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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT DOCUMENT

Country: Philippines

Number: DP/PHI/98/005

Title: Assistance in Reducing Mercury Emissions in Highly Contaminated Gold Mining Areas in Mindanao - Phase I

Planned duration: 9 months

Project site: Artisanal gold mining and processing sites along Naboc River, Davao del Norte and Hijo River, Apokon in Mindanao

**Total UNIDO budget:
(excl. support cost)** US\$194,500

**Total UNIDO budget:
(incl. support cost)** 219,785

Counterpart Agency: DENR (Department of Environment and Natural Resources) through its Mines and Geosciences Bureau, MGB

Estimated starting date: May 1998

**Government inputs
(in kind):**

Brief description

(in cash):

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to monitor mercury level in mining communities through hair, blood and urine analyses. Furthermore, the Project will strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

CONTENTS

EXECUTIVE SUMMARY.....	page 3
PART A: CONTEXT	page 5
1. DESCRIPTION OF THE SUB-SECTOR	page 5
2. GOVERNMENT STRATEGY TO REGULATE SMALL-GOLD MINING OPERATIONS AND TO ELIMINATE MERCURY POLLUTION.....	page 6
3. RELATED TECHNICAL ASSISTANCE PROJECTS.....	page 8
4. INSTITUTIONAL FRAMEWORK FOR THE SUB-SECTOR	page 8
PART B: PROJECT JUSTIFICATION	page 9
1. PROBLEMS TO BE ADDRESSED; THE PRESENT SITUATION	page 9
2. EXPECTED END-OF-PROJECT SITUATION	page 10
3. TARGET BENEFICIARIES.....	page 11
4. PROJECT STRATEGY AND INSTITUTIONAL ARRANGEMENTS	page 11
5. REASONS FOR ASSISTANCE.....	page 12
6. SPECIAL CONSIDERATIONS.....	page 13
7. CO-ORDINATION ARRANGEMENTS.....	page 14
8. COUNTERPART SUPPORT CAPACITY.....	page 15
PART C: DEVELOPMENT OBJECTIVE.....	page 15
1. IMMEDIATE OBJECTIVE.....	page 16
PART E: INPUTS.....	page 20
1. GOVERNMENT INPUTS.....	page 20
1.1 PERSONNEL AND ORGANIZATIONAL ASSISTANCE.....	page 20
1.2 OFFICE FACILITIES.....	page 20
1.3 GEOLOGICAL INFORMATION	page 20
1.4 OTHER MGB SUPPORT COMMITMENTS.....	page 20
2. UNIDO INPUTS.....	page 21
PART F: RISKS.....	page 22

PART G: PRIOR OBLIGATIONS AND PREREQUISITES.....	page 22
PART H: PROJECT REVIEWS, REPORTING AND EVALUATION	page 22
ANNEX 1: JOB DESCRIPTIONS.....	page 23
ANNEX 2: TERMS OF REFERENCE OF SUB-CONTRACT	page 36

EXECUTIVE SUMMARY

Mercury is one of the most toxic substances in the world causing significant damage to the environment and to the health of people who handle it. The adverse human and ecotoxicological consequences of mercury contamination in terrestrial and aquatic systems have been recognized since the 1950's, when the Minamata poisoning episode in Japan (arising from human exposure to methyl mercury in fish) triggered a tightening of legislative controls on mercury discharges across Europe, North America and parts of South-East Asia.

Mercury amalgamation, a virtually ubiquitous method of gold recovery with particular applicability for the beneficiation of alluvial or free gold, typically requires the use of 2 to 5 tons of mercury per ton of gold recovered. With gold production of small-scale miners worldwide currently of the order of hundreds of tons per year, the mobilization of mercury through such activities now require a first-order control on global scale.

Mercury is absorbed by the human organism through drinking water, food or breathed air. In the Philippines, mercury is used extensively by artisanal gold miners in Luzon (Cordillera Central) and Mindanao (Mount Diwalwal, Apokon, Tagum). Their activities provide income to a large number of people, from a peak around 500,000 in the mid-80s to at least 100,000 people directly or indirectly involved in the industry. A great proportion of these miners are women. For every gram of gold recovered, a significant amount of mercury is released into the environment - leaving behind a permanently ruined habitat and often resulting in sickness and even alleged death of men, women and children. The relevant simplicity and effectiveness of the technology, known as amalgamation, mask its dangers. This process can be improved with procedures using inexpensive and highly efficient devices which can be manufactured locally at low cost.

The main objectives of the UNIDO assistance in Phase I of Project are:

- Upgrade the regional laboratory for monitoring mercury, cyanide and heavy metal pollution in mining fields, river systems and affected agricultural sites.
- To monitor mercury levels in mining communities.
- To conduct a study on the extent of mercury pollution of Naboc river, Monkayo, Davao Norte and Hijo river, Apokon, and neighboring areas (rice fields and banana plantations).

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- To review mining policies on artisanal and small-scale gold mining and make recommendations for policy updating.
 - To undertake a study on establishing a Mineral Processing Centre operating under environmentally controlled and sustainable conditions for artisanal and small-scale miners.
 - To improve human safety by introducing new methods for mercury recycling in maintenance-free retorts.
 - To train 50 representatives of local small-scale mining associations, LGUs, provincial and municipal environmental offices in environmental management of small-scale mining operations.

Based on the experience gained in UNIDO, approximately US\$ 219,785 (incl. support costs) are required for the implementation of the Project in the Mindanao.

PART A: CONTEXT

1. DESCRIPTION OF THE SUB-SECTOR

In Mindanao, over 100,000 people are involved directly with artisanal gold mining activities which have led to enormous social and environmental problems emanating from poor gold mining and processing practices associated with lack of economic alternatives.

Amalgamation is the preferred method adopted by artisanal miners to process gold ore, since mercury is still a cheap and effective reagent for extracting gold. The impact of amalgamation on the environment is twofold. A direct impact is caused by evaporating mercury into the air. A second serious impact is resulting from the mercury discharged to the environment with the residues (tailings) of mining operations. Both types of pollution define the extent of mercury losses.

When the whole ore is amalgamated as it is done in the area of Mount Diwalwal, mercury losses can be as high as 2 to 5 times the amount of gold produced. When only concentrates are amalgamated, the main source of mercury emission is the burning of amalgam in open pans. This derives a gold bullion which still has 2 to 5% residual mercury. When gold bullion is melted in gold shops, about 20 g of mercury vapour per kg of gold are released. Studies have shown that the main portion of mercury emitted by gold smelters is deposited near the emission source (i.e. within 1 km), contaminating the urban environment.

Artisanal miners in Mindanao apply amalgamation to treat either the run of mine (ore) or concentrates produced by gravity concentration. When gravity concentrates are amalgamated, the mineral portion is separated from amalgam by panning, forming the amalgamation tailing which is usually dumped into the water streams forming "hot spots". Panning takes place either in water boxes, pools excavated in the ground or at creek margins. Excess mercury from amalgams is removed by filtration using a piece of fabric to squeeze by hand. The amalgam obtained, usually with 60% gold content is retorted or simply burnt in pans. Mercury entering the atmosphere can represent as much as 50% of that introduced into the amalgamation process when retorts are not used. However, when amalgamation is conducted properly and retorts are used, low mercury is lost to the environment (as low as 0.05%).

Symptoms of poisoning by mercury vapour are detected in miners, gold dealers and citizens living near the emission sources in Diwalwal, Apokon, Tagum. Part of the mercury emitted by gold miners may be transformed into methyl mercury to be bioaccumulated in the aquatic environment. The high content of organic acids in sediments and waters of the tropical forests favours oxidation of metallic mercury dumped by miners into the water streams or precipitated from the atmosphere. Soluble Hg-organic complexes are

transformed into methyl mercury and quickly taken up by aquatic biota.

Riparian communities adjacent to mercury contaminated areas who have fish as main diet and living in the vicinity of the sources of emissions, have shown high levels of mercury in the blood. Women and children, are the main victims of the lack of information and appreciation about the danger of this pollutant. The future generations will inherit the legacy to cope with this level of pollution. Education is a pre-requisite for a long-term solution of the mercury emission problem. Technical solutions must be rapidly provided to avoid a future epidemic situation.

2. GOVERNMENT STRATEGY TO REGULATE SMALL-GOLD MINING OPERATIONS AND TO ELIMINATE MERCURY POLLUTION

There is considerable evidence and concern that environmental quality has fast deteriorated (UNDP Country Cooperation Framework). Air and water quality have been observed to be deteriorating at an alarming rate, particularly in urban areas. Rehabilitation of existing watersheds, proper utilization of existing water supplies and rational land use have been recognized as top priorities of Government.

In pursuance of the thrust of environmental protection, the Implementing Rules and Regulations (IRR) of the Philippine Mining Act of 1995 or Republic Act 7942 have been amended. These amendments were formulated to ensure that mining is to be reconciled with the dictate of environmental protection and to be a pillar of economic growth consistent with sustainable development.

Among the major amendments to the IRR are:

C Governing Principles

An entirely new section has been added to emphasize that mining activities shall be conducted in a manner that it is both pro-people and pro-environment in sustaining wealth creation and an improved quality of life;

C Environmental Protection

Throughout the amended IRR, particularly in Chapter XVI, the structures, committees, funds and

procedures necessary to ensure the protection of the environment during and after mining activities have been established.

The amended IRR has provided mechanisms on environmental management, which include post-operational land use for various types of disturbed land (pits, waste dams, tailings/impoundments). Moreover, the environmental provisions include systems of environmental compliance guarantees, monitoring, reporting, cost and penal provisions.

C Social Acceptability

An entirely new section on the role of Local Government has been added which recognizes and consolidates the various responsibilities of the same in mining activities and operations.

Furthermore, the rights of indigenous people to their ancestral land are accorded greater protection and respect. Finally, the rights of local communities affected by the mining activities are likewise protected through special provisions.

The governing principles for sustainable mining are also applicable to small-scale mining operation and must guarantee inter alia:

- That activities must be always guided by current best practices in environmental management committed to reducing the impacts of mining while efficiently and effectively protecting the environment.
- That activities shall be undertaken with due and equal regard for economic and environmental considerations, as well as for health, safety, social and cultural concerns.

C Presidential Order Regarding Gold Rush Mining Operations, to Achieve Harmony, Enhance Mine Environmental Protection and Ensure Human Health and Safety

The President of the Philippines, Fidel V. Ramos ordered through a Memorandum to the Secretary of the Department of Environment and Natural Resources (DENR) that mercury and cyanide be declared as toxic materials. In compliance to such order, the DENR has come with the Administrative Order Nos. 97-38

and 97-39 providing for the chemical controls in the disposition and use of mercury and cyanide, respectively.

Further, the DENR shall formulate and implement an action plan to phase out the use of mercury in small-scale mining operations, and to provide viable alternatives, within a period of (1) one year. Moreover, DENR shall formulate and recommend to the President inter alia mechanisms for the adoption of environmentally-friendly technologies

3. RELATED TECHNICAL ASSISTANCE PROJECTS

Recent investigations on the extent of mercury pollution in Mindanao carried out by the British Geological Survey (BGS) have been published under Technical Report WC/95/72/R and WC/96/61/R, respectively.

The assessment of Hg contamination and possible human exposure and environmental damage associated with artisanal gold mining in the catchment of the Agusan River in eastern Mindanao was undertaken by BGS in collaboration with the Philippines Mines and Geoscience Bureau (MGB). This study aimed to ascertain the Hg contents of stream water and stream sediments especially in those areas which have been subject to very rapid and unregulated growth in small-scale artisanal gold mining over the last ten years following the discovery of rich gold deposits in this area.

The studies revealed high levels of Hg near some of the mining sites, and the dispersion patterns suggested that a "reservoir" of Hg may build up in the stream sediments causing a potential long-term pollution problem.

Mercury analyses of the Hijo River in the proximity of gold processing plants are carried out four times a year by DENR, Environmental Management and Protected Areas Service, Region XI, Davao City. Their data give evidence that mercury levels of effluents from processing plants with sometimes 0.005 mg/l Hg exceeded the concentration 0.002 mg/l allowed by law for surface water.

4. INSTITUTIONAL FRAMEWORK FOR THE SUB-SECTOR

The gold mining sub-sector is governed and controlled by the Department of Environment and Natural Resources (DENR) through the Mines and Geosciences Bureaux (MGB) having a local office in Mindanao. According to the Local Government Code of 1992 and the People's Small-Scale Mining Act of 1992, the granting of permits, as well as the monitoring of small-scale mining operations are the primary responsibility of the Local Government Units through the Provincial or City Mining Regulatory Board. This Board consists of representatives from the MGB, the Province or City concerned, from the large and small-scale miners group, and from the environmental NGO in the area.

The interest of the miners in the selected mining areas are represented by:

- Federation of Small Mining Association;

- Ore Processors Association.

The impact on health of mining-related activities is monitored by provincial offices of the Department of Health.

The UNIDO counterpart and Project owner will be Mines and Geoscience Bureau within the Department of Environment and Natural Resources (vide: Chapter 7 >*Coordination arrangements*<).

PART B: PROJECT JUSTIFICATION

The gold rush in the Mindanao which had started 15 years ago has involved hundred thousands of people who became artisanal miners to escape complete social marginalization. Their activities have caused a disastrous environmental impact through pollution of their habitat with mercury.

The Government is prepared to move beyond the establishment of legal frameworks for protecting the environment, to assist small-scale miners in introduction of environmentally safe technology and has recognized the constructive possibilities of working closely with local and international organizations such as UNIDO, of expanding the scope for local participation including special attention to educational and gender issues and opportunities and of establishing technical support to the small-scale mining associations.

Government has greatly appreciated UNIDO's programme and efforts in combating mercury pollution on global scale and is willing to participate in UNIDO's High Impact Programme No.4.

1. PROBLEMS TO BE ADDRESSED; THE PRESENT SITUATION

Artisanal and small-scale gold mining is regarded by Government as an enormous environmental threat because of the extensive pollution being caused in different parts of the country.

According to a new Presidential Order, Government shall formulate and implement an action plan to phase out the use of Hg in small-scale mining operations, and to provide viable alternatives within one year. Therefore, UNIDO's High-Impact Programme to introduce alternative technologies for global abatement of Hg pollution is most appreciated by Government.

C Artisanal Gold Mining in the Area of Mount Diwalwal, Apokon, Tagum

Today's "Wild West" lies in the South of the Philippines, in Mindanao Island covering roughly the size of Ireland. 100,000 people are said to work in the sub-sector. 500,000 from 16 million inhabitants might be indirectly dependent on gold mining. The gold ore which is still easily accessible contains the metal in concentrations of up to 100 grams per ton (approx. 50 to 100 times more than the famous gold ore from Witwatersrand in the Republic of South Africa). The cost of operation amount to 8 grams gold/ton of ore. The site is hardly accessible. Despite the risks of working there in small tunnels and being exposed to mercury spilling mills, toxic vapors and explosives, people are attracted by the fortune they might make in the "El Dorado". Until today, Mount Diwalwal alone is believed to have yielded more than 40 tons of gold.

Working conditions in this shanty town built on a steep mountainside are most appalling and recovery of the gold is low. Used waters are running freely through the roads filled with domestic waste and garbage from operations. Hg emissions occur through spillage of water used for processing the ore in amalgamation barrels and from the tailings being dumped or washed into the river beds. Several cases of severe Hg poisoning and a number of fatalities have been recorded, mostly from inhalation of Hg vapors.

Part of the tailings is transported on trucks to small cyanidation plants (vide above-mentioned dangers). In the area of Tagum, more than 20 plants have been visited by UNIDO in 1997, half of them had been closed by Government. However, during night-time, some of them are obviously resuming their criminal activities. The tailings management and the tailing dams were found to be absolutely inadequate for a seismic active area. Part of the dams consisting of ore bags only had been washed away during a flood which had occurred some weeks ago. The dams in Tagum present a public and environmental hazard. Seepage and ground water pollution were obvious at most places seen.

Hg pollution has reached the municipality of Tagum and Monkayo. The reasons for extensive Hg contamination of the area are mainly due to amalgamation of the raw ore, inadequate capture of mercury contained in the tailings, Hg containing effluents from processing operations, and Hg vapors from thermal treatment of gold amalgam. The situation is exacerbated by the vicinity of a residential area and schools.

Artisanal and small-scale gold mining and processing along the Naboc and Hijo rivers have already caused serious health hazards to the population. In this region, farmers claim that more than 1000 hectares of land are heavily silted and mercury contaminated (mainly banana and rice plantations), cutting their harvest to one half, killing work animals and causing sickness to inhabitants.

2. EXPECTED END-OF-PROJECT SITUATION

Based on information obtained during the UNIDO missions in March and November 1997 and discussions held with Government and various institutions and organizations, UNIDO proposes the following interventions to address the environmental problems:

- Upgrade the regional laboratory for monitoring mercury, cyanide and heavy metal pollution in mining fields, river systems and affected agricultural sites.
- To monitor mercury levels in mining communities.
- To conduct a study on the extent of mercury pollution of Naboc river, Monkayo, Davao Norte and Hijo river, Apokon, and neighboring areas (rice fields and banana plantations).
- To review mining policies on artisanal and small-scale gold mining and make recommendations for policy updating.
- To undertake a study on establishing a Mineral Processing Centre operating under environmentally controlled and sustainable conditions for artisanal and small-scale miners.
- To improve human safety by introducing new methods for mercury recycling in maintenance-free retorts.
- To train 50 representatives of local small-scale mining associations, LGUs, provincial and municipal environmental offices in environmental management of small-scale mining operations.

The results obtained in Phase I of the Project will enable the Government to base all future decisions regarding the development of the small-scale gold mining sector on a scientific assessment of the pollution and on high-level legislative and technical advice.

Moreover, the training in environmental management of key personnel from LGUs, NGOs and associations of small-scale miners will facilitate the introduction of sustainable technologies.

3. TARGET BENEFICIARIES

Target beneficiaries will be DENR-MBG, the Local Government Units and artisanal/small scale gold miners in selected areas of Mindanao exploiting gold in different operations and on different scale from

alluvial and primary deposits.

The selected mining communities will mainly benefit from training in occupational health issues related to mercury, environmental management, efficient mineral processing methods, and safe mercury recovery technology from amalgam.

4. PROJECT STRATEGY AND INSTITUTIONAL ARRANGEMENTS

The assessment of the environmental pollution of the most affected areas is considered both by Government and UNIDO as a prerequisite for any further assistance to the sub-sector. The extent of pollution must be fully assessed in the interest of health, political stability, and economic development of future rural generations (Output 1 and 2 of Project).

There is a reasonable amount of indigenous knowledge, which will be taken into account, when technologies are designed and selected for small-scale gold miners. Some of those have developed crude vat cyanidation plant which are operated together with electrowinning plants. This indigenous technology now prevalently used and preferred deserves attention for improvement (Output 4).

Artisanal gold mining has resulted in alarming amounts of mercury lost to the environment. So far, attempts by the concerned Philippine government agencies in bringing solutions to stop or reduce mercury emissions and provide safe technologies to the miners unfortunately failed due to a complex mix of socio-economic, political and technological problems. The UNIDO Project alerts the miners through educational measures and provide options for handling mercury (Output 4) and will train trainers in environmental management of small-scale mining sites (Output 5). These measures reach the artisanal miners directly or through their associations. The UNIDO strategy is to convince miners that they are being affected by mercury vapors which cause irreversible health problems for their neighbors, friends and family members.

Furthermore, the proposed project will provide advisory assistance to the MGB in the formulation of a new Small-Scale Mining Law taking into consideration the various political, social, and environmental dimensions of small-scale mining activities.

5. REASONS FOR ASSISTANCE

The Country Cooperation Framework (1997-2001) describes the UNDP's assistance in providing advice on strategies and programmes for national priorities to promote Sustainable Human Development (SHD).

Role of UNIDO to Combat Mercury Pollution

In an international UNIDO International Workshop on Ecologically Sustainable Gold Mining and Processing held in Jakarta/Indonesia in November 1995 and attended by 41 participants from 14 countries, including one expert from the Philippines, participants recognized the necessity for provision of advice and technical assistance in order to avoid further mercury pollution. Participants of this Workshop fully endorsed UNIDO's High-Impact Programme entitled "Introducing New Technologies for Global Abatement of Mercury Pollution" and supported the following recommendations:

1. Gold mining on the small and artisanal level should make a valuable contribution to alleviate poverty in developing countries.
2. Since the environmental impacts of this increased activity are considerable, particularly from the widespread use of mercury, a long term strategy for remediation and for regularization of the sector should be developed.
3. The UN system, particularly UNIDO, must play an important role in assisting developing countries in engineering ecologically sustainable development. In the gold mining sector, UNIDO should increase its assistance to developing countries, including policy advice to government, the promotion of low cost, efficient and safer equipment and techniques and the encouragement of support by both miners and the public for solutions to the numerous environmental concerns. The participants endorsed the use of bilateral agreements between developing countries for cooperation in these areas.
4. Legal and financial constraints limit the evolution of the small scale gold mining sector into formal operations. Attention needs to be given to both legalizing this sector and to creating alternative finance assistance, including linkages with the formal sector, the use of development bank finance and appropriate taxation regimes.
5. UNIDO and other donor community agencies, in cooperation with the governments concerned, should continue and increase their support to developing countries, in particular to the least developed countries, for the development of an orderly and ecologically sustainable small scale gold mining sector. Such assistance should be directed at and made in conjunction with the needs of the miners working in the field.

6. Women play a major role in artisanal and small scale gold mining, and special efforts should be made to ensure that they benefit from any assistance given to this sector.
7. Because of the widespread use of child labour in the informal gold mining sector, the relevant governments and agencies should be urged to provide the resources needed to abolish this abuse.

Since the issue of damage caused to the environment and human health by mercury pollution due to artisanal gold mining is multifaceted and complex, education, communication of information and technology transfer can be considered as keys for improving the situation. For achieving this, UNIDO is well prepared and experienced in putting together cross-discipline programmes, covering environmental protection, introduction of new technologies and manufacturing, mineral beneficiation as well as integration of women in industry.

In the latter context, UNIDO will make a special effort to ensure that women participate equally in -and benefit equally from - the introduction of new equipment and processing techniques. UNIDO is also counting on women miners to be the most ardent advocates for the alternative technology because of their traditional care-giver roles.

6. SPECIAL CONSIDERATIONS

Artisanal gold mining activities occur at several places in Mindanao. These operations are concentrated in relatively few localities spread through-out the island, the most important production area being Diwalwal, Monkayo, Pantukan Gold Rush area, Mainit, Inupan, Saraban, Panganason, Siat, Boringot, Lumanggang, Gumayan, Biasona, all in the Province of Davao del Norte. Because of the impact of the sub-sector on environment and health, the Project will be implemented at those places which are said to be most polluted, i.e. along the rivers Naboc and Hijo.

The selected project sites are located in disadvantaged areas which suffered most from poor living, work and safety conditions, pollution, unplanned development, social problems and poor resource utilization.

The Government will continue at the same time putting in force simple, transparent legislation and incentives to promote the development of the small-scale gold mining sector through land and mineral rights reforms, the regulated use and even outright ban on mercury and other toxic substances, and the protection

of children from mine labour.

7. CO-ORDINATION ARRANGEMENTS

The Mines and Geoscience Bureau (MGB), as the agency specifically mandated by law for the management of mineral resources and to regulate mining activities within the Department of Environment and Natural Resources (DENR) will ensure the overall coordination of the Project. It shall appoint a National Director and an administrative secretary and provide national experts in environmentally related studies as well as experts in the area of mining and supervise the necessary field work. The national coordination and National Director shall be based at the MGB Central Office in Manila.

Moreover, MGB will monitor, during the whole project cycle, introduction of new equipment as well as the progress of training. It will have a lead role in all technology- and environment-related issues.

The Federation of Small Scale Miners in Mindanao will advise on gender-related issues and monitor the integration of women in all educational activities of the Project and will encourage women participation in the offered training programme.

All information and expertise related to the social patters in the country will be made available by MGB and their central and regional offices. This includes the availability to project personnel of reports and studies, both published and unpublished.

UNIDO will be responsible for the overall control of the project and will put together the cross-discipline programme involving coordination of environmentalists, experts in mining legislation, small-scale mining and mineral processing. For the purpose of project management, a Steering Committee will be established comprising DENR, NEDA, UNDP and UNIDO. The Steering Committee will meet every three months to review progress.

8. COUNTERPART SUPPORT CAPACITY

MGB Central Office and the regional and district offices have the full administrative supervision over the small scale mining programme and will provide support to the UNIDO project through the existent infrastructure of their headquarter organization and the regional office. MGB will supervise and control the project activities. In the selected artisanal mining fields, MGB will in particular nominate the Local Governmental Units and small-scale mining associations participating in the project as well as ensure

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- legal ownership of participating individuals/cooperatives/associations to land and facilities.
 - free access of UNIDO personnel to conduct project activities, provided such activities do not unduly interfere with the operations of the small scale miners.

Furthermore, MGB will provide assistance to the Project through their metallurgical, geological and other laboratory facilities, which are primarily based in the MGB Manila office, if such services are requested by the National Project Director.

PART C: DEVELOPMENT OBJECTIVE

The Project is focusing on the Government's developing target to phase out the use of mercury in artisanal and small scale mining operations by providing improved health, working and living conditions as well as increased income for the gold mining population. The project will help the Government in bridging the technological gap from which the sub-sector is suffering and introducing environmental management and cleaner production being unknown to the rural population.

PART D: OBJECTIVES, OUTPUTS AND ACTIVITIES

1. IMMEDIATE OBJECTIVE

Assistance in reducing mercury emissions in highly contaminated gold mining areas in Mindanao.

Output 1:

To upgrade the regional laboratory for monitoring mercury, cyanide and heavy metal pollution in mining areas, river systems and affected agricultural sites.

Activities:

- Purchase and installation of an Atomic Adsorption Spectrophotometer (AAS), Mercury Analyzer, Cyanide Analyzer and Arsenic Analyzer, with appropriate fume hoods, water bath, and other accessories, glassware and chemicals, to enable the chemical laboratory of the DENR-MGB in Davao to determine mercury and other chemicals in water, silt, sediments, vegetables and fruits.
- Training of laboratory technicians at the regional laboratory through the equipment suppliers.
- Analysis of samples for study on the extent of mercury pollution, including other related chemicals (e.g. arsenic, sulfur, cyanide, cadmium, lead) in selected river systems and other sites, required for study on the extent of chemical pollution and environmental degradation.

Output 2:

Assessment of mercury levels in humans.

- Develop questionnaire on general health condition of members of mining communities and on indications for symptoms of mercury poisoning.
 - Evaluate/estimate the occupational health risk in people directly exposed to mercury through amalgamation activities.
 - Evaluate/estimate the occupational health risk of people living in the vicinity of gold extraction plants and gold melting shops.
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- Check general health condition of directly exposed people and non-directly exposed members of mining population.
 - Take hair, urine, and blood samples according to state of the art in clinical studies.
 - Assess the health condition of people affected by mercury poisoning, for example regarding buccal health, alterations in hand-writing, muscle pain, typical neurological and organic dysfunction etc.
 - Propose training programs for toxicologists from Department of Health and hospitals (e.g. using computer systems such as Hg-Ex) for fast diagnosis of mercurialism and treatment measures.
 - Draft report summarizing facts and conclusions.

Output 3:

A study on the extent of mercury and related chemical pollution along the Naboc river, Monkayo, Davao del Norte; Hijo River, Apokon ore processing site; and their neighboring areas (rice fields and banana plantations).

Activities:

- Evaluation of the nature and extent of mercury and other chemical pollution.
- Conduct systematic sampling and chemical studies on the nature and extent of cyanide, arsenic, cadmium and lead contamination.
- Introduce and set up a monitoring system for continuous water quality assessment.
- Summarize facts and conclusions on the assessment of mercury levels in humans for consideration of concerned agencies/bodies.
- Formulate measures for the remediation and possible rehabilitation of hot spots in the river systems and vicinities.

Output 4:

A study on the establishment of Mineral Processing Centres operating under environmentally controlled and sustainable conditions for artisanal and small-scale miners.

Activities:

- Identification of possible sites for Mineral Processing Centres, with appropriate mine waste disposal site, taking into consideration access to users, safe geochemical environment, and protection of the surface environment and groundwater resources.
- To identify technologies, machineries and equipment; estimate the costs of investments; and study the economic viability of establishing such centres.
- To orient in various training sessions the LGUs and other stakeholders about the nature, operations and services to be made available in such a Mineral Processing Centre.

Output 5:

Improvement of human safety through demonstration of mercury recycling by using maintenance-free retorts and training in their proper utilization.

Activities:

- Purchase of 50 maintenance-free and user-friendly retorts to be made available at the mining sites/processing centers.
- Training of miners in occupational safety aspects related to mercury.
- Training of miners through the local MGB office in proper handling and recycling of mercury at Diwalwal, Monkayo, Pantukan Gold Rush area, Mainit, Inupan, Saraban, Panganason, Siat, Boringot, Lumanggang, Gumayan, Biasona, all in the Province of Davao del Norte.

Output 6:

Some 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental officials, and DENR-MGB technical personnel, trained by UNEP in environmental management of small-scale mining operations.

Activities:

Design of training in:

- Environmental Management Strategies;
- Sustainable Development Strategies;
- Regulatory Framework.

Implementation of training in:

- Mining and Environmental Protection Legislation;
- Environmental Impact Assessment;
- Environmental Risk Assessment;
- Environmental Quality Standards and Criteria;
- Enforcement Mechanisms.

Output 7:

A Report on mining policies regarding artisanal and small-scale gold mining including recommendations for policy updating.

Activities:

- Based on experience in other countries, advise the MGB on possible legal and administrative framework to address the various environmental challenges of small-scale gold mining.
- Provide advisory assistance to the MGB in the formulation of new Small-Scale Mining Law, taking into consideration the various political, social, and environmental dimensions of small-scale mining activities.

PART E: INPUTS

1. GOVERNMENT INPUTS

1.1 PERSONNEL AND ORGANIZATIONAL ASSISTANCE

The DENR, through its Mines and Geoscience Bureau (MGB) will appoint a National Project Director and a secretary to the project. Furthermore, it will make available all expertise gained, its archives and personnel for research and will assist through its liaison with the LGUs.

The DENR, through its Mines and Geoscience Bureau (MGB) and together with its Environmental Management Bureau (EMB) as well as in close cooperation with the Department of Health will supervise and monitor the introduction of the new equipment and the progress of the work. DENR will have the lead role in all technology- and environment-related issues.

1.2 OFFICE FACILITIES

The DENR, through its Mines and Geoscience Bureau (MGB) will provide adequately equipped offices with air-conditioning and telephone to NPD and International Experts.

1.3 GEOLOGICAL INFORMATION

The DENR, through its Mines and Geoscience Bureau (MGB) will make available to project personnel all pertinent geological reports and maps, both published and unpublished, from the archives in Manila and its offices in Luzon and Mindanao.

1.4 OTHER MGB SUPPORT COMMITMENTS

- Additional vehicle support;
- Geologists, Chemists, Mining Engineer, Metallurgist in any number as the Project might require;
- Laboratory support of MGB Manila Office;
- Support of travel costs of MGB personnel;
- Office space for the Project in MGB Manila, if required;
- Support in the purchase of some chemicals and gases.

2. UNIDO INPUTS

Budget Line	Functional Title	TOTAL		YEAR 1998	
		m/m	US\$	m/m	US\$
11-01	UNEP Expert on Environmental Management (Output 5)	1.0	13,000	1.0	13,000
11-02	Environmental Expert on conduct of surveys on river systems (Output 2)	2.0	26,000	2.0	26,000
11-03	Environmental Expert on conduct of sampling and analyses of biological samples (Output 2)	1.0	13,000	1.0	13,000
11-04	Expert in Mineral Processing (Output 3)	2.0	26,000	2.0	26,000
11-05	Expert in Mining & Environmental Law (Output 6)	1.0	13,000	1.0	13,000
11-06	Toxicologist for assessment of mercury levels in humans	1.0	13,000	1.0	13,000
15-00	Project travel in the country		12,500		12,500
16-00	Other personnel costs including UNIDO staff missions for coordination of project		15,000		15,000
19-99	Total Personnel Component	8.0	131,500	8.0	131,500
21-01	Subcontract for hair, blood and urine analyses		5,000		5,000
49-99	Total Equipment		44,000		44,000
59-99	Total Miscellaneous Component (Operation & Maintenance)		14,000		14,000
99-99	Total Budget excluding 13 % Support Cost	8.0	194,500	8.0	194,500
	+ 13 % Support Cost		25,285		25,285

	Total Budget including 13 % Support Cost	8.0	219,785	8.0	219,785
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PART F: RISKS

EQUIPMENT BREAKDOWN:

This can be expected in any project operating in remote field areas or countries out of immediate reach of spares or repair facilities. Vehicle breakdown has a particular leverage at shutting the project down for a short while.

PART G: PRIOR OBLIGATIONS AND PREREQUISITES

Prior obligations: none

Prerequisites:

DENR Recruitment of National Project Director, assignment of one administrative assistance for preparation of adequate premises for project staff.

DENR Assignment of one extensionist to establish industrial contacts between Manila and the project sites in Mindanao.

PART H: PROJECT REVIEWS, REPORTING AND EVALUATION

Succinct progress will be produced every two months throughout the project.

Summary reports by experts on the results of the studies undertaken pursuant to the major outputs will be produced as conclusions become firm.

A project performance evaluation report (PER) will be produced three months prior to the first tripartite review meeting.

A project terminal report will be produced sufficiently in advance of the terminal tripartite review meeting to allow review and technical clearance by the implementing agency.

The project will be subject to evaluation 1 months prior to scheduled termination. The organization, terms of

reference, and timing will be decided after consultation among the parties to the project document.

ANNEX 1: JOB DESCRIPTIONS

JOB DESCRIPTIONS

Post 11-01
Post 11-02
Post 11-03
Post 11-04
Post 11-04
Post 11-05
Post 11-06

JOB DESCRIPTION
XX/PHI/98/XXX/11-01

- Post Title:** UNEP Expert on environmental management
- Duration:** 1.0 m/m (breakdown: 0.4 m/m home based work, 0.6 m/m teaching in the field)
- Duty station:** Tagum/Mindanao
- Purpose of project:** Assistance in reducing mercury emissions in highly contaminated gold mining areas.
- Duties:** Under the direction of the National Project Coordinator, and in cooperation with national personnel, the expert will be responsible for the following duties:
1. Prepare and give lectures on:
 - * Mining and Environmental Protection Legislation;
 - * Methodologies for environmental management;
 - * Environmental Impact Assessment;
 - * Environmental Risk Management;
 - * Environmental Quality Standards and Criteria;
 - * Mitigation measures to improve environmental performance;
 - * Examples of good practices;
 - * Environmental management networks to improve access to information, technologies and solutions.

Qualification:

Senior Mining Engineer with experience in environmental management of mining sites.

Background and Justification:

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems

and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

JOB DESCRIPTION
XX/PHI/98/XXX/11-02

- Post Title:** Environmental Expert on conduct of surveys on river systems.
- Duration:** 2.0 m/ms (breakdown: 0,2 m/m home based work, 1,8 m/m field work)
- Duty station:** Mining areas along Naboc and Hijo rivers
- Purpose of project:** Assistance in reducing mercury emissions in highly contaminated gold mining areas.
- Duties:** Under the direction of the National Project Coordinator, and in cooperation with national personnel, the expert will be responsible for the following duties:

Duties:

1. Meet officials of Government and mining related institutions and discuss present situation of the environment in gold mining areas and evaluating and comparing with data of conducted analyses in the past.
2. Investigate the situation of the environment on the spot, take samples from waters and soils where pollution can be assumed.
3. Evaluate the nature and extent of the mercury, cyanide and heavy metal pollution in a selected river system and adjacent agricultural sites.
4. Introduce and set-up a monitoring system for continuous water quality assessment.
5. Formulate measures for the remediation and possible rehabilitation of hot spots in the river systems and vicinities.
6. Advise on necessary interactions between government departments, mining industry and research institutions.

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7. Prepare a concise report on all findings and data including recommendations.

Qualification:

Senior Chemist/Environmentalist with experience in industrial pollution emanating from mining operation.

Background and Justification:

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

JOB DESCRIPTION
XX/PHI/98/XXX/11-03

Post Title: Environmental Expert on conduct of sampling and analyses of biological samples.

Duration: 1.0 m/m (field work)

Duty station: Mining areas along Naboc and Hijo rivers

Purpose of project: Assistance in reducing mercury emissions in highly contaminated gold mining areas.

Duties: Under the direction of the National Project Coordinator, and in cooperation with national personnel, the expert will be responsible for the following duties:

Duties:

1. Meet officials of Government and mining related institutions and discuss present situation of the environment and health in gold mining and processing areas and evaluate existing data of analyses conducted in the past.
2. Investigate the situation of the environment on the spot, take biological samples from agricultural sites where pollution can be assumed from irrigation.
3. Evaluate the nature and extent of the mercury and heavy metal pollution in produce, especially rice and bananas.
4. Introduce and set-up a monitoring system for continuous biological sampling and analyses.
5. Advise on necessary interactions between government departments, mining industry and research institutions.
6. Prepare a concise report on all findings and data including recommendations.

Qualification:

Senior Chemist/Environmentalist with experience in biological monitoring, sampling and analysis.

Background and Justification:

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

JOB DESCRIPTION
XX/PHI/98/XXX/11-04

- Post Title:** Expert in Mineral Processing
- Duration:** 2.0 m/ms (1 month field work and 1 month home-based work)
- Duty station:** Monkayo and mining areas along Naboc and Hijo rivers
- Purpose of project:** Assistance in reducing mercury emissions in highly contaminated gold mining areas.
- Duties:** Under the direction of the National Project Coordinator, and in cooperation with national personnel, the expert will be responsible for the following duties:

Duties:

1. Meet officials of Government and mining related institutions and discuss present situation of mineral processing activities and their impact on environment and health in Monkayo.
2. Identify possible sites for a Mineral Processing Centre, with appropriate mine waste disposal site; taking into consideration access to users, safe geological-geochemical environment, and protection of the surface environment and groundwater resources.
3. Identify technologies, machineries and equipment; estimate the costs of investment, and study the economic viability of establishing such Centre.
4. To orient in various training sessions the LGUs and other stakeholders about the nature, operations and services to be made available in such Mineral Processing Centre.
5. Prepare a study on the establishment of Mineral Processing Centres operating under environmentally controlled and sustainable conditions for artisanal and small-scale miners.

Qualification:

Senior Mining/Mineral Processing Expert with experience in small-scale gold mining and extraction.

Background and Justification:

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

JOB DESCRIPTION
XX/PHI/98/XXX/11-05

Post Title: Expert in Mining and Environmental Law

Duration: 1.0 m/m (0.2 m/m field work, 0.8 m/m home-based work)

Duty station: Manila

Purpose of project: Assistance in reducing mercury emissions in highly contaminated gold mining areas.

Duties: Under the direction of the National Project Coordinator, and in cooperation with national personnel, the expert will be responsible for the following duties:

Duties:

1. Meet officials of Government and mining related institutions and discuss present mining and environmental legislation.
2. Based on experience in other countries, advise the MGB on possible legal and administrative framework to address the various environmental challenges of small-scale gold mining.
3. Provide advisory assistance to the MGB in the formulation of a new Small-Scale Mining Law, taking into consideration the various political, social, and environmental dimensions of small-scale mining activities.
4. Prepare a report summarizing recommendations for updating mining and environmental policies with respect to artisanal and small-scale mining.

Qualification:

Senior Mining Expert with experience in environmental and mining law.

Background and Justification:

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

JOB DESCRIPTION
XX/PHI/98/XXX/11-06

- Post Title:** Toxicologist for assessment of mercury levels in humans
- Duration:** 1.0 m/m field work
- Duty station:** Mining areas along Naboc and Hijo rivers
- Purpose of project:** Assistance in reducing mercury emissions in highly contaminated gold mining areas.
- Duties:** Under the direction of the National Project Coordinator, and in cooperation with national personnel, the expert will be responsible for the following duties:
- Develop questionnaire on general health condition of members of mining communities and on indications for symptoms of mercury poisoning.
 - Evaluate/estimate the occupational health risk in people directly exposed to mercury through amalgamation activities.
 - Evaluate/estimate the occupational health risk of people living in the vicinity of gold extraction plants and gold melting shops.
 - Check general health condition of directly exposed people and non-directly exposed members of mining population.
 - Take hair, urine, and blood samples according to state of the art in clinical studies.
 - Assess the health condition of people affected by mercury poisoning, for example regarding buccal health, alterations in hand-writing, muscle pain, typical neurological and organic dysfunction etc.
 - Propose training programs for toxicologists from Department of Health and hospitals (e.g. using computer systems such as Hg-Ex) for fast diagnosis of mercurialism and treatment measures.

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- Draft report summarizing facts and conclusions.

Qualification:

Senior Toxicologist with experience in Industrial Hygiene and Occupational Health.

Background and Justification:

The lack of appropriate technology and proper health and safety procedures in the informal gold mining sector in Mindanao have led to severe environmental degradation and mercury pollution of river systems and adjacent agricultural sites. In some areas, the health of people and working animals has already been affected. Due to a lack of trained personnel and equipment, the extent of the pollution has not yet been assessed. The project is planned to strengthen the capacity of the local DENR laboratory in Mindanao for undertaking mercury analyses in affected river systems and neighboring rice and banana plantations. Based on the results proposals will be prepared on introduction and promotion of legislative and technical measures to introduce more efficient gold recovery techniques that minimize the utilization of mercury and stop the dangerous pollution with the toxic metal. In cooperation with UNEP 50 representatives from local small-scale mining associations, LGUs, provincial and municipal environmental offices including DENR-MGB personnel will be trained in environmental management of small-scale mining operations.

ANNEX 2: TERMS OF REFERENCE OF SUB-CONTRACT

1. Background Information

Mercury is one of the most toxic substances in the world causing significant damage to the environment and to the health of people who handle it. The adverse human and ecotoxicological consequences of mercury contamination in terrestrial and aquatic systems have been recognized since the 1950's, when the Minamata poisoning episode in Japan (arising from human exposure to methyl mercury in fish) triggered a tightening of legislative controls on mercury discharges across Europe, North America and parts of South-East Asia.

Mercury amalgamation, a virtually ubiquitous method of gold recovery with particular applicability for the beneficiation of alluvial or free gold, typically requires the use of 2 to 5 tons of mercury per ton of gold recovered. With gold production of small-scale miners worldwide currently of the order of hundreds of tons per annum, the mobilization of mercury through such activities now require a first-order control on global scale.

Mercury is absorbed by the human organism through drinking water, food or breathed air. In the Philippines, mercury is used extensively by artisanal gold miners in Luzon (Cordillera Central) and Mindanao (Mount Diwalwal, Apokon, Tagum). Their activities provide income to a large number of people, from a peak around 500,000 in the mid-80s to at least 100,000 people directly or indirectly involved in the industry. A great proportion of these miners are women. For every gram of gold recovered, about two to five grams of mercury are released into the environment - leaving behind a permanently ruined habitat and often resulting in sickness and even alleged death of men, women and children. The relevant simplicity and effectiveness of the technology, known as amalgamation, mask its dangers. This process can be improved with procedures using inexpensive and highly efficient devices which can be manufactured locally at low cost.

The main objectives of the UNIDO assistance in Phase I of Project are:

- Upgrade the regional laboratory for monitoring mercury, cyanide and heavy metal pollution in mining fields, river systems and affected agricultural sites.
- To monitor mercury levels in mining communities.
- To conduct a study on the extent of mercury pollution of Naboc river, Monkayo, Davao Norte and

Hijo river, Apokon, and neighboring areas (rice fields and banana plantations).

- To review mining policies on artisanal and small-scale gold mining and make recommendations for policy updating.
- To undertake a study on establishing a Mineral Processing Centre operating under environmentally controlled and sustainable conditions for artisanal and small-scale miners.
- To improve human safety by introducing new methods for mercury recycling in maintenance-free retorts.
- To train 50 representatives of local small-scale mining associations, LGUs, provincial and municipal environmental offices in environmental management of small-scale mining operations.

2. The Scope of Contracting Services

The project requires substantial input, mainly in form of biochemical analyses for determining mercury concentrations in human blood, urine and hair.

The services of the subcontractor must encompass:

- Develop together with International Expert 11-06 (Toxicologist) questionnaire on general health condition of members of mining communities and on indications for symptoms of mercury poisoning.
- Advise on best preservation methods for hair, urine, and blood samples taken by the International Expert.
- Analyze biological samples taken by the International Expert.
- Based on analytical results advise on the risk of general public living near mining operations and gold shops where gold is melted.
- Propose training program on analyzing mercury in humans for toxicologists working in Department of Health and hospitals.
- Draft report summarizing facts and conclusions.

Reports:

- a) A Draft Final Report, to be submitted to UNIDO/Contract Section in 3 copies, not later than 1 month after receipt of last samples.
- b) A Final Report, in English, in seven (7) copies and a diskette, submission 3 weeks after the Contractor's receipt of UNIDO's comments on the Draft Final Report.