

**Mining, Sustainable Development, and Health in Ghana  
The Akwatia Case-Study**

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March 2004**



***Saltpond Small-Scale Mining Site, Ghana Consolidated Diamonds, Ltd  
Akwatia, Kwaebirem District, Ghana***

***Based on Research Conducted in Ghana from July-August 2003  
Research Sponsored by the Brown University Luce Environmental Scholars Program***

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**Note: All images in this paper were taken by Kaakpema Yelapaala in Ghana**

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## **Mining, Sustainable Development, and Health in Ghana The Akwatia Case-Study**

### **Introduction**

The negative impact of mining activities on the environment is well documented (Heath et al., 1993; Veiga, M.M. and Beinhoff, C., 1997; Warhurst, A. 1999; Warhurst, A., 1994). Particular attention has been given to the effect of small-scale gold mining activities on environmental contamination. While the land degradation caused by the gold mining is significant, chemical contamination from the gold extraction process imposes a double burden on the environment, with harmful health outcomes for mining communities and persons residing in close proximity to such activities. However, less attention has been paid to environmental degradation and health topics in diamond mining towns, primarily because diamond-mining production does not entail chemical processes.

This paper discusses the environmental impact of diamond mining activities in Ghana's largest diamond mining production town, Akwatia. Akwatia provides a unique example of the negative impact of diamond mining on environmental degradation and sustainable development. Indeed, while the health impacts of diamond mining in Akwatia are not linked to environmental contamination, there are also important questions about economic development and health that this paper addresses.

## **Methodology**

Information for this paper was collected via a combination of library research in the United States and Ghana, and field research in the case-study town. Fieldwork for the research project spanned from July to August 2003. Both qualitative and quantitative research techniques were employed to collect data on the mining industry in Ghana, mining practices in Akwatia, mining-related sickness, and information from the major diamond mining company in Akwatia. This process included informal interviews with miners, mining officials, government officials, and local community members. The project was sponsored by the Brown University Luce Environmental Scholars Program, and was officially supported by the Ghana National Development Planning Commission. Support was also obtained from the Minerals Commission, the Ministry of Environment and Science, and the Ministry of Health.

## **An Overview of Mining in Ghana**

### *The Geological Setting*

Ghana, a West African nation located on the Gulf of Guinea, is well endowed with many natural resources. The country covers an area of 238,555 square kilometers, about the size of Great Britain or the state of Oregon. Ghana's population is approximately twenty million, and Cote D'Ivoire, Burkina Faso, and Togo border the country. It was formerly a British colony, at which time the territory was known as the Gold Coast for its abundance of gold reserves.<sup>1</sup>

Small-scale mining activities in Ghana date back more than 2000 years. There is evidence citing gold mining going as far back as the seventh and eight centuries AD (Hilson, 2001). Ghana is presently the second largest producer of gold in sub-Saharan Africa, only behind South Africa, and a leading exporter of bauxite, diamonds, and timber. Ghana's geographic setting is the primary reason for its wealth of mineral resources. The country falls within the Precambrian Shield of West Africa. The major Precambrian rock units in Ghana are the primary source of the country's major mineral products: gold, bauxite, diamonds, and manganese (Grubaugh, 2002). They are associated with Proterozoic, Birimian, and Tarkwaian rocks, and the majority of gold produced in Ghana comes from Birimian rocks, which constitute approximately one-third of the country (Grubaugh, 2002).

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<sup>1</sup> The Portuguese were the first Europeans to occupy the territory that is now known as Ghana in the late fifteenth century. The Dutch also had a short stay in the territory, but it is the British that colonized the Gold Coast for the longest period of time, from 1844 until March 6, 1957, Ghana's independence day.

*Driving Forces for Boosting Investment in the Ghanaian Mining Sector: A Brief*

*Overview of the Evolution of Mineral Laws and Policies in Ghana Since 1986*

Ghana gained independence from British colonial rule on March 7, 1957, and became a republic on July 1, 1960 (Austin, 1964; Apter, 1955). At that time, Ghana was one of the strongest economies in sub-Saharan Africa, with a per capita income that was comparable to South Korea, and was one of the world's largest producers of cocoa. President Kwame Nkrumah, the country's first president and leader of the nation's independence movement, adopted socialist planning techniques, with a public sector that was primarily buttressed by cocoa revenues (Agdbodeka, 1992; Nkrumah, 1968; Fitch and Oppenheimer, 1966). The cornerstone of President Nkrumah's industrial development strategy was the construction of the Akosombo Dam, a hydroelectric dam on the Volta River that would electrify Ghana, while providing linkages to an aluminum industry fuelled by Ghana's bauxite reserves (Hart, 1980).

On February 24, 1966, there was a political coup in Ghana that led to the ousting and exile of President Kwame Nkrumah. For almost two decades following this coup d'état, Ghanaian political development was plagued by coups, failed coup attempts, and general socio-political turmoil. This harsh political environment had negative impacts on socio-economic development, and contributed to economic decline and a decrease in living standards in Ghana (Frimpong-Ansah, 1992). A combination of political turmoil, declining cocoa revenues, a large foreign debt, much of which was incurred from the Volta Dam project, and rapidly increasing oil prices with the formation of OPEC led Ghana into economic crisis by the late 1970s and early 1980s (Chazan, 1983).

In 1983, Ghana adopted a World Bank Economic Recovery Program (ERP), with the general objectives of short-term economic stabilization and long-term economic structural adjustment. These aims included improving government finances, stabilizing Ghana's currency (the cedi), improving the domestic production of goods and services, and strengthening the social and economic infrastructure of the country (Nyanteng, 1997; Lynn and Legge, 1996; Sarris and Shams, 1991; Sawyer, 1990). Despite the economic potential of the mining industry in Ghana, mining output had decreased significantly since the late 1950s, with gold experiencing the most dramatic decline in production. As Aryee (2001) puts it:

“For four decades, up to the 1980s, no new mine was opened in Ghana due to a myriad of problems faced by mining sector investors and potential investors alike, as a result of the economic, financial, institutional and legal framework within which the mining sector operated” (p. 62).

To stimulate investment into the minerals economy in Ghana, from 1985 onwards, the government implemented a series of laws and policy measures to create an effective regulatory framework for the mining industry (Akabzaa, 2000; Iddirisu and Tsikata, 1998).

Up until this time, mining in the gold sector was not regulated, though diamond-mining activities had been regulated through the Minerals Regulation since 1962. The primary laws were:

- The Additional Profile Tax Law (PNDCL 122; 1985);
- The Minerals and Mining Law (PNDCL 153; 1986);
- The Minerals (Royalties) Regulations (LI 1349; 1985,1987);
- The Small Scale Mining Law (PNDCL 218; 1989); and
- The Precious Marketing Corporation Law (PNDCL 219; 1989).

To complement these legal reforms, the government founded the Minerals Commission in 1986 as the primary institution to oversee domestic and international actors in the

Ghanaian mining sector. In 1989, the Precious Minerals Marketing Corporation (PMMC) was established as the primary buyer and seller of minerals produced by the small-scale mining sector.<sup>2</sup>

In addition the regulatory framework developed via the laws and institutions described above, generous incentives were provided to foreign investors to boost foreign direct investment in mining. For example, corporate income tax on the mineral production of private companies in Ghana decreased from 50-55% in 1975 to 45% in 1986 and 35% in 1994 (Campbell, 2003, p. 4-6; Akabzaa, Thomas and Darimani, 2001, p. 20-21). Royalties paid to the government decreased from 6% of total value of mineral production in 1975 to 3.7% in 1987 (Campbell, 2003, p. 4-6; Akabzaa, Thomas and Darimani, 2001, p. 20-21). Companies received breaks on import duties on equipment and accessories necessary for mining production. Additionally, mining companies were allowed to keep a minimum of 25% of foreign exchange in an external account for various purposes, including acquiring physical capital requirements necessary for production and dividend payment and remittance for expatriate labor (Campbell, 2003, p. 4-6; Akabzaa, Thomas and Darimani, 2001, p. 20-21). The benefits accrued by mining companies as a result of the dynamic evolution of mineral laws and policies, in turn, led to the rapid growth of Ghana's mining economy.

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<sup>2</sup> On July 5, 2001, nearly forty countries adopted the 'Kimberly Process' to adopt minimum standards for a certification system to reduce the trade of conflict diamonds (Gberie, 2003; Rapport News, July 6, 2001; <http://www.diamonds.net>; UN, 2000; Kimberly Process Certification Scheme). In West Africa, Guinea, Liberia, and Sierra Leone have all had significant problems with conflict diamonds, which have fuelled social, economic, political, and regional instability. Ghana has not had a significant problem with conflict diamonds, though Gberie (2003) points out that foreigners bring diamonds to sell to licensed sellers in Accra, many of which are conflict diamonds from Guinea, Liberia, and Sierra Leone.

*The Growth of the Mining Industry in Ghana and Small-Scale Mining*

As stated, mining productivity has increased in the nation over the last two decades (Figure 1, Appendix 1). Gold production has experienced the most rapid growth of all the mining sectors in Ghana. In 1999 alone, large-scale gold mining accounted for approximately 2.5 million ounces of gold production (Minerals Commission, 2000). Between 1983 and 1998, the mining industry brought approximately US \$4 billion in foreign direct investment to Ghana (Minerals Commission, 2000). Technological advances in the mining and mineral extraction process, including heap leaching, have led to an increase in surface mining activities in Ghana, which is relatively more capital intensive, and less labor intensive than deep, underground mining.

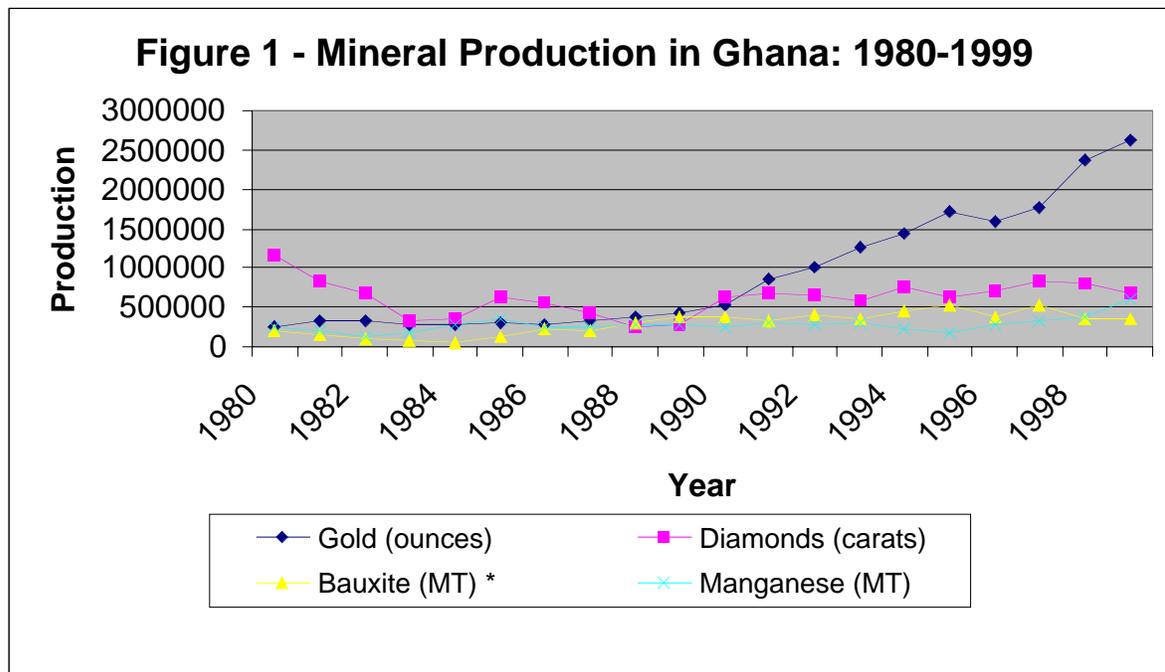
Though the Ghanaian economy is not, by the United Nations' definition, a mining economy,<sup>3</sup> the minerals sector has made noteworthy contributions to foreign exchange earnings and gross domestic product (GDP). Ghana's mining sector contributes to approximately 40% of gross foreign exchange earning and accounts for approximately 5.6% of Gross Domestic Product (GDP). In 2000, minerals accounted for 38.96% of total export earnings, followed by cocoa (22.51%) and timber (9.03%) (ISSER, 2001).

Since the enactment of the Small Scale Mining Law (PNDCL 218) in 1989, which formalized small-scale gold mining activities nationwide, and other mineral regulations associated with ERP, there has been a subsequent surge in licensed small-scale production of gold (See Figure 2). Small-scale miners must obtain licenses to mine from either the Minerals Commission or from the mining company with concession rights in a

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<sup>3</sup> By the United Nations' definition, a mining economy is one that generates "at least 10 percent of gross domestic product from mining and at least 40 percent of foreign exchange earnings from mineral exports" (United Nations, Item 7 – UN Publication No. E/C.7/1998/4).

mineral rich area.<sup>4</sup> There has also been an increase in illicit mining activities by individuals engaged in mining without licenses, known in Ghana as “*galamseys*.”



\* Production for Ghana Bauxite Company  
Source: Minerals Commission, 2000

As stated earlier, diamonds have been subject to regulations and laws since the Minerals Regulation of 1962. At this time, the Diamond Marketing Corporation was the primary entity responsible for purchasing and selling diamonds produced in Ghana; this responsibility was taken over by the PMMC in 1989. Between 1989-2000, small-scale mining produced approximately US \$117 million worth of gold, and \$US 98 million worth of diamonds (PMMC, 2001). In 1997 alone, small-scale gold mining brought \$US 33 million in revenue, up from \$US 6 million in 1990, while small-scale diamond product earned \$US 11 million (Minerals Commission, 2000).

<sup>4</sup> In some cases, a person or group or people may obtain a license to mine a plot of land, and then hire laborers to do the mine the plot, paying them a percentage of findings.

It should be noted that there has not been an internationally agreed upon common definition for small-scale or artisanal mining, though certain common characteristics of the terms have been recognized globally. According to Hentschel et al (2002), these common characteristics include: “lack or reduced degree of mechanization; [a] great amount of physically demanding work; low level of occupational safety and health care; deficient qualification of the personnel on all levels of operation; inefficiency in the exploitation and processing of the mineral production; low level of productivity; insufficient consideration of environmental issues; and lack of social security” (p. 8). In this paper, the terms “artisanal” and “small-scale” (as they relate to mining) refer to licensed miners as well as *galamseys*. This described interchangeability is in accordance with the common usage of the terms in Ghana.<sup>5</sup>

There are no exact figures on the number of small-scale miners in Ghana, though it is estimated that approximately 100,000 Ghanaians are legally employed by mining (Aryee, 2003). *Galamseys* involved in illegal mining activities also create challenges for monitoring and regulating small-scale mining activities in the country. A UN study on artisanal mining and poverty reduction reports that there may be 50,000 – 80,000 people engaged in illegal small-scale mining activities in Ghana (Carnegie, et al, 2000).

Artisanal mining activities bring benefits to developing countries, primarily employment and a means of quick wealth. Labor-intensive small-scale mining operations are economically feasible because investment costs per job are typically only 10-12 percent of those costs associated with large-scale mining (United Nations, 1992). Most small-scale mining activities in Ghana have occurred in the southern regions of the

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<sup>5</sup> There is also a distinction between artisanal and small-scale mining, dependant upon what miners do with the mineral. See <http://www.casmsite.org>.

country, but in recent years, there has been an increase in mining in the northern, savannah areas of the country, particularly in Bolgatanga (Northern Region) (Yembilah, 1997). The recent growth of small-scale mining activities in savannah areas extends to Ghana's northern neighbor, Burkina Faso (Bayah, 2003; Gueye, 2001).<sup>6</sup>

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<sup>6</sup> Small-scale diamond mining in Burkina Faso began in the late 1980s, when the country was suffering from a severe drought. Given the persistence of the drought, which put pressures on the agricultural industry in Burkina Faso, small-scale gold mining became primarily a rural, poverty-driven activity to earn quick revenue for survival. It is estimated that there are approximately 100,000-200,000 artisanal miners in the country.

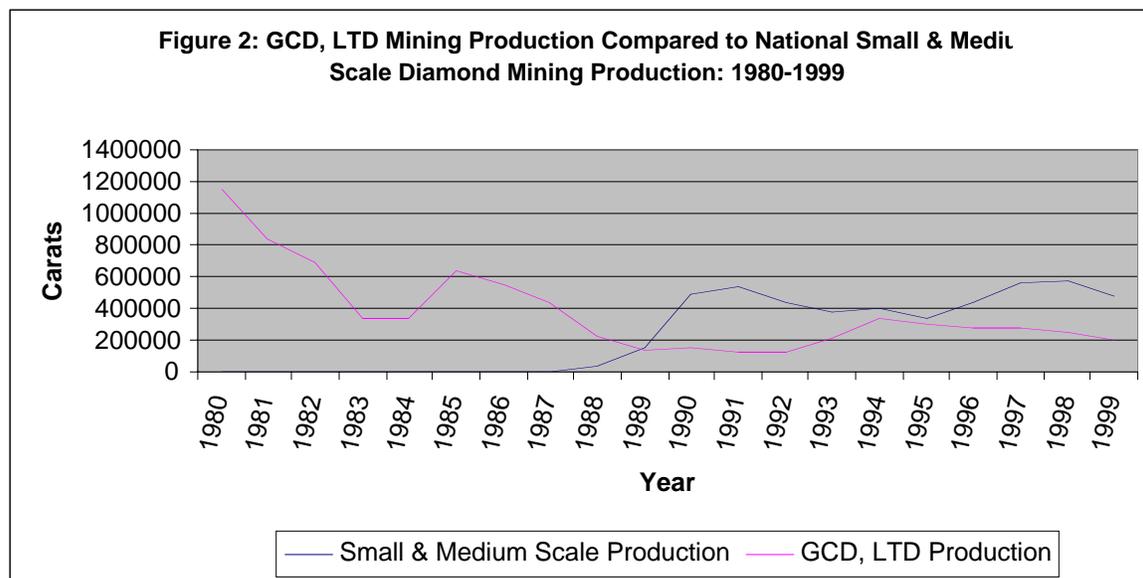
## **Mining, Environmental Degradation, and Health in Akwatia**

### *Ghana Consolidated Diamonds, Small Scale Mining and Diamonds in Akwatia – The Environmental Burden*

Akwatia is a small town located in the Kwaebibirem District, Ghana (Eastern Region). Diamonds were first discovered along the Birim River, in an area nineteen miles northwest of Akwatia, in 1919 (GCD, 1999). Over 100 million carats of diamonds have been recovered from the area. Ghana Consolidated Diamonds, Ltd (GCD) is the chief producer of diamonds in the town and the country, having a total concession area of 185.35 square miles within the Birim diamond field and Kobriso Gold Concession (GCD, 1999). Historically, mining has brought economic benefits to Akwatia, including a means of employment and poverty alleviation.

For many years, GCD's large-scale mining production eclipsed artisanal diamond mining in Ghana. While there has been a steady decline in total diamond mining production in Ghana over the past two decades, small-scale diamond mining product has increased exponentially (Figure 2, Appendix 2). Between 1980 and 1989, the artisanal mining sector produced 207,272 carats of diamonds, in comparison to 5,328,054 carats by GCD (GCD, 2003). In contrast, between 1990 and 1999, small-scale diamond mining product drastically increased to 4,637,093 carats, while GCD production declined by about 50% to 2,244,240. In 1980, artisanal mining accounted for less than 1% of total diamond mining product in Ghana, but by 1989 it was 53%, and by 1999, it was approximately 70% of national diamond output. This paralleled a decrease in production by GCD from 99% of national diamond mining production in 1980, to 47% in 1989, and 30% in 1999.

The primary driving force for an increase in artisanal mining activities in Akwatia was that GCD, Ltd began to sell licenses to small-scale miners to mine its concession (Iddirisu and Tsikata, 1998). The main small-mining site in Akwatia is Saltpond, a site on the GCD premises, but there are problems with illicit *galamsey* mining activities in the town as well.



Outsourcing production to the small-scale mining sector has been a way to compensate for decreased production by GCD, Ltd due to the depreciation of its capital stock (Personal Correspondence, 08/06/2003). GCD has been in dire need of re-capitalization and went up for sale to private bidders in 1995, but because of unsuccessful divestiture deals, it has not gained the financial resources necessary to refurbish its production machinery (Gberie, 2003; Personal Correspondence, 08/07/2003).<sup>7</sup> In GCD's 2002 Annual Technical Report, a number of plant equipment and machinery breakdowns were

<sup>7</sup> GCD, Ltd. is the last government mining company in Ghana in need of divestiture. In August 2003, there was a strike in Akwatia of small-scale miners and GCD employees, related to the breakdown of the most recent bidding process for GCD. An article on this topic can be found in the August 2003 Ghanaian Times. In a recent popular press article, it was reported that the Ghanaian government has not abandoned the divestiture of GCD, and will continue to pursue an investor for the mine (SpaceFM.Com, January 27, 2004).

noted as hampering the overall productivity and efficiency of the company. For example, the report stated that in 2002, the company's machinery for the diamond mining process operated at anywhere between a dismal 30.18% to 60.20% efficiency (GCD, Ltd, 2002).

Mining activities in Akwatia have incurred a significant negative impact on the environment. GCD's mining process involves stripping the land of gravel, as deep as 1 meter, with a 2 metric ton ( $M^3$ ) capacity bucket. The extracted land is taken to the plant for processing, at which stage the waste is to be trucked back to its original location, or used for the production of other goods. For example, GCD uses by-products of its mining process for other sources of income, including sand and stones and the sale of tailings (GCD, 2002). An average of 1,100  $M^3$  of gravel is mined by GCD per day (GCD, 2002). Between 1959 and 2002, GCD extracted approximately 29 million  $M^3$  of gravel for 50 million carats of diamonds (GCD, 2003); this equates to an average grade of diamond production for that time period of 1.73. The table below shows that the grade of diamonds (Carat/ $M^3$ ) has significantly declined over the past four decades. Metric tons of gravel extracted by GCD, Ltd. per carat of diamond ( $M^3$ /Carat) has increased over time, implying increased land degradation by mining activities relative to diamond output.

**Table 1: Tons of Gravel Extracted by GCD, Ltd and Mining Production Gradient**

Year Period	$M^3$ Gravel Extracted	Total Diamonds (Carats)	Avg. Grade	Avg. $M^3$ /Carat (Inverse Grade)
1963-1972	10,968,011	23,416,024	2.16	0.47
1973-1982	9,617,806	16,435,832	1.65	0.62
1983-1992	2,945,434	3,062,772.8	1.00	1.02
1993-2002	3,558,635	2,384,776	0.67	1.52

Source: GCD, Ltd, 2003

Artisanal mining in Akwatia also imposes a burden on the environment. Miners dig the land on licensed plots as deep as 10-12 feet to reach the diamondiferous zone.

They then carry the gravel to a water source, where the diamonds are separated from the gravel through a washing process. In Akwatia, most of the mining licenses given to small-scale miners are on plots already mined by GCD.

**Figure 3: Miner Digs for Diamonds – Saltpond Mining Site, Ghana Consolidated Diamonds, Ltd**



According to a mining official at GCD, this allows for more intense mining of the land in which GCD, Ltd. obtains the best gradient on the diamonds, but also benefits from the efforts of artisanal mining to mine lower grade diamonds on the same land (Personal Correspondence, GCD Technical Services Officer, 08/07/2003). This increased intensity of mining the land has a double burden on the environment by both GCD, Ltd. and artisanal miners. In addition, mining activities in Akwatia decrease the agricultural productivity of the land (Tetteh, 1996).

In 1991, Ghana adopted a National Environmental Policy for “ensuring a sound management of resources and the environment, and to avoid any exploitation of these

resources in a manner that might cause irreparable damage to the environment” (Ghana Environmental Protection Council, 1991, p. ix). Three years later, the Ghanaian government, in collaboration with the Minerals Commission, adopted guidelines mandating environmental impact assessments for mining activities in the country (Minerals Commission and Environmental Protection Council, 1994).<sup>8</sup> GCD’s environmental policy is in accordance with national guidelines, declaring that: “GCD, Ltd. is committed to managing all its mining activities so as to demonstrate a high leadership and excellence in the care and safety for its employees and environment” (GCD Environmental Policy, 2002).

Ghana Consolidated Diamonds is engaged in activities to mitigate environmental degradation from its mining processes. Between 2000 and 2002, GCD invested over \$75,000 towards filling open pits from its mining activities with 420,400 M<sup>3</sup> of gravel (GCD, 2000). In this same time period, through its re-vegetation plan, GCD planted 140 beds in areas that could be re-vegetated with 28,000 seedlings, investing just over \$20,000 for this project (GCD, 2000). Nonetheless, the report also points out that GCD’s financial resources are limited to fully reclaim all mined-out areas (GCD, 2000). Despite GCD’s reclamation efforts, it is evident that the environmental degradation caused by mining activities in Akwatia is significant, and contributes to unsustainable land depletion and environmental burden.

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<sup>8</sup> According to the policy, environmental impact assessments must ensure that mining companies: “demonstrate that the project has been planned in an environmentally sensitive manner and that appropriate pre-emptive or mitigative measures and safeguards have been integrated into the projects design” (Minerals Commission and Environmental Protection Council, 1994, p. 20).

Perspectives on Development and Health in Akwatia

The connections between a healthy environment and healthy, productive communities are significant. There is a combination of physical, chemical, biological, political, social, economic, and cultural factors that relate to how people experience the environment around them (Corvolán et al, 1999). From an environmental health perspective, these complex interactions mandate that these issues are not only addressed in the health sector, but also as broader issues of every segment of society.<sup>9</sup> Moreover, the connections between economic development and health are also salient. A cornerstone policy document addressing health and development in the 1990s was the World Bank 1993 World Development Report, entitled Investing in Health (WB, 1993). In recognition of this major topic in the health sector, former WHO Director-General, Dr. Gro Harlem Brundtland, established the Commission on Macroeconomics and Health (CMH) in January of 2000 to assess the interrelationship between health and global economic development.<sup>10</sup>

Attention has been given to the occupational and environmental health impact of mining practices for artisanal and large-scale miners, and communities within close proximity of such activities. Health and safety risks associated with small and large-scale mining are complex, and dependent upon the mineral mined, depth of mining, and its scale (Ahern and Stephens, 2001). Migratory labor at mines in African countries such as South Africa has been identified as a major factor in the spread of HIV/AIDS (Campbell,

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<sup>9</sup> In support of this claim, Corvolán et al (1999) point out that: “It is [now] understood that appropriate developments must occur in agriculture, industry, and energy if sustainable health improvements are to be attained. That said, the health sector has an important role as advocate and guide for healthy development.”

<sup>10</sup> It was recognized in a report published by the CMH in 2001 that: “improving the health and longevity of the poor is an end in itself, a fundamental goal of economic development. But it is also a *means* to achieving the other development goals of the United Nations Millennium Development Goals relating to poverty reduction” (WHO, 2001, p. 3).

2000; Campbell and Williams, 1999; Jochelson and Mothibeli, 1991). Small-scale gold mining, which involves chemical processes to extract the gold, and its associated health and environmental impact, is a topic that has been given attention in recent years.

Artisanal miners worldwide use mercury in the gold extraction process, which has been documented to have a negative environmental and healthcare impact in countries including: Brazil, French Guiana, Ghana, the Philippines, Tanzania, and Zimbabwe (Frery, N., R. Maury-Brachet, et al, 2001); Malm, O., 1998); UNIDO, 2001; UNIDO, 2003; van Straaten, P., 2000a, van Straaten, P., 2000b).

Chemical environmental contamination is not a major health issue in Akwatia because diamond mining does not involve chemical processes. However, health problems are directly and proximately related to mining in Akwatia. Ghana is a malaria endemic country – malaria accounts for 43% of total outpatient morbidity in the country, and 38% in the Eastern Region, where Akwatia is located (MOH, 2001). Malaria is also the leading cause of outpatient cases at St. Dominic’s Hospital, the major healthcare provider in Akwatia (St. Dominic’s Hospital, 2001).<sup>11</sup> The digging of the land to mine diamonds by both legal mining activities on GCD’s sites and *galamseys* leaves large pits, which fill with water during the rainy season. Standing water creates a breeding ground for *Anopheles gambiae* mosquitoes, the vector of transmission for malaria in African countries. Standing water from mining activities is a commonly cited problem in both gold and diamond mining communities in Ghana and other parts of the world (Clarke, 1998; Dianou and Poda, 1999). Nonetheless, according to health officials in the area, there have been no substantial or sustained interventions in Akwatia to drain these pits, or

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<sup>11</sup> Malaria accounted for 20% of outpatient cases at St. Dominic’s Hospital in 2001.

to determine cost-effective ways to mitigate malaria-related morbidity (Personal Correspondence, 08/06/2003).

**Figure 4: Standing Water in Akwatia from Diamond Mining**

In an informal interview, a company official explained that when GCD, Ltd. does not fill its pits and vegetation grows over them; these pits can become death traps, creating health and safety hazards for Akwatia residents (Personal Correspondence, 08/07/2003). As described in the previous section of this paper, limited resources makes it a challenge for GCD to fill pits in all mined-out areas, which can have detrimental health outcomes. The land degradation from illicit mining activities reduces biodiversity, and can subsequently decrease the availability of medicinal plants (Savannah Resources Management Project, 2000; Biodiversity Support Program, 1993; Ayitey-Smith, 1989; Barbier, 1989). An herbalist in the area certified by the Traditional Medical Practitioners Association in Ghana (TMPAG) claimed that the mining activities of galamseys destroys medicinal plants that are used for a variety of ailments including: anemia, asthma,

gonorrhoea, measles, and typhoid. The healer did maintain that it was still possible to find the herbs, but he often has to travel longer distances to obtain plants that were once found near his shop. This illuminates the potential of mining activities to deplete local natural resources relevant to treating health problems of people in Akwatia and surrounding areas.

Ghana Consolidated Diamonds, Ltd. has a hospital on its company's grounds to serve the healthcare needs of its company workers and their dependants, and the people of Akwatia, though it is severely under resourced (GCD, 2001). The company takes various measures to minimize occupational and safety hazards, in accordance with Ghana's national policy; in 2000, there were three fatal accidents on the company's grounds (GCD, 2001). GCD has historically provided drinking water to residents of Akwatia from a water tower, but in recent years, the company has not been able to treat the water because of limited financial resources. This has been cited as a major problem for water borne diseases in Akwatia such as diarrheal disease, cholera, and typhoid. In 2001, diarrheal disease was the 2<sup>nd</sup> leading cause of outpatient morbidity in Kwaebibirem District, only behind malaria (Kwaebibirem District Health Administration, 2001; See Appendix 4). At the same time, diarrheal disease is not a significant cause of morbidity at St. Dominic's Hospital in Akwatia, being the 12<sup>th</sup> ranking cause of outpatient morbidity at the hospital (St. Dominic's Hospital, 2001). Community members and health officials in Akwatia complain that only with the beginning of purchasing bottled water in the area has there been a decrease in water borne diseases (Personal Correspondence, 2003).

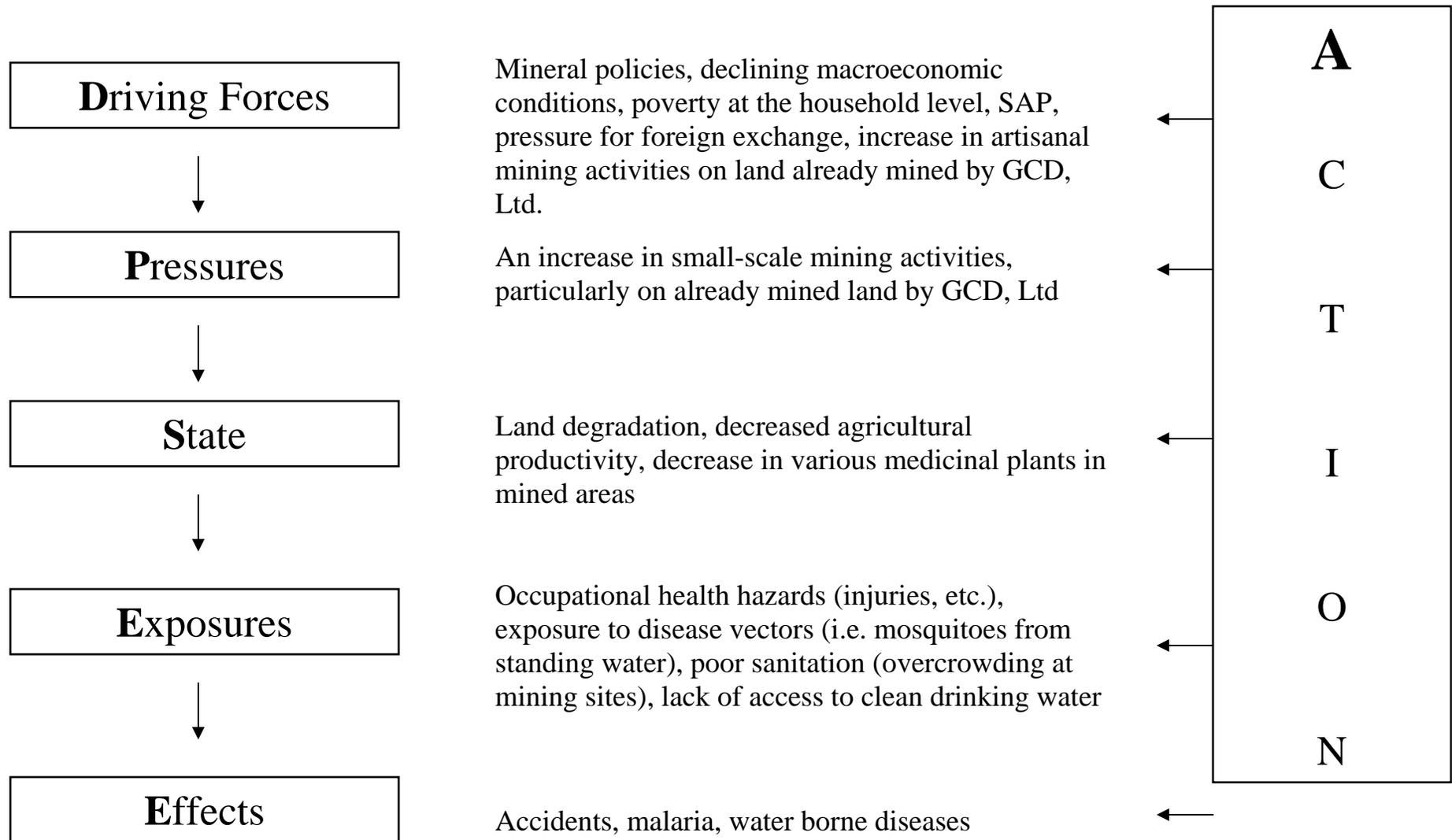
As we have seen, there are a number of health problems and topics related to mining in Akwatia. Much of the information provided has been qualitative in nature, pulled together through field research and informal interviews. This indicates the need for stronger quantitative analysis of the impact of mining activities on health in Akwatia to produce sound data to justify the most cost-effective interventions to address Akwatia's health problems, as they relate to mining activities. From the perspective of mining and health, a fundamental question arises: *In a mining town that has earned \$48.5 million in net revenue between 1993-2002, how is it that persons do not have access to clean drinking water?* (GCD, 2003; Appendix 5). This poses a fundamental question about whether the economic benefits accrued from mining activities in the town have a substantial impact on the health and quality of life of people living in Akwatia that must be answered.

## Conclusion

It is evident that there is a combination of factors that led to the growth of the mining industry in Ghana since the country's Economic Recovery Program in 1983. While mining has positive returns in Akwatia and for Ghana's economy, including foreign exchange, employment, and governmental revenue, the extent of the localized benefits of mining activities in improving quality of life in Akwatia is questionable. In October 2002, the World Health Organization adopted a Strategy on Health and Environment in Africa to: "stimulate the development of environmental health policies as well as sound management of environmental determinants of health" (WHO, 2002, p. 1). As we have seen in this case-study, diamond mining by GCD, Ltd. and artisanal miners has led to significant and unsustainable land degradation, while the efforts of the company to address this topic have been minimal; this has primarily been linked to the financial difficulties of GCD according to company officials interviewed.

The DPSSEA framework is a commonly used to examine environmental health issues (Briggs, 1999). According to the framework, **D**iving forces such as economic policies and population growth create **P**ressures on the environment, which alter its **S**tate. This altered state of the environment, subsequently impacts environmental **E**xposures of people within a defined space, which ultimately can have negative health **E**ffects. Once this framework has been established, **A**ction can be taken at each level of the framework to mitigate negative health outcomes related to environmental factors. As we have seen, GCD policies changes, as well the evolution of Ghana's mining policy measures, were driving forces for increased mining activities. This created various pressures on the environment, particularly land degradation in our case. Pressures on the environment

Figure 5 - DPSEEA Framework: Small-Scale Diamond Mining and Health in Akwatia, Ghana



Source: Environmental Health Indicators: Framework and Methodology, WHO, Geneva: 1999

alter human interactions with the environment (Exposure), which have an impact on health outcomes. Policy actions are necessary to address each level of this framework.

In Akwatia, as has been seen, there is a need for choosing strong environmental health indicators that can be used to address the health issues. Health-related environmental monitoring mandated in mining areas by Ghana's National Environmental Policy include monitoring: air, water, noise, emission, and food contamination (Minerals Commission and Environmental Protection Council, 1994). There is a need for a study in Akwatia to investigate whether the described indicators are relevant to Akwatia, and how significant the links are between the various components of this DPSEEA framework. This will allow for the determination of the best stage of the framework at which action should be taken to address health problems related to mining, which were discovered in this report through qualitative investigation.

The World Health Organization defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1946). In the context of sustainable development and the environment, it is important to keep in mind how efforts to bolster the Ghanaian economy and quality of life in Ghana may also have detrimental environmental health impacts. Moreover, if these negative links exist, we are challenged to find ways of producing sound, convincing data that this is the case, as described above by the DPSEEA framework.

To sum up, achieving good health and living in a healthy environment are justifiable rights of any person, and should be in the center of any major governmental policies (Sen, 1999). In recognition of this fact, the Ghanaian government recently established a country branch of the Commission on Macroeconomics and Health to begin

to address this major issue for economic development (GMHI, 2002). In the context of Akwatia, a fundamental question arises about economic development and health when a small town can be the source of \$48 million in diamond mining revenue, and people in the community do not have access to clean drinking water, or other health-improving interventions. A controlled study in Akwatia to examine the strength of the links between mining and health outcomes would be relevant to this end. Gaining insights into questions of economic development, environmental degradation, and health are critical to building sustained, and effective interventions to bolster health and quality of life, while improving economic livelihood.

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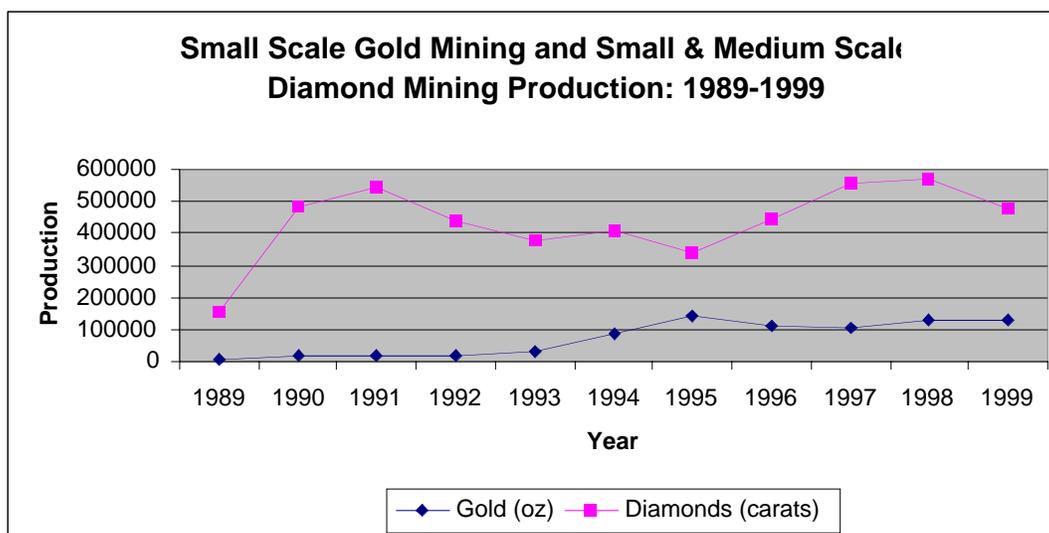
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## Appendices

### Appendix 1 - Mining Production in Ghana: 1980-1999

Year	Gold (oz)	Diamonds (carats)	Bauxite (MT)	Manganese (MT)
1980	242,904	1,150,042	196,892	240,006
1981	338,042	836,491	156,769	197,439
1982	337,754	683,585	92,954	132,232
1983	285,393	338,771	82,310	175,288
1984	282,299	345,675	44,169	267,996
1985	299,615	636,127	124,453	357,270
1986	287,124	560,538	226,461	262,900
1987	327,960	440,681	201,483	242,410
1988	372,851	259,358	299,939	284,911
1989	428,936	285,636	374,646	273,993
1990	534,530	636,503	368,659	246,869
1991	847,560	687,736	324,313	311,824
1992	999,950	656,421	399,155	276,019
1993	1,257,489	590,842	364,641	295,296
1994	1,428,011	757,991	451,802	238,429
1995	1,717,654	631,708	530,389	186,901
1996	1,597,575	714,738	383,370	266,440
1997	1,755,240	829,524	536,723	332,443
1998	2,382,339	805,742	341,121	384,173
1999	2,619,993	681,576	355,262	611,500

### Appendix 2 - Small Scale Gold Mining and Small & Medium Scale Diamond Mining: 1989-1999



**Appendix 3 - GCD, LTD Mining Production and Small & Medium Scale Mining Production (Carats): 1980-1999**

	<b>GCD Production</b>	<b>Small &amp; Medium Scale</b>	<b>Total</b>	<b>GCD (%)</b>	<b>Small &amp; Medium (%)</b>
1980	1,148,698	1,364	1,150,062	99.88	.12
1981	836,020	471	836,491	99.94	.06
1982	682,354	1,170	683,524	99.83	.17
1983	336,307	2,462	338,769	99.27	.73
1984	341,978	3,697	345,675	98.93	1.07
1985	631,801	4,326	636,127	99.32	.68
1986	555,771	3,237	559,008	99.42	.58
1987	435,900	4,781	440,681	98.92	1.08
1988	225,200	34,158	259,358	86.83	13.17
1989	134,025	151,606	285,631	46.92	53.08
<b>Sub-total</b>	<b>5,328,054</b>	<b>207,272</b>	<b>5,535,326</b>	<b>96.25%</b>	<b>3.75%</b>
1990	150,220	484,876	635,096	23.65	76.35
1991	126,670	541,849	668,519	18.95	81.05
1992	124,901	442,266	567,167	22.02	77.98
1993	214,443	376,400	590,843	36.29	63.71
1994	334,139	405,830	739,969	45.16	54.84
1995	293,881	337,457	631,338	46.55	53.45
1996	271,494	443,244	714,738	37.99	62.01
1997	271,283	558,241	829,524	32.70	67.30
1998	252,377	570,186	822,563	30.68	69.32
1999	204,832	476,744	681,576	30.05	69.95
<b>Sub-total</b>	<b>2,244,240</b>	<b>4,637,093</b>	<b>6,881,333</b>	<b>32.62%</b>	<b>67.38%</b>
<b>TOTAL</b>	<b>7,572,294</b>	<b>4,844,365</b>	<b>12,416,659</b>	<b>--</b>	<b>--</b>

**Appendix 4 - 2001 Top Five Causes of Outpatient Morbidity: National, Eastern Region, Kwaebibirem District, St. Dominic's Hospital, GCD Hospital**

	<b>Ghana</b>	<b>Eastern Region</b>	<b>Kwaebibirem District</b>	<b>St. Dominic's Hospital</b>
<b>1</b>	Malaria	Malaria	Malaria	Malaria
<b>2</b>	Upper Respiratory Tract Infection	Pregnancy and Related Compl	<b>Diarrheal Disease</b>	All Other Diseases *
<b>3</b>	<b>Diarrheal Disease</b>	Upper Respiratory Tract Infection	All Other Diseases *	Gynecological Disorder
<b>4</b>	Diseases of Skin and Ulcer	Gynecological Disorder	Upper Respiratory Tract Infection	Pregnancy and Related Compl
<b>5</b>	Accidents (Fracture and Burns)	Accidents (Fracture and Burns)	Accidents (Fracture and Burns)	Hypertension

\* The District Level Ministry of Health Outpatient Morbidity Tally Sheets do not identify what diseases are classified. The same is also the case for St. Dominic's Hospital.

### Appendix 5 - GCD Mining Production Revenue: 1993-2002

Year	Revenue (\$US)
1993	5,283,667.88
1994	8,352,724.75
1995	5,366,803.38
1996	4,416,217.44
1997	5,098,344.36
1998	4,437,430.59
1999	3,464,675.77
2000	4,249,413.05
2001	4,434,858.35
2002	3,469,170.15
Total	48,573,305.72

Source: *Ghana Consolidated Diamonds, Ltd: 2003*

### Appendix 6 - Mining Revenue (Cedis) on Mining Plot at Saltpond Small-Scale Mining Site, GCD, Ltd: August 8, 2003

In the figure below, it is evident that there is significant variability in the earnings of small-scale miners on different plots of land. This can be a driving force for illicit diamond mining activities in areas outside of those set aside for legal mining, to compensate for revenue not gained.

Mining Team	Total Revenue (\$US Conversion)	Revenue Earned by Team	Team % Total	Net Revenue for Plot Owner	Plot Owner % Total
1	230,000	80,000	35%	150,000	65%
2	550,000	150,000	27%	400,000	73%
3	0	0	--	0	--
4	290,000	100,000	34%	190,000	66%
5	0	0	--	0	--
6	0	0	--	0	--
7	65,000	20,000	31%	45,000	69%
8	0	0	--	0	--
9	400,000	140,000	54%	260,000	46%
10	No Show - 0	No Show - 0	--	0	--
Total	1,535,000 (\$220)	490,000 (\$70)	32%	1,045,000 (\$150)	68%

Source: *Saltpond Plot Owner (Anonymous), Personal Correspondence, August 9, 2003*  
Exchange Rate Used for Dollar Calculations: \$1:7000 cedis

### Appendix 7 - The Diamond Rich Zone

For this 6+ foot profile of land at the Saltpond Small-Scale Diamond Mining Site at GCD, Ltd. Approximately horizontal of where the gentleman is pointing would be considered the diamond rich zone.



### Appendix 8 - The Diamond Washing Process



**Appendix 9 - GCD, Ltd Hospital**

