significant in terms of uptake and accumulation of mercury by man as this compound can block enzymes and so damage essential metabolic processes.

Available data indicate that the amount of mercury released during burning of the amalgam is approximately in the ratio of 1.2 - 1.5:1 to the amount of gold produced. There are clear indications that mercury pollution from small-scale mining is a threat to public health not only in the proximity of mineral processing activities, but also in the mining villages themselves and even far downstream of contaminated rivers. New results from UNIDO projects in Ghana and Philippines give evidence that approximately 50 percent of gold mining communities in these countries must be considered as mercury-intoxicated, i.e. the threshold limits in body fluids are by far exceeded and the neurological symptoms can be detected.

At present, there is not any single “off-shelf ” solution to problems related to artisanal mining. The introduction of cleaner mining and extraction technology would go a long way to minimize the activities impacts to the environment, maximize the socio-economic benefits and ensure that operations are sustainable and adhere to health and safety standards. Although piecemeal solutions have been tried in many countries, a more holistic approach is required in dealing with artisanal mining problems. Attempts to such an approach that will ensure the introduction of cleaner mining and extraction technologies is a priority for UNIDO.

## **INTERNATIONAL AND NATIONAL ACTIONS**

The plight of artisanal and small-scale mining has attracted the world attention since the seventies. In 1972, the United Nations Department of Economic and Social Affairs published the proceedings from a seminar organized to discuss small-scale mining activities. Although a number of meetings have since been held and strategies laid on how to transform the sector, there have been limited actions "on the ground". A meeting of different international organizations and mining experts that was convened in Harare, Zimbabwe in 1993 in search for solutions to artisanal mining problems, came up with what is known as “The Harare Guidelines on small / Medium-Scale Mining”. The implementation of the guidelines whose main objective was to provide a framework for encouraging development of small and medium-scale mining as legal sustainable activities was left to individual countries and has had limited impacts.

In 1995 the World Bank hosted a “Round Table on Artisanal Mining” meeting in Washington to chart out a strategy for dealing with the sector's problems. The meeting came up with what the Bank published as a proposal for assistance known as “A Comprehensive Strategy Towards Artisanal Mining” aimed at minimizing the negative side effects and thus maximize socio-economic benefits of



artisanal mining. The strategy which has since been implemented in a number of countries identified the negative side effects of artisanal mining as being; unacceptable environmental practices; poor social, health and safety conditions; illegal mining and marketing and waste of resources. Where it has been implemented, the programme has succeeded in strengthening the institutional capacity and introducing internationally competitive legal, regulatory and fiscal frameworks and hence enhanced the process of legalizing the artisanal mining activities. With the increase in poverty in the developing world and the lack of coordinated international actions, the amount of mercury that is released to the environment from artisanal gold mining activities is bound to keep increasing.

Following the problems of the gold rush experienced during the 1980s, the Brazilian House of Representatives commissioned the Centre for Minerals Research, CETEM, of the Brazilian Research Council, to evaluate the state of the art of the operations, propose solutions, and advise the House on possible control legal measures. Through a four-year programme, comprehensive descriptions of the activities, data related to mercury and particulate matter pollution, proposals for control legislative measures, were produced. However, practical implementations of the findings of this programme were hampered by the lack of adequate resources especially when dealing with such a large area like the Amazon Basin. Some years later, the Government of Tanzania in collaboration with the World Bank formulated the Mineral Sector Development Technical Assistance Project in order to provide the Government with necessary technical, managerial and material support for the implementation of its new private sector oriented mining development strategies. One of the major components of the US \$13.9 million five-year project was to improve the economic, social and environmental performance of the artisanal mining in order to encourage and expand private investment in the mining sector. Although the project resulted in the country's first mining environmental legal and regulatory framework, it has not

addressed itself fully to the negative environmental impacts resulting from artisanal mining activities. The European Union in collaboration with the Government of Zimbabwe has embarked on a US \$38.7 million project part of which will be spent on development and control of the small-scale mining sector. Although there are similar programmes in other countries, most do not address environmental problems of a global nature.

#### **UNIDO'S RELEVANT EXPERIENCE AND POSITION REGARDING SUSTAINABILITY OF SMALL-SCALE MINING OPERATIONS**

Over the years, UNIDO has gained a lot of experience in dealing with artisanal related problems especially in developing countries. In 1995, UNIDO initiated a programme named "High Impact Programme" with the main theme being to "Introduce New Technologies for the Abatement of Global Mercury Pollution". Following the launch of this programme, an international workshop was conducted in November 1995, in Jakarta, Indonesia on "Ecologically Sustainable Gold Mining and Processing" and it attracted 41 participants from 14 countries. Based on the recommendations of the workshop and with support from the donor community and host Governments, UNIDO initiated programmes in a number of countries, e.g., Cameroon, Ghana, Philippines, and Tanzania, aimed at assessing the potential for the introduction of new technologies for the abatement of mercury pollution. These programmes, some of which are ongoing, have enabled UNIDO to gain experience and appreciation of the magnitude of the mercury pollution problems, project co-ordination and establishment of working relationships with Governments and local institutions. In addition, during the preparatory phase of this GEF project, UNIDO conducted preliminary investigations in the six countries participating in order to assess the intensity of the artisanal mining activities and

their impacts on the International Waterbodies. Review of previous related studies, identification of the “hot spots” areas (rivers and waterbodies) and estimation of levels of pollution resulting from the application of mercury around these areas, were carried out. Apart from assessing the most affected International Waterbodies, barriers limiting the introduction of cleaner technologies were identified in each of the participating countries.

### **CURRENT OPTIONS FOR DEVELOPING SUSTAINABLE ARTISANAL MINING**

The barriers limiting artisanal miners from adopting sustainable and cleaner technology result from the fact that both the miners and the relevant Governments find themselves in negative circles of cause and effect. The application of poor technology leads to low productivity that in turn results in low revenue earnings and hence inability to invest in appropriate technology, it traps miners in crude and inefficient working methods and hence results in severe negative impacts to the environment, health and safety. On the other hand, the institutional weaknesses that lead to inability to enforce the existing legislation results in illegal operations, poor environmental, health and safety standards and loss of the badly needed fiscal revenues. The loss of fiscal revenues makes the authorities unable to perform their regulatory functions and hence perpetuates uncontrolled artisanal mining. In order to develop artisanal mining into sustainable and environmentally acceptable activities, both negative circles must be broken.

In view of the difficulties facing both miners and the governing authorities, the increase in knowledge and awareness and the introduction of efficient and cleaner technologies are at present the best option for developing environmentally acceptable activities. Prior to such intervention measures, the baseline data regarding environmental, technological and socio-economic issues, should be

established. Both training and awareness campaigns should be developed through involvement of miners and their organizations in order to enhance their acceptability. Such programmes should provide special considerations for women whose direct entry into artisanal mining activities is often limited by socio-cultural issues and the strenuous nature of the activities.

Since there is medical evidence that women and the unborn are especially vulnerable to mercury, it is regarded as indispensable to give priority to women miners during training and awareness campaign programmes so that the majority of them can adopt cleaner technology. Demonstration of efficient and cleaner technologies should be conducted in selected demonstration sites so as to enable miners appreciate the monetary and non-monetary benefits. Assistance should be provided to Governments to enable them develop policies and legislation that would lead to implementable standards. Development of enforcement programmes and building capacity to enable local institutions to carry out continuous monitoring, is essential for promotion of environmentally acceptable artisanal gold extraction activities.

#### **IMPORTANCE OF THE GEF INTERVENTION**

It is now widely accepted that the problems associated with artisanal mining in developing countries are similar and require integrated solutions and partnership between different players. The problems relate to protection and effective resources utilization, to general environmental conditions in areas surrounding the mines and in remote areas receiving mine waste and contaminants and to safe working and health conditions of miners. Whereas most attempts indicate appreciation of the extent of the negative environmental impacts resulting from these activities, no single programme within the six countries has addressed itself to the effects of these impacts on International Waterbodies.

The GEF intervention will show, through the establishment of the envisioned demonstration projects, how the current uncontrolled artisanal mining activities can be transformed into more organized, environmentally acceptable and sustainable operations. In each of the participating countries, the programme will aim at assessing the extent of mercury pollution, raising awareness and increasing knowledge of the miners and the public, introducing and demonstrating the application of cleaner and efficient technology, assisting the Government to put in place practical and implementable policies and legislation and building capacity to ensure continuous monitoring of mercury pollution on the surrounding waterbodies.

## **PROJECT STRATEGY**

### **LONG-TERM OBJECTIVE**

The long-term objective of the GEF project is to protect international waters from mercury pollution emanating from small-scale mining operations. Measures and methods to reduce this pollution are demonstrated in a pilot suite of developing countries located in several key transboundary river/lake basins. The main tools for reducing the pollution consist in assessing the extent of mercury pollution from current activities, introducing cleaner gold mining and extraction technology that minimize or eliminate mercury releases and developing capacity and regulatory mechanisms that will enable the sector to minimize negative environmental impacts.

### **BROAD DEVELOPMENT OBJECTIVE**

The broad development objectives of the six participating countries is to transform the current artisanal mining activities into organized activities in order to enhance incomes of the participating members of the population,

minimize negative environmental impacts and enhance development of the mineral sector and hence the economy. Like in many developing countries, artisanal mining activities are carried out in the six participating countries mainly as a way of dealing with poverty by the rural populations. As a result, the short-term gains envisaged by miners in order to escape from poverty have largely been outweighed by the negative impacts caused by these activities to their environment, health and safety and the neighboring communities. In addressing the negative environmental impacts resulting from these activities, some Governments have initiated programmes to address the issues related to the uncontrolled use of mercury in the recovery of gold. However, since most activities have been operating outside the legal framework, major efforts are still directed towards putting in place legislative and regulatory frameworks upon which artisanal mining activities can be conducted.

#### **GLOBAL ENVIRONMENTAL OBJECTIVE**

The global environmental objective is to assist developing countries in creating conditions necessary to minimize mercury pollution and other negative environmental impacts on International Waterbodies resulting from artisanal gold mining and extraction activities. Most artisanal gold mining activities within the participating countries are carried out within basins of major ecological significance and that cross geographical boundaries to many countries, e.g., the basins of the Amazon, River Nile, Lake Victoria, River Zambezi, River Mekong and River Kahayan in Indonesia. As such, the negative environmental impacts on the International Waterbodies within these basins are bound to affect many countries most of which do not even have gold mining activities. The Governments of the participating countries, acting

unilaterally are unable to finance the high initial start up costs of dealing with mercury related pollution problems. The GEF project will lead to an assessment of the extent of mercury pollution, increase of knowledge and awareness on environmental issues, introduction and demonstration of the application of efficient and clean technology and provision of assistance to Governments to enable them develop policies and legislation that are practical and enforceable. These efforts will in turn lead to artisanal mining activities that are efficient and environmentally acceptable.

### **SPECIFIC PROJECT OBJECTIVES**

There is general agreement on the need for a globally consistent approach to address the removal of barriers to the introduction of cleaner artisanal gold mining and extraction technologies. Since the issue cannot be addressed at the same time in dozens of countries suffering from the same problem, typical cases for mercury pollution of international waters have been selected.

The following specific project objectives and related activities will be implemented within the participating countries.

Objective 1A: To ensure effective project coordination and support (providing information, communications, professional assistance, programme implementation and evaluation and assessment) through establishment of a UNIDO based Programme Coordination Unit (PCU) and a Global Project Task Force.

Objective 1B: Identification of, and provision of resources for the establishment of the programme management structures in each of the six participating countries and the creation and operation of the basin and country specific project task forces.

- Objective 2: Identify project demonstration sites and organize training aimed at increasing knowledge and raising awareness of miners, Governments, NGOs and the general public on the environmental and health impacts associated with the current artisanal mining practices and the environmental, health and economic benefits of employing appropriate technology.
- Objective 3: Identify hotspots in project demonstration sites, conduct geochemical and toxicological studies and other field investigations in order to assess the extent of environmental (mercury) pollution in surrounding water bodies and devise intervention measures.
- Objective 4: Establish a databank comprising of technological requirements relevant to artisanal gold mining and extraction activities through field investigations, interviews with miners, miners' associations and other relevant institutions.
- Objective 5: Acquire and demonstrate, within the project demonstration sites, the application of affordable high-efficiency clean technology with improved gold processing methods while avoiding environmental degradation from mercury contamination.
- Objective 6: Based on the acquired experience, develop sustainable extraction indicators and hence assist Governments to develop generic and to the extent possible, country specific policies and legislation that will lead to implementable standards on the application of mercury with special attention to minimization of environmental impacts.
- Objective 7: Promote the dissemination of the produced project results and identify opportunities that will allow the



project to continue beyond the three-year time frame through self-financing and to initiate and conduct a Donor Conference to solicit financing.

## **CONCLUSION**

One of the priority areas identified by GEF under the “international waters focal area” is the degradation of the quality of the transboundary water resources, primarily due to pollution from land-based activities. The negative impacts resulting from artisanal mining, which is a land-based activity, lead to degradation of the selected International Waterbodies resulting to far reaching consequences. The project is also consistent with the GEF Operational Programme #10, which targets projects that “help to demonstrate ways of overcoming barriers to the adoption of best practices, waste minimization strategies and pollution prevention measures that limit contamination of the international waters environment”. The activities aim at removing barriers that inhibit artisanal miners from applying cleaner and efficient technology. Apart from removing the barriers the project is demonstrating the application of cleaner technology and conduct training to the miners in order to enhance the application of cleaner technology and thus reduce pollution and minimize waste resulting from the currently applied poor technology. Supplementing ongoing activities of the respective countries in developing the artisanal activities to the level of an organized small-scale gold mining sector, the project contributes to a substantial incremental progress regarding the reduction of mercury pollution.