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Report on Small-scale Mining in Papua New Guinea

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Summary

Small-scale mining is a legally recognized economic activity and a significant contributor to the rural economy in PNG. Characteristics of gold mining are quite different from any other industry (cash crops, fisheries and timber) because the value of the gold mined is paid directly to the miner. Most rural commodities are priced differently and the PNG growers are often paid a small percentage of the price paid by the ultimate consumer of the final product.

Since alluvial gold is very common in PNG and it is readily seen and mined in all provinces there is a strong possibility to increase the present production rate of 4.0 tonnes a year valued about PNG K100m. There is potentially a high number of miners. Current estimates are between 50,000-60,000 and possibly up to 80,000-100,000. Approximately 90 per cent of miners are categorized as grassroots miners and so most of the attention will be given to training and broadening the mining knowledge and skills of this group. PNG can achieve these objectives by:

- Encouraging new alluvial miners;
- Improving the efficiency of existing miners; and
- Identifying new alluvial gold areas.

It should be stated clearly here that each miner is a small business operator and by supporting them, PNG is promoting and supporting a substantial economic and business infrastructure development.

PNG's strong desires and ambitious plans to expand the artisanal and small-scale mining sector has been inspired by the AusAid pilot educational project undertaken in the last three years. The experience and encouragement drawn from the AusAid support is that, despite the financial constraints, small-scale mining functions can be developed and promoted by soliciting resources from within PNG and through external donor sources. It is encouraging to note the country's only private metal-refining company (MRO) has consistently supported this pilot project while some medium and major mining companies have committed both logistical and organizational support. The financial limitations encountered from national government annual budgets and the individual private company assistance are not solid enough foundation for future developments therefore external donor funds will be sought for the next five years.

The proposal by the ADB to set up a pilot micro-finance scheme in Wau will be an encouraging incentive for the advancement of small-scale miners. It will provide financial support to members of the small-scale mining community who can show solid business ability. Possible support from both the Japanese Social Development Fund and the EU's Sysim scheme will build solid foundations such as infrastructure, training facilities and pilot programmes which will consolidate efforts towards long-term development. DOM's vision have been documented in a Five-year Plan for 2002-2006. The expansion programmes

proposed for funding under ADB, JSDF and EU Sysim Fund will be guided by priorities set in the Five-year Plan.

DOM has a strategic plan to become a corporate body within the next five years. If this becomes a reality and a 1 per cent levy is charged on all gold exports, long-term sustainable development can be internally financed. The ultimate objective to increase and strengthen the PNG economy is not impossible task and certainly our rural population will enjoy great benefits together with improvements to livelihoods.

Introduction

The largest section of PNG miners (approximately 90 per cent according to a Department of Mining (DOM) informal survey) are widely dispersed rural people heavily dependent on panning dishes, shovels and rudimentary sluice boxes. These miners together with their families are exposed to harsh working conditions in order to gain some cash income. They are also in a high-risk situation, endangering their own health as well as that of the surrounding environment.

The main centres of small-scale mining activities in PNG are:

- the Wau/Bulolo areas in Morobe Province;
- the Maprik area, East Sepik;
- the Mt Kare and Porgera areas in Enga Province; and
- the Kinantu area of Eastern Highlands Province.

However, alluvial and placer gold is found almost everywhere in PNG. Metal Refining Operations Ltd (MRO), a company based in Port Moresby, has reported considerable gold coming in from Oro Province, Sudest Island, Milne Bay, Rabaul and even Bouganville, despite the social unrest in that region. None of these centres was previously considered as even a potential large small-scale (alluvial) mining, gold-producing districts. It indicates the potential around the country for small-scale mining as a source of income for remote rural people.

The situation is further compounded by the global economic and regional financial crisis identified and discussed in the World Bank report on Poverty Reduction Strategy Papers (PSRP) and the PNG Country Assistance (CAS) of 1999. In addition to the poverty level discussed in the Asian Development Bank Report (ADB) describes the harsh conditions under which the miners work.

The pilot educational project funded by AusAid, PNG government and private companies during the last three years (1998–2001) shows that miners have to be educated and necessary skills acquired in order to perform mining activities in a safe and environmentally friendly manner. PNG will require external donor support and assistance in both finance and technical services to address both internal and global crises affecting its small-scale mining industry.

In areas where miners are trespassing on customary land of indigenous or tribal people, there can be serious inter-group conflict. The miners can also contribute to environmental degradation and even introduce new diseases to local people. The absence of knowledge and skills is demonstrated and evidenced by miners' continuous use of basic production, processing and marketing techniques. The lack of financial services available to miners is also a drawback to expanding capital investment in the small-scale mining sector.

Official Definition of Small-scale Mining

There is no particular definition given to the artisanal and small-scale mining sector. Several parameters do influence what can accurately be described as a small-scale mining operations and it is normally a country specific. During the small-scale mining conference in Ankara, Turkey in 1988, a survey amongst the participants produced the significant results to illustrate how varied was the definition. The notable definitions and classifications emerged during the survey are as follows:

- Production: 12,500–100,000 tons per year or 50–5,000 tons per day.
- Employment: 10–100 persons employed.
- Capital investment: US\$120,000–\$10m.
- Revenue: \$120,000–\$10m.
- Mine life: 1–10 years.

In PNG the capital investment in major mining projects is high and easily classified and so definition of the Mt Victor and New Guinea Gold projects were classed as small mines, compared to Bougainville, Ok Tedi, Porgera and Misima Mines. In accordance with our guidelines definition, a small-scale mine is an operation with a capital investment of up to \$25 million. In developing countries this level of capitalization represents a substantial investment and it will always be a difficult task to source adequate capital for mining projects. It has been estimated that many small-scale mining operations in PNG start with as little as \$15 (price of a gold pan), to as much as \$3,000 in terms of expenditure for basic tools and portable equipment such as high bankers and suction dredges.

Also in the PNG context, small-scale mining applies equally to alluvial and hard rock that are covered by mining permits such as an Alluvial Mining Lease (AML) and Mining Lease (ML). With the alluvial gold it is defined as all unconsolidated rock materials, transported and deposited by stream action or gravitational action which are capable of being freely excavated without prior ripping or blasting.

The Status, Role and Importance of Artisanal and Small-scale Mining

Small-scale mining in PNG probably started as early as 1888 when gold was first found in quantities on Sudest Island in the east. This was followed by discoveries in other parts of the country. This was followed by a gold rush in the Wau and Bulolo districts where payable gold was found at Koranga Creek in 1922. The gold rush developed into a major dredging operation along the Bulolo valley and spread to small open-pit mining in the Wau region from the 1930s to the early 1990s.

The early discovery and mining of small-scale gold deposits then spread to other parts of the country. Some of the early alluvial gold districts known about include the Kainantu and Porgera areas in Highlands Region, Amanab, Maprik and Ganamambu districts in the Sepik region, around the borders of Oro and Morobe provinces and Misima and Woodlark districts in the Milne Bay Province. Alluvial gold mining was mostly dominated by expatriates in those early gold rushes. That trend changed when indigenous people decided to go into mining for the first time in 1949, along the Wanion River. The transfer of skills and knowledge of alluvial gold mining took place in the 1950s and 1960s when many residents, especially around the Wau/Bulolo area, applied for and were granted MLs. By the early 1970s, most expatriates who originally held mining leases for small-scale gold mining in the country had transferred their leases to citizens. This may have been influenced by the country's move towards independence.

At present, small-scale mining is recognized as legal cash-earning activity and it is given importance by the government which is using donor funds from AusAid and ADB to implement educational and micro-finance projects. The major objective of government policy is to improve the small-scale miners' efficiency and economic performance while reducing the negative impact of environmental and social factors. The small-scale mining sector currently mines gold with some silver. There are three main types of small-scale mining operation. First is mechanised mining which uses heavy earth-moving equipment such as bulldozers and excavators and high-capacity ore-processing kit such as trommels and jigs. This category accounts for only about 1 per cent of the operations in PNG. The second group includes simple mechanized miners, who use hand-held portable equipment such as pontoon dredges, hydraulic sluice pumps and sluice boxes. This group accounts for about approximately 10 per cent of this sector's operations. The last group includes the individual artisanal (micro-scale) miners who use simple panning dishes, shovels and rudimentary sluice boxes and comprises about 90 per cent of this sector. Mining practices and gold recovery are both very inefficient and hazardous. The bulk of the 50–60,000 small-scale miners throughout the country falls into this category and it is estimated that they earn an average monthly income of K250–K500.

The miners within these three categories are expected to have registered formal mining leases preferably MLs and AMLs granted under the Mining Act of 1992. Most of these grassroots miners operate on unregistered customary-owned land and they are recognized as formal miners as provided under the act. The simple mechanized miners are not permitted to mine without proper registration and other formalities owing to the nature of their operations.

As of 31 December 2000, the tenement registry records 113 AMLs and 367 MLs. For the convenience of administration each lease is represented by only one miner. In some particular situations, especially under earlier arrangements for business or family connections a lease may be registered under two or three miners' names,

Prior to the coming into force of the Mining Act of 1992 and regulation, miners operated under mining tenements such as Gold Mining Lease GML, DSC, Hydraulic Claim (HC), ERCC and more. These tenements were granted under the repealed mining legislation Mining Act, chapter 195.

In addition to miners who have registered mining tenements, other miners have operated on traditional or customary land. The miners in this category use mainly unsophisticated tools. These miners were issued with identity cards by the small-scale mining branch to enable them to mine, possess and sell gold. This system was discontinued when gold dealing was deregulated in 1987. The registered number of small-scale mining miners prior to the Mining Act 1992 coming into force were as follows:

- Mining tenement holders: 615;
- Miners with ID holders: 1,700; and
- RGC tributes: 167.

Records are not sufficiently complete to determine whether or not these were the only people mining gold. It may have well been that many more people were mining and when any gold was recovered, it was sold on by the person holding the appropriate registration.

It is difficult to provide a best estimate simply because there is very little information available to indicate the numbers of miners involved on customary land.

Statistics on Mineral Production or Revenues Derived from Artisanal and Small-scale Mining Activities

Dealing in small-scale mining-produced (alluvial) gold was deregulated in 1987, allowing anyone to buy and market gold. Prior to deregulation, a person had authority to deal in gold only when in possession of either a gold dealer's permit or a lease. The deregulation approach has removed the 10 per cent withholding tax and the 2.5 per cent royalty and replaced both with a 5 per cent export duty. In 1994, the 5 per cent duty was removed completely. Small-scale miners are no longer subject to any form of tax and therefore enjoy the full benefit of their gold proceeds.

A licence is required to export gold. The export licence is issued on an annual basis by the bank of PNG through its Exchange Control Department.

In accordance with the provisions of the mining legislation, miners are required to submit monthly production returns to the DOM. Most miners do not do this regularly, so the production figures submitted by miners do not accurately reflect total production from the small-scale mining sector. The gold-production statistics are therefore related to volume of gold exported by authorized gold dealers. In general, miners use existing marketing facilities, namely direct sale to commercial banks, individual gold dealers or the Metals Refinery Operation Ltd.

Past and present reports to the department and central bank strongly indicate that there is considerable illegal gold export. This is particularly evident when gold production started at Mt

Kare. Gold production during the 1988–90 period was particularly significant in the recent history of alluvial gold mining in PNG. The production and exports amounted to some 2.673 tonnes of alluvial gold with a corresponding value of some K29.8 million. After the abrupt closure of the Mt Kare operation in 1991, production dropped to just over 1.0 tonne of gold with a corresponding value of K11.3 million.

Although there have been no reported instances of illegal gold exports during the Mt Kare gold rush, the increased commercial activities by Mt Kare miners at the Mt Hagen commercial centre did not reflect the volume of gold lodged at the refinery or handled by the authorized gold dealers. There is a strong possibility that Mt Kare gold was exported illegally.

There is no official declaration about the increased gold production in 2001. However, the number of applications lodged for gold-exporting licences with the central bank (about five), and the number of expatriate miners enquiring about joint venture mining illustrate the anticipated increases in production.

In the last two years, there has been a marked increase in gold production. In 1999 and 2000 the production figures came to 59,080oz and 59,761oz, respectively. The resurgence could be attributed to factors such as improved marketing efforts, and the extensive outreach programme conducted throughout the country by the small-scale mining branch and MRO. This increasing trend should be continued into this year (2001) as the small-scale mining project, MRO and other interested parties continues and picks up momentum during 2001.

Participation in Non-formal or Non-registered Mining, Processing and Marketing Activities

The number of miners involved in small-scale alluvial mining varies from time to time, depending on the occupational preferences of miners. Some engage in small-scale mining and agricultural activity alternatively, so the actual numbers can be difficult to determine. It is difficult to separate out formal and non-formal miners as many people mine on their own customary land and no records are kept of this activity unless they apply for an ALM.

The total number of miners registered under old Mining Act, chapter 195 was 2,500. It is estimated that number of miners could far exceed this officially registered number. In addition, some miners conduct mining in very remote areas and where it is difficult to estimate numbers. The actual number of miners directly engaged in small-scale mining could be double the figure registered (as many as 5,000 people). This estimate is based on the number of miners involved in remote areas and also the new unsurveyed alluvial gold areas. This is the best estimation for the preceding period. The source of information is the DOM informal survey carried out during the outreach programme.

In countries where small-scale mining occurs, it is often the case that the numbers of people involved are very difficult to quantify. In part this is because of acknowledged seasonal fluctuations but in many cases it is chiefly because no formal count been undertaken.

In PNG, there are similar fluctuations in activity, as well as no formal counting yet been done. The estimated figure ranges between 50,000 and 80,000 people directly involved in small-scale mining at any one time. A working estimate of 60,000 people directly and legally involved in small-scale mining has been used for the purposes of this report. Even though acknowledged as a conservative estimate, it nonetheless represents 1.25 per cent of the population of PNG. Of this 60,000, 20 per cent are women and 30 per cent are school-age children under the age of 16 (figures from an informal survey carried out during a DOM outreach programme, 1998–2001).

Table I Estimated mining population in PNG

Province	Estimated mining population
Bougainville	900–1,000
Central	2–300
East New Britain	50–100
East Sepik	10–12,000
Eastern Highlands	1,000
Enga	4–5,000
Gulf	3–4,000
Madang	2–3,000
Manus	20–50
Milne Bay	1,000
Morobe	15–20,000
National Capital District	Uncertain
New Ireland	4–500
Oro	4–500
Southern Highlands	2–300
Simbu	Uncertain
West New Britain	A few only
West Sepik	3–5,000
Western	50–100
Western Highlands	50–100
<i>Total</i>	<i>41,270–53,950</i>

Source: This is an updated chart (October 2001), based on data presented at the GEM conference in Port Moresby by Tongo and Crispin June 2001.

Estimate of Numbers Supported by Income Generated from Artisanal and Small-scale Mining Activities

In addition to those directly involved, there are many people connected with the sector but indirectly involved. This group is usually involved in the supply of goods and services. A usual calculation is for seven people dependent in some way upon the industry for every directly involved miner (European Union Interim Report of Sysmin eligibility of PNG, 2001). In PNG's case this means a further 420,000 people are dependent in some way upon small-scale

mining which represents approximately 9–10 per cent of the population — a very considerable number.

Relative Importance of the Different Socio-economic Formalities Across the Sub-sector or for Most Important Minerals

The DOM has been collecting data on an informal basis over the past three years and the picture that emerges is variable.

The Wau area of Morobe Province in the latest census of last year (unofficial figures) reports a population of about 25,000. The unofficial figure used by DOM is that in this area a massive 75 per cent of the population are engaged in mining at some time or another. This includes women and school-age children. Mining is so pervasive that many people do not garden anymore. Their income derives solely from mining. In PNG this is unusual as gardening had been a way of life for almost everyone.

As a result of the informal survey carried out as part of the DOM outreach programme estimations have been made about mining populations in a number of areas based on talking to miners and the numbers of people involved. In the Porgera/Mt Kare area, the situation is similar to Wau/Bulolo for some of the population, in Sepik around Maprik and near Kainantu in Eastern Highlands Province. It is difficult to estimate the numbers but around Maprik probably about 10–15 per cent are full-time miners. In some of the villages around Kainantu such as Bilimoia, about 75 per cent are engaged in mining. In some of the areas around Mt Kare downstream from the project, virtually all of the 2,000–3,000 people are mining except for very small children.

As a general rule people use mining as a source of cash. When they need money for school fees, medical expenses, social obligations or travel, they mine some gold. This means that some people mine full time around the beginning of the year when school fees are due and again around Easter (many are Christians).

Another sizeable proportion of the population mines on a part-time basis year round. Another section have agricultural interests such as growing coffee. When the coffee has to be harvested then no mining is carried out until that is finished.

In PNG most of the rural population's income is agriculture based and many of the people are paid in kind or given non-wage rewards for their activities. This shows how the social organization has changed in the gold-mining areas. About 50 per cent of the population receive some money and the rest are mainly subsistence farmers or fish dependent (ADB report, 2000).

The situation varies between full-time miners and those who only do it when cash is needed. The terrain and limited resources means that a complete picture of the population and who and how many are mining and what percentage of their income derives from mining is difficult to

ascertain. Word of mouth indicates that there are more communities mining than have been visited to date by the DOM.

Arrangements for Production and Processing Activity

At present artisanal alluvial miners use simple panning dishes, shovels, rudimentary sluice and shaking boxes, as well as sometimes small drainage pumps to mine alluvial gold. The mining practice and gold recovery of these groups are both very inefficient and could be greatly improved by relatively small measures of sizeable investment. They account for about 90 per cent of sector operations. They are usually family-based businesses with women and any children capable also helping in the work. Those children not working can often be seen playing in and around the mining activity.

The simple mechanized miners use hand-held portable equipment such as pontoon dredges, hydraulic sluice pumps and riffled sluice boxes. The recovery of gold is more efficient than by simple panning, however, there are operational problems concerning safe pumping practice and the removal of overburden or waste material. These types of activities account for about 10 per cent of sector operations.

Small-scale miners using mechanized equipment, such as heavy earth-moving bulldozers, excavators and high-capacity ore-processing equipment, make up 1 per cent of the small-scale mining sector. Their use of mercury is usually contained in special equipment and the ore is mechanically crushed and separated. The gold-recovery rate from these operations is reasonably high.

Estimates of Net Income to Miners Generated by Different Types of Activities

The small-scale mining sector already has considerable economic impact in PNG, with average earnings estimated at around or over K250 per month. ADB reports on micro-finance in PNG (2001) indicate that in more than two-thirds of the provinces the average cash income is clustered around K461/year and the cash income is decreasing compared to non-monetary income. Approximately 60,000 people are directly involved, and it is suggested that earnings of some K180m per annum are anticipated from gold production of small-scale mining. This is close to 3 per cent of the 1997 gross domestic product.

The alluvial gold is the only small-scale mining activity widespread in PNG. The above estimate therefore covers alluvial gold mining alone.

Estimates of Number and Nature of Work of Women and Children Involved

The estimated mining population is 60,000. Of this, 20 per cent are women and some 30 per cent are school-age children under 16. These figures are from an informal survey carried out by the DOM. The actual numbers vary from place to place. In some areas, very few women are

seen at work mining, but elsewhere, especially where families are involved, there may be several generations involved from children, to grandmothers and close relatives. Very few women have been identified as miners in their own right although this does occur in a few areas. Most women are engaged in transporting the materials to preferred sites for panning and sluicing and final separation of gold. Women do some of the digging as well. Stronger children are also engaged in digging, transporting, panning, sluicing and final separation of gold. Rarely have we seen women doing the amalgam 'cooking'; this appears to be an almost exclusively male activity.

Estimate of Indirect Economic Benefits or Multiplier Effects of the Identified Activities

In addition to the numbers of people involved indirectly described above (420,000), PNG's family and extended-family bonds assures fair distribution of benefits from their mining clansmen and women. It is difficult to estimate mining's total economic benefit and multiplier effects, nevertheless PNG social security and benefits distribution structure is flexible enough to ensure that small-scale mining-generated income trickles down to family and clan members.

The surrounding areas benefit considerably from extra cash activity in the economy. For example there are seven large trading stores in Wau, Morobe Province. In a more normal rural backwater, the population would be more likely to support only two or three stores and these probably smaller. The call on manufactured food is probably greater in Wau as well owing to the lack of individual gardens.

Negative Impacts on Environment, Surrounding Communities and Health Linked to Small-Scale Mining

The main hazard to alluvial miners is from mercury use in the mining process. At present some 4.0 tonnes of mercury per year is sold to alluvial miners (wholesaler's records canvassed by DOM in 1999. There may be illegal imports but no figures are available to estimate them). Mercury is used in gold panning to extract gold from black sand. The mercury/gold amalgam is then heated to evaporate the mercury and leave a pure gold residue. In many cases this heating takes place over the family cooking stove. Since the miners handle mercury without gloves, they absorb mercury through their skin or inhale it as vapour when cooking the amalgam. The continual cooking of amalgam in their huts over a period of years can also lead to a build-up of mercury vapours in the hut and subsequent mercury-poisoning effects. This cannot be proven at this stage but it would appear from hearsay evidence that headaches and feeling unwell are likely results of this activity.

Most of the gold worked on by small-scale miners are alluvial deposits in which the gold particles are separated from the waste using simple mining equipment and techniques. In most

cases miners use some mercury either in between the sluice-box compartments or in the pan to separate gold from the final black sand.

Mercury poses a hazard to the environment as well as to people. In the Wau/Bulolo area where dredge mining began in the late 1920s and continued into the 1960s, it is still common for bulldozers to uncover large puddles of mercury. Recently a field trip to Bougainville (October 2001) by MRO, returned with observations that the same situation was occurring around the alluvial centre on this island as a result of mining carried out earlier this century.

Hydraulic sluice operators occasionally dislodge a naturally formed large amalgam of mercury and alluvial gold. Mercury is non-soluble, so it remains in river sediment. It is not unusual for the river water to flow clear of mercury while high levels of mercury lie on the river bed. This mercury is then transported through the food chain and subsequently affects humans.

Recent studies indicate that some of the mercury in the environment may be a result of the burning of native forests. In the Amazon basin it has been argued that up to 50 per cent of the mercury present in the waterways and subsequent mercury poisoning in people comes from this.¹

This is important in PNG because of the drought during 1987/8. Huge tracts of forest were burnt in and around the Wau/Bulolo mining area, and this could have led to increased levels of mercury and or methylmercury in circulation in the environment.

Several small studies have been done over the years on mercury levels in humans and the environment and revealed some very high values. The largest study to date is being carried out at the moment funded by AusAid in the Wau/Bulolo area. Results should be available in a few months.

Medical staff have not been trained to recognize the symptoms of mercury poisoning and have no drugs to treat it. The point has been made to the relevant authorities and to the local communities that there should be some attempts to address this shortfall.

The small-scale alluvial mining operation in rivers, creeks and banks have also caused damage to riverine environment and a substantial degree of environmental degradation. In the Wau/Bulolo area many artisanal operations are working over the tailings of old mines in an already degraded environment. In areas of placer gold, such as Mt Kare, artisanal miners dig pits of various depths, all relatively small and shallow. These activities have a very detrimental effect on the environment. In places of intensive mining activity such as Eddie Creek and Namie in Wau, the landscape has been completely transformed into a degraded area of pits and waste. Digging around the roots of large trees along riverbanks eventually causes them to fall

¹ Viega et al. *Mercury Pollution from Deforestation*. At http://water.ugs.gov/public/wid/FS_216-95.html. Pearce (1999) *A Nightmare Revisited*, *New Scientist*, 6 February; also available online.

into the river, accelerating erosion and creating dangers from logs in the river when flooding for those downstream.

Many PNG miners have no training in mining so they dig and burrow at the side of the mountain without regard for slope stability or other safety measures. Several deaths occur each year as a consequence of mudslides and falls of ground. This can be easily prevented by proper training or the continuation of awareness programmes.

Range of Practices in Mining Processing and Environmental Control across the Sub-sector and Recent Changes

An informal survey carried out by the DOM over the past three years indicates that approximately 85–90 per cent of all miners use gold-panning techniques or sluice boxes without any mechanical aids. Approximately 10 per cent use semi-mechanized equipment and less than 1 per cent use fully mechanized heavy machinery.

The non-mechanized sector can use banana leaves to catch gold or their bare hands to pick up pieces that are visible. The gold pans may be carved out of wood or purchased from suppliers. The lack of skills and supplies has restricted the use of more sophisticated recovery equipment.

The use of sluice boxes varies, and would include about 60–70 per cent of the population working in the Wau/Bulolo area. These boxes range from simple wooden constructions with no riffles or mats to store-bought lightweight aluminium with lift-out riffle ladders and purpose-supplied matting. The simpler sluice boxes are made out of any wood available and can be a straight-through rectangular shape, or with a large area to contain the gravel and a narrow channel through which the gravel can be washed. The simplest sluice box can be steel-reinforced mesh laid on the ground, the wash then passes over and only the coarsest gold is retained.

Many wooden sluice boxes have no riffles or only have one at the top or bottom. The boxes are fed by water that has been diverted from a flowing stream and the velocity of the water is probably insufficient to effect a quality separation of the gold passing through. Many people do use this, however, and recover sufficient gold to make it worthwhile.

Once beyond the simple panning and sluicing water pumps are used in a number of ways to help with gold recovery. Gravity-fed water is used by a significant proportion of the miners in the Wau/Bulolo area. This is because the steep topography allows for stream diversion through a polypipe or from small dams or direct from a river with sufficient pressure to run a jet set/monitor/musket and wash the gravel into a sluice box.

Water pumps are used for removing water from holes in the river bed, transferring water to dams to run a musket directly and wash gravel into a sluice box. Diesel pumps are used to operate a musket, but those used for water transfer are mostly petrol. Petrol pumps are much

cheaper and lighter although the fuel is more expensive and they require continuous maintenance attention.

Mining in some areas requires the removal of large boulders to get at the gold underneath such as in the Waria valley in Morobe Province. Boulders can be winched away, or fires lit and the stone broken down by applying boiling water. They can also be moved by simple mechanical means by removing the soil on one side and allowing the boulder to roll away under its own weight.

In the Sepik Province and also in Madang, floating dredges are used. The best of these have a large readily available water supply in places where the gold is still found in reasonable quantities in the river and stream beds. These dredges range from about 2-inch diameter hose to 7–8-inch diameter hose. These are supplied by retailers and come mostly from the US. One manufacturer was making them in Wewak but it is not known whether that is still open in 2001.

Hard-rock mining is carried out in a number of areas. Mt Kaindi in the Wau/Bulolo area (Morobe Province), Bilamoia in the Kainantu area (Eastern Highlands Province), Mt Kare and Porgera areas of Enga Province, in and around the Tolokuma gold mine in Central Province. There are others as well in Sepik and probably places of which the DOM is not aware.

The techniques are very variable. At Bilamoia, very sophisticated tunnels are constructed with well-engineered wooden supporting frames for both sinks and drives. In other areas the gold veins are exposed by machinery and then worked by hand to recover the gold-bearing portion. The host rock is altered so it is reasonably soft for this technique to be used.

In some areas, unsupported tunnels are dug following any gold vein that is uncovered or suspected to be present. This tunnelling can be quite common in alluvial deposits where the drive is following the bottom of the wash where most of the gold accumulates. This tunnelling has led in some areas to destruction of public roads and also to miners being killed when they tunnel in behind an area that a major mining company is currently or previously exploiting.

Gold is recovered by pounding in a dolly pot and then panned to recover the gold fraction. Rarely is mechanical crushing carried out.

Mercury is used by about 60 per cent of the mining population surveyed by the DOM. In both alluvial and hard-rock mining it is used to recover the fine gold.

Environmental issues do not seem to be a strong concern for members of the small-scale artisanal mining community. Issues such as damage to river beds, solids in water and destruction of riverbanks are not addressed. The DOM awareness outreach programme has been operating for the past two years and has attempted to bring these issues to the attention of miners.

Major changes over the last ten years include:

- Increase in the number of people mining as the economy declines and agricultural returns diminish.
- More use of dredges in the areas where there is abundant water and appropriate deposits that can be worked by these methods.
- It is hard to tell how rapidly the gross numbers are increasing. When the DOM survey started in December 1998, it was estimated there were about 18,000–20,000 miners. This figure has now increased to 50,000–60,000 that can be proved and probably 80,000–100,000 as an upper limit as a result of the field visits to many of the goldfields both remote and easily accessible. The topography and the widespread occurrence of gold throughout PNG in many rural and remote areas makes an accurate census very difficult.
- It has become more of a source of income for people in rural areas as prices for traditional crops of coffee and copra remain low. In some areas rural cropping has been almost completely abandoned in favour of mining. The Wau area in Morobe Province is an example of this. PNG people are by tradition gardeners and previously gardens were everywhere but in Wau this is no longer the case. The local economy has been transformed from a subsistence one to a cash-based one.

In some areas such as Milne Bay Province small-scale mining had virtually disappeared as there was no infrastructure to support the activity. The gold buyers who were still buying were only paying approximately one-third of a fair market value. This is changing as more equipment is made available and gold buyers return to the area and give a more realistic price for the gold bought.

Some reef areas of Milne Bay are in the process of being preserved so local fishermen will need an alternative source of income. Small-scale mining may provide this as long as it is done carefully and surrounding waters are not degraded.

The DOM has recognized the importance of small-scale gold mining to the rural community and is helping to re-invigorate the small-scale mining branch. This has been helped by money from AusAid and private donors as poverty alleviation and income generation for rural people.

Estimates of the gold recovered by the small miners varies from about 100m Kina to 180m Kina. This money goes directly into the pockets of the rural people. There is no accurate measure of illegal exports but figures are based on what it is assumed goes overseas based on gold seen but not passed through the formal system and information from local people — both miners and non-miners.

The present technical and educational programme extended to small-scale miners and the staff of small-scale mining branch of DOM under AusAid has created or opened up much vigour and interest to promote and broaden the small-scale mining industry. The support provided has included environmental awareness, health awareness and skills development. This

programme has produced a series of booklets and videos on various aspects of small-scale mining in both Tok Pisin and English to generate awareness of various issues related to gold mining.

Inventory of Support Activities for Small-Scale Mining

There are no financial institutions or credit schemes especially designed to provide financial services to the small-scale miners nor do any existing banks finance small-scale mining operations. Some particular branches had lent money in the past but had difficulty getting repayment. The Rural Development Bank has lent a small amount of money but only to people in a small area. The most appropriate source of funds would normally be from people's own savings. Borrowed capital is the next source, however, most financial institutions would not risk capital in mining projects which are perceived as uneconomic.

There is a persistent perception that those engaged in small-scale alluvial mining do not adequately evaluate the resource first to determine its economics and this means that it will always be financially risky venture. Because of this, the miners continually encounter a brick wall when seeking financial services. PNG's financial system displays a significant institutional gap that leaves micro and small enterprises, subsistence farmers and poor householders without any services. Knowledge of micro-finance best practice is limited. The ability to design appropriate savings and loan products to suit actual client needs is non-existent.

A joint venture between the PNG government, ADB and the Bank of PNG in 2001 (with the estimated capital outlay of \$13.5m) will now start in 2002. It is designed to provide sustainable delivery of micro-finance services to a large number of micro-enterprises and to provide saving facilities to poor and currently unserved communities. The pilot project will be established at Wau — a decision strongly influenced by the cash flow generated by small-scale mining.

There is no established umbrella organization, federation or association representing the interest in all capacities of small-scale mining activities. The idea of setting up a mining association was mooted some years back and did function for a short period, however, there is no sense of urgency and purpose for such an organization at the moment. The difficulty of getting such a diverse group together, both geographically and culturally, will be a challenging task. There may be a place for smaller regionally based organizations or perhaps associations based on the size of the activities, for example a mechanized miners' association. There is a PNG Chamber of Mining and Petroleum that represents the major companies and has recently given increasing attention to small-scale mining.

Small-scale mining is one recognized economic activity that generate income for the rural population, however, government support in terms of funds and manpower has been limited and inconsistent during the last decade. Government policy on small-scale mining is not easily supported or implemented. The present AusAid-funded technical and education assistance programme grew from a single officer's initiatives and persistence and is the first attempt at comprehensive assistance.

There are some current projects in PNG run by Conservation International and the World Wildlife Fund. These are involved in areas where there is small-scale mining but they are mostly concerned with conservation rather than exploitation of alluvial gold resources.

Private sector support and initiatives for small-scale mining in PNG has picked up tremendously during the last three years. The DOM is now coordinating and facilitating this support and endeavours to maintain continuity by holding meetings occasionally. Metals Refining Operations Ltd (MRO) is the major contributor and supporter of AusAid's Technical Assistance. This has led to the production of booklets and videos on small-scale mining. Other mining companies, such as Aurora Gold Ltd, Highlands Pacific, Porgera Joint Venture, have also assisted. A number of provincial governments have also helped including Milne Bay Province, New Ireland Province and East Sepik. Some landowner groups have also assisted including the Porgera Development Corporation.

The DOM has plans to co-sponsor donor-funded projects like Sysmin's Infrastructure Development (EU), and Japan's Social Development Funds extension programme with private sector technical and financial assistance.

The present increase in alluvial gold production is partly contributed to by AusAid's technical, educational and outreach programme implemented with the help of a technical adviser. This project has been very successful as there were new opportunities opening up for further expansion and coverage. Almost 15,000 people have been contacted, three staff members of the small-scale mining branch have received preliminary training and educational materials have been produced. The private sector has also seconded people to the project: five people have been trained at DOM and MRO has trained an additional 5–10 people.

There is strong possibility that AusAid assistance will continue for next 2–3 years but at a reduced rate. An estimated K380,000 will be committed by AusAid this year (2001).

The EU's Sysmin is another source of funds the DOM is seeking for infrastructure development at Wau, Wewak and Porgera. The cost of the project is 6.8m Euros to be funded as a grant. This project is expected to take effect in early 2003.

Japan's Social Development Fund is another source. Aid from that would continue the technical, governance, training and extension programmes throughout PNG. The cost of this project is \$468,300. This fund is expected to come onstream in 2002.

Recent Interaction between Small-scale Miners and Medium- and Large-scale Exploration and Mining Companies

As stated before, there are no medium-sized mining activities in PNG. There are only big mines and, after them, the largest of the small-scale mining community's washing plants and small-scale crushing plants which employ about 10 people. There are only about six of these in PNG. The 7- and 8-inch dredges are used in some places but there are only a few that are used on a regular basis (a estimate would be about 30–40 larger dredges).

There are five large mines operating in PNG at the beginning of 2001. Exploration had virtually come to a halt with little happening except for some work expanding reserves of known deposits.

There is a lack of awareness that the state owns the minerals in the ground. Many still believe that 'mi papa bilong ground', or minerals belong to me. Compensation is demanded for all activities. There is no differentiation by local people between exploration and mining activities.

One exploration company tried to steer the artisanal miners away from the hard-rock deposit and helped them work the alluvial gravels. The company provided expert assistance to help design and build appropriate equipment and assist with initial production. The company attempted to ban the use of mercury on its leased land and wanted to stop safety information about mercury being disseminated despite the fact that downstream from the camp mercury was being used in processing.

It appeared that the company representatives were aware of the problems of mercury poisoning and believed that the best way to handle a possible problem was by not allowing widespread information about the use of mercury. This changed with a visit of the outreach programme of the DOM during which the dangers associated with mercury were explained. The local mining community was unaware of these dangers and awareness was raised and the company decided that it was best to allow the information to be passed on but still banned the use of the material on their lease.

Large mining companies' interactions with small-scale mining communities varies from no interaction as no small-scale mining is occurring because of the type of deposit (disseminated, such as Lihir), with the gold too fine to recover easily using artisanal methods. The other extreme is antagonism as artisanal mining is intruding upon leases illegally, stealing gold and creating dangerous situations for both themselves and the company.

In one case artisanal miners dug into the back of the mountain containing a gold deposit already being exploited by a large mining company. Several were killed when blasting occurred even despite ignoring repeated warnings of the danger. The artisanal miners are working the tailings below the outlet and recovering gold from that source.

The intrusion of small-scale miners into areas that are controlled by mining companies will continue to be a problem. It is impossible to stop people attempting to mine gold for themselves completely without resorting to vigorous interventions. The ultimate solution may be for the people to be assisted to work the alluvial gold deposits leaving the major hard-rock deposits for the major companies. As indicated above, some companies are already attempting to address this issue and try to find a way peacefully to resolve the issue with a win-win solution. In that way both will benefit from the gold that belongs to PNG.

Examples of Positive Change or Successful Interventions

In the first visit to the Middle Sepik area in November 1999, we visited Bisario near the headwaters of the Crossamarie River. People there had been given mercury to capture fine gold by the gold buyers but not been told of the dangers. The intention was for the gold to be returned to the gold buyers because of the mercury was supplied for free. Through its workshops, the outreach programme helped people understand the dangers and how to reduce the risks to both children and pregnant women. Many people expressed their concern and anger at the deceptive lack of information from the people who gave them the mercury.

Acquiring concrete information it is not always possible in PNG. It is difficult even to get accurate numbers of people. We do not have the resources nor the time to stop the education programme and spend all our time on census activities. It will be an essential part of the ongoing programme that these numbers are verified in some way. The AusAid adviser is in the process of writing up an evaluation of the mercury awareness and the effect of the education programme in the Wau and Bulolo areas.

This story has been repeated in a number of areas in PNG. Many times the dangers of mercury have been explained (the Waria river valley, Porgera area, Kainantu area, Milne Bay and many communities in and around the Wau/Bulolo), and as a consequence practices have been changed and people become more aware. The main catalyst for this has been a video that shows the effects of mercury on the people in Minamarta Bay in Japan and on small-scale mining communities in Brazil. This has been put together by the DOM assisted by AusAid. The education outreach programme has been working since 1999 and forms part of the education travelling road show.

Another practice that occurs in some areas is burning amalgam cake in huts where people live. The main reason is to make sure that potential thieves cannot see what they are doing, and how much gold they have. The dangers of this practice have been explained (accumulation of mercury and mercury vapours in the huts), and some people have changed this practice. Emphasis has always been on the possible effects on children and pregnant women.

The various methods of burning the amalgam have been explained in all of the areas visited by the DOM/AusAid education outreach programme. Various options that can be used range from full retorting to the use of the 'tin fish tin' method of recycling mercury (described in detail in

Mercury-safe uses in Small-scale Alluvial Mining published by the DOM in 1999). It has been emphasized that people can also save money by recycling mercury. People can also save money by recycling mercury as well as reducing health risks. Traditionally people have burned the amalgam cake wrapped in leaves or on a tin exposed to the atmosphere.

Often we have seen people burning the amalgam cake and others sitting downwind in the smoke. We point out constantly that this is dangerous and many people have taken this on board and now try to keep upwind of the fire. Allied with this is the habit of smoking cigarettes while burning the amalgam cake or sitting in the smoke to keep warm. Again many times this has been pointed out and people accept the advice once the dangers are explained.

In one village called Sambio (Morobe Province), several people were burning their amalgam cakes on the blade of a knife that was later used for preparing food. After a visit from the outreach team who explained the dangers of this practice, residents indicated that they would stop doing this and use a different method to burn the amalgam.

In the Simbai Valley (Madang Province) no mercury was used to recover gold because they only try to recover nugget gold. This is changing however as information on mercury was filtering through to this isolated valley. The outreach team carried out a full mercury awareness so that the miners will be aware of the dangers before wide spread mercury use in the valley.

As a result of the programme AusAid has funded a base-line mercury-level study of the Wau/Bulolo area. There have been no large-scale investigations of mercury levels in people until this was started in May 2001. If a problem is identified then further investigations will be carried out to see if the problem comes from naturally occurring mercury, mercury from previous mining, mercury from current practices or mercury from the forest fires during the major drought in 1997.

In the river below the giant Porgera gold mine, mining practice has changed according to the local mining community. Before the mine, people were able to capture gold which was of a larger size. Now that the tailings from the mine cover over the original gravel beds the gold is much finer and mercury is needed to capture it.

The outreach programme of the DOM has also continuously raised the issue of environmental degradation from mining activities and the necessity to take care that damage is not done to private property or public land/property. It is continually emphasized that damage to the surrounding environment can affect future generations, their ability to garden and feed themselves and their future health. This is demonstrated by use of pictures and videotapes showing areas that have been affected in the past and not rehabilitated.

In many places although information is available in both Tok Pisin and English, now through the programme, Tokples is used with translation done by local people. The message can then be relayed direct to specific people and questions can be asked and answered at the village.

There are over 700 different language groups in PNG. Nearly all mining takes place in rural and remote areas so language becomes a vital part of the communication package.

On Misima Island a gold mine has been operating since 1989 and is now entering the close-down phase. The mine-closure plan developed includes assistance to the community to cope with the changed economic conditions when the mine is shut. The mine operators have mainly pursued agricultural options as income generators. The financial returns, however, are restricted due to the isolated location, distance from markets and limited agricultural land.

Small-scale mining, however, has the potential to replace a major part of the royalties paid out each year (an average 1.7m Kina/year, Misima Mines annual reports). This would be spread across the community of Milne Bay not just to the traditional landowners where the mine is located. Talks were held with the business development arm of the Misima Mines on these issues and how with their cooperation we could accelerate and make sustainable the development of small-scale mining in Misima itself and the other islands in the area. The suggestion was put forward that Misima Mines would consider the possibility that they provide a scholarship for a member of the Milne Bay Provincial Administration to work with the small-scale mining branch of the DOM in Wau for a period of six months. This would provide some hands-on experience in all aspects of the industry and that person would then act as the liaison person for small-scale mining in the province. A major issue throughout PNG is the lack of trained personnel to deal with the administration of small-scale mining.

Two of the gold miners who brought gold to be sold during the last trip to Milne Bay (October 2001) were employees of the mine who realized that their employment was coming to an end and they needed to find an alternative source of income. They have become part of the cash-based economic system and going back to the village to live as a subsistence food producer no longer held a strong appeal.

It should be pointed out that environmental issues are an important part of the scenario for any island-based small-scale mining. Pollution of fishing grounds from high sediment loads in streams added to by mining may damage reef systems and therefore lead to food-source problems. It may be overcome by simple low key appropriate technology such as settling ponds. This would be appropriate especially where soils are clay based which may lead to sediments being held in suspension for longer periods of time or carried greater distances.

Sustainability for small scale mining in Milne Bay can be reinforced by cooperation of all of the stakeholders. In this case Misima Mines is now committed to supporting the programme initiated by DOM with in-kind donations of transport both local and from Port Moresby as well as accommodation. The private sector is committed to supporting the initial skills base development, making available simple mining equipment, and economic infrastructure support by buying the gold produced at a fair price at the local level.

This acceptance that small-scale mining can be part of mine-closure organization is an important breakthrough for the future. It may convince other mining companies that small-scale mining must be an integral part of any mine closure.

Inventory of Legal Codes and Regulations

The legislation which provides administrative and the regulatory mechanism for the small-scale mining operations include the following.

- Mining Act 1992: The applicable sections are 2(1), and 48–64 for alluvial mining leases and sections 38–47 for mining leases.
- Mining Regulations 1992, Sections 3, 4, 7–18 and sections 25 to 28 are relevant provisions related to small-scale mining lease process and procedures.
- Mining (Safety) Act, chapter 195A and the associated regulations stipulate safe mining practices and habits.
- Environment Planning Act, chapter 370.
- Water Resources Act, chapter 205.
- Central Banking (Foreign Exchange and Gold) Regulation, chapter 138.
- Lands Act.
- Customs Act.

We have neither fully used nor tested the two main pieces of mining legislation — the Mining Act of 1992 and the Mining Safety Act, chapter 195. We have come to know the weaknesses and strengths but do not have exhaustive knowledge of the two laws.

Official Policy Statements

The broad policy statement covering the small-scale mining sector is the government's Eight-point Plan which emphasizes promotion of rural-based industries where participation by PNG citizens is encouraged. Legally, small-scale mining is recognized as rurally based, cash-generating economic activity. It also stresses that any development activities or industries promoted must be done in an environmentally friendly manner beneficial for both present and future generations.

In the recent Medium-term Development Strategy (covering the 1997–2002 period) the government emphasized the importance of private sector development for the future of PNG. The development of vibrant micro, small- and medium-sized enterprises to spearhead economic growth is of critical importance to the government. In trying to improve the business environment, the government further identifies and addresses key issues and constraints

hindering business development. The weakness of the financial system and the lack of financial services available to the private sector were seen as the main obstacles to business development. The regulatory framework of the Banks, Banks and Financial Institution Acts were brought into being recently. The micro-finance Policy Paper in 2000 was the first attempt by a micro-finance working group, involving all stakeholders, to develop a micro-finance project assisted by the Asian Development Bank (ADB). The pilot project will be set up in Wau, Morobe Province in 2003.

The specific policy statement directly related to small-scale mining is the government's Five-year Development Plan for 1989–1993 which emphasizes the importance attached to the PNG citizens' participation in small-scale mining. It is recognized that small-scale mining is a viable economic industry for indigenous people that needs vigorous promotion work.

The small-scale mining policy is an extension of broad-based government policy for minerals development in PNG. While there are some aspects of mineral policy covering both large and small-scale mining operations, there are specific policies exclusively designed for the small-scale mining sector alone. For instance, there are administrative and legal procedures clearly detailed in the Mining Act of 1992 and other relevant legislation specifically for small-scale mining. The DOM is the responsible agent for administering the mining legislation and certain officers have been appointed with the statutory functions to ensure interpretation and application of the legislation and the regulation.

In order to encourage orderly and efficient development, the DOM continues to promote the small-scale mining industry through the established administrative and technical structures carrying out the following functions:

- To continue to provide the technical extension services to miners. The staffing level of the small-scale mining branch has been increased in the recent approved departmental structure (namely, increased from the present five to nine).
- To review sections of the Mining Act 1992 that appears to be difficult for small tenements applicants and make it simpler to administer.
- To encourage foreign investors with interest in mining to participate in contract development of tenements with landowners using their financial expertise.
- To provide safeguards in consultation with the relevant agencies, to protect the environment from pollution by miners and ensure that mercury is used in accordance with good mineral processing practice.
- To maintain surveillance on mining activities to ensure safety of the mining operations.
- To strengthen the institutional capacity of the small-scale mining branch through infrastructure establishment, regular reviews of branch operations and staff development.

Changes to the Legal or Policy Framework Occurring during the Past Ten Years

The old Mining Act, chapter 195 adopted from the colonial administration in 1975 was reviewed, repealed and enacted in 1992 together with a new Mining Act. There were a number of licences and permits for mining activities stipulated under the small-scale mining category, so it became administratively cumbersome. The procedure for tenement application, registration and final processing was too difficult to follow. There was no provision that legally allowed customary landowners of alluvial gold grounds formally to engage in mining activities.

The new Mining Act 1992 has cut down the number of tenements required under small-scale mining to two: the alluvial mining lease (AML) and the mining lease (ML). Some of the permits such as homestead leases were referred on for appropriate legislation such as the Land Act. The administrative procedures for processing the tenement (AML and ML) application were corrected with establishment of a registrar's office and the statutory appointment of a registrar to simplify the structures and approval process. The favourable improvement in the new legislation was that the AML was restricted to PNG citizens only who are traditional landowners of the alluvial deposits.

There have been some practical difficulties encountered in interpreting and administering the Mining Act 1992 including:

- No provision was made for mechanized mining on AMLs and yet some sections of the act allow mechanized mining operations under joint venture arrangements with foreign investors.
- The properly surveyed lease maps were not fully implemented when the lease conversion exercise took place in 1994. This anomaly will be rectified when consultants engaged under terms of a World Bank loan will resurvey all the old leases under the Mineral Lease conversion and Cadastral Survey Assistance component.
- Finally, the broad policy framework on small-scale mining was not fully implemented to test the institutional capacity within the DOM and the potential of the artisanal and small-scale mining sector in PNG. It was only within last three years that small-scale mining administration and field extension work has started to produce results and create more opportunities for further training, educational and promotional work. It only happened when the new DOM Secretary supported small-scale mining work by increasing the staff strength from three to eight officers and assigned donor funding support from AusAid.

Bibliography

Arpa, G (1998) *Wau/Bulolo Alluvial Mining Practice. Small-scale Hand Operation to Mechanized Alluvial Mining Operation*. University of Technology, Lae.

- Blowers, M (ed) (1983) *Proceedings of the Conference on Small-scale Mining in Papua New Guinea*. University of Technology, Lae.
- Blowers, M (1992) *Handbook of Small-scale Mining for Papua New Guinea*. Pacific Resource Publications, Christchurch.
- Bugnoson, E (1996) *General Notes and References on Small-scale Mining in PNG*. Department of Mining and Petroleum, Port Moresby.
- Department of Mining (Mineral Resources) (1998–2000) Various informal reports, unpublished during the period. Authors usually members of the department.
- Gavu, V, Tongo, G and Lole, H (1999) *Introduction to Small-scale Mining Techniques*. Department of Mining, Port Moresby.
- Gavu, V, Tongo, G and Lole, H (1999) *Mercury-safe Uses in Small-Scale Alluvial Gold Mining*. Department of Mining, Port Moresby.
- Gavu, V, Tongo G and Lole, H (1999) *Introduction to Mechanised Small-scale Gold Mining*. Department of Mining, Port Moresby.
- Mallard, A E and Hugman, S J (nd) *The Impact of Mercury on the Bulolo River Valley*. Report CT/13 Department of Chemical Technology, University of Technology, Lae.
- Subasinghe, G H and Okada, S (1998) *The Role of Mercury in Alluvial Gold Mining: Handling, Toxicity, Pollution and Possible Alternatives*. Department of Mining Engineering, University of Technology, Lae.

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