Sustainable Mining in Africa: Standards as Essential Catalysts

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Introduction

The US Geological Survey (USGS) ranks Africa as the largest or second-largest reserve worldwide for bauxite (the main source of aluminium), cobalt (used to make alloys and batteries), and industrial diamonds (needed to cut hard materials), manganese (the anticorrosive element in steel), phosphate rock (a key ingredient in fertilizers), platinum group metals (a primary component in automotive catalytic convertors), soda ash (an element in glass production), vermiculite (a component in fireproof materials) and zirconium (used to manufacture heat-resistant ceramic materials) (KPMG, 2012). All of these products except for fertilizers are found in everyday life within the automobiles we use to travel from point A to point B. In an eco-conscious world where renewable materials are becoming more important, many new automobiles have an increasing volume of plant based materials in them, phosphate rock is as important to the cars being manufactured today as the other minerals found on the continent. This is an illustration of how world citizens are directly and indirectly linked to the fortunes of the African mining sector. But the application of its metal and mineral produce goes much further than just automobiles.

Mining and quarrying of some 60 mineral products currently represents around 20% of Africa’s economic activity, while minerals are the continent’s second-largest export category worth 10% of the continent’s total exports only exceeded by hydrocarbons. More than 80% by value of these mineral commodities originate in just five countries: platinum leader South Africa; diamond-rich Botswana; as well as gold producers Ghana, Burkina Faso and Tanzania (KPMG, 2012). The African continent contributed 6.5% of the world’s mineral exports during 2011 from mining 20% of the world’s land area. From a regional perspective, members of the Southern African Development Community (SADC) produce two thirds of Africa’s mineral exports by value. The biggest player in the region is South Africa (the continent’s largest economy at present) who has almost all the commodities essential for international competition except crude oil and bauxite. Together with its northern neighbour Zimbabwe, these two economies hold the majority of the world’s platinum group metals (PGMs) reserves. To the west of Zimbabwe is the diamond-rich Botswana who is the world’s largest producer by value of these precious stones and to its north Angola. Other key mineral producers in the region are Namibia (uranium), Zambia (copper) and the Democratic Republic of the Congo (copper and cobalt). In Africa mining in done both at large scale and small scale.

In some African countries, environmental problems and social issues caused by mining have been sources of protests and conflicts between mining companies and communities in mining areas. Mining has often been associated with deforestation, land degradation, air pollution, and disruption of the ecosystem. For example, the recent strikes and deaths in major platinum and gold fields in South Africa have highlighted the social impacts and uncertainties surrounding the country’s strategic mining sector. To curb social and environmental impacts of mining, industry players and governments should strive for a more inclusive and transparent partnership by encouraging public participation in mining communities.
Sustainable Mining in Africa: Standards as Essential Catalysts

1. Significance of the Mining Sector in Africa

Nations richly endowed with minerals should be able to develop these resources for their own benefit, creating opportunities for employment and regional economic development, ultimately facilitating broader national economic and social development. This is because mineral resources represent a form of capital, which can be thought of as anything with the ability to generate economic well-being or development, such as a highly educated workforce or abundant agricultural land. Generally speaking, the more capital a nation has, the higher its level of economic well-being or development. UNECA (2004) indicates that many of the world’s richest countries have benefited greatly from minerals extraction. Australia, Canada, Finland, Sweden, and the United States, for example, have all had extensive minerals industries and used them as a platform for broad-based industrial development. By any standards, these are now some of the world’s most successful economies: in 2001 all five were among the top 10 countries in the Human Development Index prepared by the United Nations Development Programme (UNDP, 2001). Moreover, in these countries minerals development seems by at least some measures to have brought benefits specifically to regions with mines. In nineteenth-century Australia, for instance, mineral exploitation brought development to the states of Victoria and Western Australia.

UNECA (2004) highlights the fact that minerals in the ground are only potential wealth. They have the potential to create well-being. For this potential to be realized, however, mineral wealth must be created. In one sense, mineral wealth is created if someone pays to acquire the right to explore for minerals on a property or for the right to develop a known but undeveloped mineral deposit. The seller benefits from the proceeds received from the sale of the exploration or development right. In a broader sense, the creation of mineral wealth requires that a deposit be discovered, developed, and mined for a profit. Once created mineral wealth brings benefits in the form of consumption or investment. If consumed, the goods and services purchased with mineral revenues bring immediate benefits to the purchaser. For example, miners spend part of their wages on food and clothing, which makes them better off than if they did not have food or clothing. Moreover, there are spillover (or multiplier) benefits when food or clothing merchants, in turn, spend a portion of their new income on goods and services that make them feel better off than before, and so on. If mineral revenues are invested, the goods and services purchased with these revenues enhance society’s ability to create well-being in the future. For example, mineral revenues might be invested in financial instruments, such as stocks or bonds, which will earn income in the future; other businesses which will generate future income; physical infrastructure, such as roads and electric power systems, which will enhance the ability to undertake future economic activities; or education or health care which will create healthier and better educated workers and citizens for the future.

Africa is ranked as the largest or second-largest reserve worldwide for antimony (used mainly for flame retardants, also for ammunition, automotive batteries and decolorizing agent in glass manufacture); bauxite (the main source of aluminium); chromite (used in stainless and specialized steels); cobalt (used to make batteries, catalysts, cemented carbides for cutting tools and drill bits, drying agents for paints, magnets, and super alloys for jet engine components); industrial diamonds (needed to cut hard materials); manganese (the anticorrosive element in steel), phosphate rock (a key ingredient in fertilisers); platinum group metals (PGM) (iridium, osmium, palladium, platinum, rhodium & ruthenium) (a primary component in automotive catalytic convertors); soda ash (an element in glass production); vanadium (used as an alloying agent for iron and steel); vermiculite (a component in fireproof materials) and zirconium (used to manufacture heat-resistant ceramic materials); and others include gold, ilmenite (titanium), mercury, rutile, (Taylor et al., 2009); (KPMG, 2012); (Yager et al., 2014).

KPMG (2012) reports that the mining and quarrying of some 60 mineral products currently represents around 20% of Africa’s economic activity, while minerals are the continent’s second-largest export category — worth 10% of the continent’s total exports — only exceeded by hydrocarbons. More than 80% by value of these mineral commodities originate in just five countries: platinum leader South Africa; diamond-rich Botswana; as well as gold producers
Ghana, Burkina Faso and Tanzania. The African continent contributed 6.5% of the world’s mineral exports during 2011 from mining 20% of the world’s land area.

The African countries’ commercially viable mineral resources are listed in Annex A (KPMG, 2012).

2. Mining in Africa: Managing the Impacts

Although negative impacts from mining activities are inevitable, it should be noted that most of them can be avoided during the mining cycle (during the pre-development, development and post-development stages) if prevention and mitigation measures are established. Lower adverse impacts and risks often translate into lower costs of doing business—and offer opportunities for building relationships with local communities, leading to reduced conflict between the mining industry and those who work or live near mines.

It is also clear that there is a direct link among environmental impacts, human rights violations and obstacles to sustainable development in mining. But lessons from Africa, and elsewhere, indicate that strong transparent and participatory governance processes, at all levels, can assist mineral-rich countries attain sustainable economic growth and good environmental practices through applying and enforcing human rights, labour and environmental norms and standards.

2.1 The Environmental Impacts

Mining activities accelerate the rate and degree of changes in the natural environment. The activities modify landscapes and can have long-term impacts on communities and natural resources due to their physical degrading nature, as well as their use of chemicals and other harmful substances. The following environmental impacts are associated with mining.

2.1.1 Impacts on Water Resources

ELAW (2010) notes that perhaps the most significant impact of a mining project is its effects on water quality and availability of water resources within the project area. Key impacts are outlined as follows:

2.1.1.1 Acid Mine Drainage and Contaminant Leaching

ELAW (2010) and UNECA & AUC (2011) explain that acid mine drainage is considered one of mining’s most serious threats to water resources. Acid mine drainage is a concern at many metal mines, because metals such as gold, copper, silver and molybdenum, are often found in rock with sulfide minerals. When the sulfides in the rock are excavated and exposed to water and air during mining, they form sulfuric acid. This acidic water dissolves other harmful metals in the surrounding rock. If uncontrolled, the acid mine drainage may runoff into streams or rivers or leach into groundwater. Acid mine drainage may be released from any part of the mine where sulfides are exposed to air and water, including waste rock piles, tailings, open pits, underground tunnels, and leach pads.

A mine with acid mine drainage has the potential for long-term devastating impacts on rivers, streams and aquatic life. Many streams impacted by acid mine drainage have a pH value of 4 or lower — similar to battery acid — which destroys plant, animal, and fish life downstream.

Acid mine drainage also dissolves toxic metals, such as copper, aluminum, cadmium, arsenic, lead and mercury, from the surrounding rock. These metals, particularly the iron, coats the stream bottom with an orange-red coloured slime called yellowboy. Even in very small amounts, metals can be toxic to humans and wildlife. Carried in water, the metals can travel far, contaminating streams and groundwater for great distances. The impacts to aquatic life may range from immediate fish kills to sublethal, impacts affecting growth, behaviour or the ability to reproduce.

Metals are particularly problematic because they do not break down in the environment. They settle to the bottom and persist in the stream for long periods of time, providing a long-term source of contamination to the aquatic insects that live there, and the fish that feed on them.
Acid mine drainage is particularly harmful because it can continue indefinitely causing damage long after mining has ended. Due to the severity of water quality impacts from acid mine drainage, many hardrock mines across the west require water treatment in perpetuity. Even with existing technology, acid mine drainage is virtually impossible to stop once the reactions begin. To permit an acid generating mine means that future generations will take responsibility for a mine that must be managed for possibly hundreds of years.

Figure 1: (a) On Mt Te Aroha, poisonous waste from 90,000 m³ of tailings of the Tui mine, abandoned in 1970 when the mining company went bankrupt, is costing taxpayers over $17.5 million to attempt to fix (Macskasy, 2012). (b) Acid mine drainage in South Africa (ELAW, 2010; McCarthy, 2011; Reinders, 2015)

Figure 2: (a) AMD seeps from St. Kevin Gulch near Leadville, Colorado, an area mined for gold, silver, lead, and zinc burning all aquatic life (b) Metal-rich runoff pools below the mine site at Kayford Mountain, about 35 miles south-east of Charleston, West Virginia (Fields, 2003; Holzman, 2011)
2.1.1.2 Erosion of Soils and Mine Wastes into Surface Waters

For most mining projects, the potential of soil and sediment eroding into and degrading surface water quality is a serious problem. Because of the large area of land disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion is a major concern at hardrock mining sites. Consequently, erosion control must be considered from the beginning of operations through completion of reclamation. Erosion may cause significant loading of sediments (and any entrained chemical pollutants) to nearby waterbodies, especially during severe storm events and high snow melt periods.

Sediment-laden surface runoff typically originates as sheet flow and collects in rills, natural channels or gullies, or artificial conveyances. The ultimate deposition of the sediment may occur in surface waters or it may be deposited within the floodplains of a stream valley. Historically, erosion and sedimentation processes have caused the build-up of thick layers of mineral fines and sediment within regional flood plains and the alteration of aquatic habitat and the loss of storage.
capacity within surface waters. The main factors influencing erosion includes the volume and velocity of runoff from precipitation events, the rate of precipitation infiltration downward through the soil, the amount of vegetative cover, the slope length or the distance from the point of origin of overland flow to the point where deposition begins, and operational erosion control structures.

Major sources of erosion/sediment loading at mining sites can include open pit areas, heap and dump leaches, waste rock and overburden piles, tailings piles and dams, haul roads and access roads, ore stockpiles, vehicle and equipment maintenance areas, exploration areas, and reclamation areas. A further concern is that exposed materials from mining operations (mine workings, wastes, contaminated soils, etc.) may contribute sediments with chemical pollutants, principally heavy metals. The variability in natural site conditions (e.g., geology, vegetation, topography, climate, and proximity to and characteristics of surface waters), combined with significant differences in the quantities and characteristics of exposed materials at mines, preclude any generalisation of the quantities and characteristics of sediment loading.

The types of impacts associated with erosion and sedimentation are numerous, typically producing both short-term and long-term impacts. Adverse effects of inadequate minesite water management and design include: unacceptably high levels of suspended solids (Non-Filterable Residue) and dissolved solids (Filterable Residue) in surface runoff and bed and bank erosion in waterways. In surface waters, elevated concentrations of particulate matter in the water column can produce both chronic and acute toxic effects in fish. It is self-evident that a Sediment and Erosion Control Plan is a fundamental component of a Minesite Water Management Plan.

Sediments deposited in layers in flood plains or terrestrial ecosystems can produce many impacts associated with surface waters, ground water, and terrestrial ecosystems. Minerals associated with deposited sediments may depress the pH of surface runoff thereby mobilising heavy metals that can infiltrate into the surrounding subsoil or can be carried away to nearby surface waters. The associated impacts could include substantial pH depression or metals loading to surface waters and/or persistent contamination of ground water sources. Contaminated sediments may also lower the pH of soils to the extent that vegetation and suitable habitat are lost. As reported by Gomeson et al. (2013) some mining sediments can have pH levels lower than 3 which is severely acidic.

Beyond the potential for pollutant impacts on human and aquatic life, there are potential physical impacts associated with the increased runoff velocities and volumes from new land disturbance activities. Increased velocities and volumes can lead to downstream flooding, scouring of stream channels, and structural damage to bridge footings and culvert entries. In areas where air emissions have deposited acidic particles and the native vegetation has been destroyed, runoff has the potential to increase the rate of erosion and lead to removal of soil from the affected area. This is particularly true where the landscape is characterised by steep and rocky slopes. Once the soils have been removed, it is difficult for the slope to be revegetated either naturally or with human assistance.

Figure 5: (a) Gulley soil erosion due to upstream mining activities. (b) this slope shows visible soil erosion and degradation (Bsiojo2009, 2011).
Figure 6: Evident soil erosion at Luwowo Coltan mine near Rubaya, North Kivu (Liechti & MONUSCO, 2014)

Figure 7: Erosion due to artisanal open-pit mining at the Ndassima gold mine, near Djoubissi north of Bambari, Central African Republic (Madola & Reuters, 2014)
2.1.1.3 Impacts of tailing impoundments, waste rock, heap leach, and dump leach facilities

Tailings (a by-product of metallic ore processing) is a high-volume waste that can contain harmful quantities of toxic substances, including arsenic, lead, cadmium, chromium, nickel, and cyanide. Most mining companies dispose of tailings by mixing them with water (to form a slurry) and disposing of the slurry behind a tall dam in a large wet tailings impoundment. Because the ore is usually extracted as a slurry, the resulting waste contains large amounts of water, and generally forms ponds at the top of the tailings dams that can be a threat to wildlife. Cyanide tailings in precious metals mines are particularly dangerous. Adverse impacts of tailings include contamination of groundwater beneath these facilities, surface and groundwater. During periods of heavy rain, more water may enter a tailings impoundment than it has the capacity to contain, necessitating the release of tailings impoundment effluent. Since this effluent can contain toxic substances, the release of this effluent can seriously degrade water quality of surrounding rivers and streams, especially if the effluent is not treated prior to discharge.

Dozens of dam breaks at wet tailings impoundments have created some of the worst environmental consequences of all industrial accidents. When wet tailings impoundments fail, they release large quantities of toxic waters that kill aquatic life and poison drinking water supplies downstream of the impoundment.

Figure 9: (a) USA, North Carolina. Duke Energy Coal Ash Spill. Coal ash leaks from the collapsed unlined coal ash pond into Dan River. Duke Energy said that 50,000 to 82,000 tons of coal ash and up to 27 million gallons of water were released. Despite the closing of the plant in 2012, the ash pond remains. Prior to the spill, the pond was already classified by the Environmental Protection Agency as “high hazard”. (b) Tailings pond at Marlin gold/silver mine in San Miguel Ixtahuacán and Sipacapa municipalities (Guatemala) owned by Canadian company Goldcorp’s subsidiary Montana Explorado (Nolin, 2008).
2.1.1.4 Impacts of Mine Dewatering

Mine water is produced when the water table is higher than the underground mine workings or the depth of an open pit surface mine. When this occurs, the water must be pumped out of the mine. Alternatively, water may be pumped from wells surrounding the mine to create a cone of depression in the ground water table, thereby reducing infiltration. When the mine is operational, mine water must be continually removed from the mine to facilitate the removal of the ore. However, once mining operations end, the removal and management of mine water often end, resulting in possible accumulation in rock fractures, shafts, tunnels, and open pits and uncontrolled releases to the environment.

Ground water drawdown and associated impacts to surface waters and nearby wetlands can be a serious concern in some areas.

Impacts from ground water drawdown may include reduction or elimination of surface water flows; degradation of surface water quality and beneficial uses; degradation of habitat (not only riparian zones, springs, and other wetland habitats, but also upland habitats as ground water levels decline below the deep root zone); reduced or eliminated production in domestic supply wells; water quality/quantity problems associated with discharge of the pumped ground water back into surface waters downstream from the dewatered area. The impacts could last for many decades. While dewatering is occurring, discharge of the pumped water, after appropriate treatment, can often be used to mitigate adverse effects on surface waters. However, when dewatering ceases, the cones of depression may take many decades to recharge and may continue to reduce surface flows. Mitigation measures that rely on the use of pumped water to create wetlands may only last as long as dewatering occurs.
Figure 11: The Process of Mine Pit Dewatering (Holden, 2012)

Figure 12: Aerial View of Newmont Mining Corp.’s Lone Tree Pit Lake, Sierra Nevada, USA (Gordon & McKown, 2015).
2.1.2 Impacts of Mining Projects on Air Quality

Airborne emissions occur during each stage of the mine cycle, but especially during exploration, development, construction, and operational activities. All activities during ore extraction, processing, handling, and transport depend on equipment, generators, processes, and materials that generate hazardous air pollutants such as particulate matter, heavy metals, carbon monoxide, sulfur dioxide, and nitrogen oxides. The largest sources of air pollution in mining operations are:

1. Particulate matter transported by the wind as a result of excavations, blasting, transportation of materials, wind erosion (more frequent in open-pit mining), fugitive dust from tailings facilities, stockpiles, waste dumps, and haul roads. Exhaust emissions from mobile sources (cars, trucks, heavy equipment) raise these particulate levels; and

2. Gas emissions from the combustion of fuels in stationary and mobile sources, explosions, and mineral processing.

Once pollutants enter the atmosphere, they undergo physical and chemical changes before reaching a receptor. These pollutants can cause serious effects to people's health and to the environment.

2.1.2.1 Mobile Sources
Mobile sources of air pollutants include heavy vehicles used in excavation operations, cars that transport personnel at the mining site, and trucks that transport mining materials. The level of polluting emissions from these sources depends on the fuel and conditions of the equipment. Even though individual emissions can be relatively small, collectively these emissions can be of real concern. In addition, mobile sources are a major source of particulate matter, carbon monoxide, and volatile organic compounds that contribute significantly to the formation of ground-level ozone.

2.1.2.2 Stationary Sources
The main gaseous emissions are from combustion of fuels in power generation installations, and drying, roasting, and smelting operations. Many producers of precious metals smelt metal on-site, prior to shipping to off-site refineries. Typically, gold and silver is produced in melting/fluxing furnaces that may produce elevated levels of airborne mercury, arsenic, sulfur dioxide, and other metals.

2.1.2.3 Fugitive Emissions
These are emissions which could not reasonably pass through a stack, chimney, vent or other functionally-equivalent opening. Common sources of fugitive emissions include: storage and handling of materials; mine processing; fugitive dust, blasting, construction activities, and roadways associated with mining activities; leach pads, and tailing piles and ponds; and waste rock piles.

2.1.2.4 Incidental Releases of Mercury
Mercury is commonly present in gold ore. Although concentrations vary substantially, even within a specific ore deposit, mercury is found in gold ore and associated waste materials. If the content of mercury in a gold ore is 10 mg/kg, and one million tons of ore is processed at a particular mine, 10 tons of mercury are potentially released to the environment. This is a major source of mercury and should be controlled. In some gold mining projects, gold-containing ore is crushed and then, if necessary, heated and oxidized in roasters or autoclaves to remove sulfur and carbonaceous material that affects gold recovery. Mercury that is present in the ore is vaporized, particularly in roasters, which are some of the largest sources of mercury emitted to the atmosphere.

Following roasting or autoclaving, the ore is mixed with water and reacted with a cyanide leach solution, where gold and mercury are dissolved and solids removed via filtration. The purified solution is sent to an electrowinning process, where the gold is recovered. In this process, mercury must also be recovered and collected. If not collected by air pollution control devices, this mercury could be released to the atmosphere and impact the environment and public health.

Volatilization of mercury from active heaps and tailings facilities has recently been identified as another substantial source of mercury emitted to the atmosphere. This process should be
assessed and controlled. Overall, mercury present in gold ore may be released to the land (in disposed air pollution control wastes and spent ore tailings), to the air (not removed by air pollution control devices, or from tailings or heaps), or in the gold product (i.e., as an impurity).

2.1.2.5 Noise and Vibration
Noise pollution associated with mining may include noise from vehicle engines, loading and unloading of rock into steel dumpers, chutes, power generation, and other sources. Cumulative impacts of shovelling, ripping, drilling, blasting, transport, crushing, grinding, and stock-piling can significantly affect wildlife and nearby residents.

Vibrations are associated with many types of equipment used in mining operations, but blasting is considered the major source. Shocks and vibrations as a result of blasting in connection with mining can lead to noise, dust and collapse of infrastructures, buildings, and homes of people living in surrounding inhabited areas. The animal life, on which the local population may depend, might also be disturbed.

Figure 13: (a) Air Pollution From Mobile Mining Machinery in an Australian Mine. (b) Noise, Dust and Vibration from Mine Blasting (Robins & Ker, 2014).

Figure 14: Air Pollution from Tar Sands Mining and Processing for Oil in Alberta, Canada (Linnitt, 2013)
2.1.3 Climate Change Considerations

ELAW (2010) explains that large-scale mining projects have the potential to alter global carbon in at least the following ways:

**Lost CO₂ uptake** by forests and vegetation that is cleared. Many large-scale mining projects are proposed in heavily forested areas that are critical for absorbing atmospheric carbon dioxide (CO₂) and maintaining a healthy balance between CO₂ emissions and CO₂ uptake. EIAs for mining projects must include a careful accounting of how any proposed disturbance of forests will alter the carbon budget.

**CO₂ emitted by machines:** The EIA should include a quantitative estimate of CO₂ emissions from machines and vehicles that will be needed during the life of the mining project, typically based on the types and rates of fuel consumption.

**CO₂ emitted by the processing of ore into metal:** Using the Life Cycle Assessment methodology, CSIRO estimates that greenhouse gas emissions from copper and nickel production range from 3.3 kilograms (kg) of CO₂ per kg of metal for copper produced by smelting to 16.1 kg of CO₂ per kg of metal for nickel produced by pressure acid leaching followed by solvent extraction and electrowinning, and this does not take into account lost carbon uptake of cleared forests.

2.1.4 Impacts of Mining Projects on Soil Quality

Mining operations routinely modify the surrounding landscape by exposing previously undisturbed earthen materials. Erosion of exposed soils, extracted mineral ores, tailings, and fine material in waste rock piles can result in substantial sediment loading to surface waters and drainage ways. In addition, spills and leaks of hazardous materials and the deposition of contaminated windblown dust can lead to soil contamination.

Human health and environmental risks from soils generally fall into two categories: (1) contaminated soil resulting from windblown dust, and (2) soils contaminated from chemical spills and residues. Fugitive dust can pose significant environmental problems at some mines. The inherent toxicity of the dust depends upon the proximity of environmental receptors and type of ore being mined. High levels of arsenic, lead, and radionucleides in windblown dust usually pose the greatest risk. Soils contaminated from chemical spills and residues at mine sites may pose a direct contact risk when these materials are misused as fill materials, ornamental landscaping, or soil supplements.

![Figure 15: Soil Pollution from Acid Mine Drainage Showing Little Support for Vegetation (Reinders, 2015)](image-url)
2.1.5 Impacts of Mining Projects on Wildlife

Wildlife is a broad term that refers to all plants and any animals (or other organisms) that are not domesticated. Mining affects the environment and associated biota through the removal of vegetation and topsoil, the displacement of fauna, the release of pollutants, and the generation of noise.

2.1.5.1 Habitat Loss

Wildlife species live in communities that depend on each other. Survival of these species can depend on soil conditions, local climate, altitude, and other features of the local habitat. Mining causes direct and indirect damage to wildlife. The impacts stem primarily from disturbing, removing, and redistributing the land surface. Some impacts are short-term and confined to the mine site; others may have far-reaching, long-term effects.

The most direct effect on wildlife is destruction or displacement of species in areas of excavation and piling of mine wastes. Mobile wildlife species, like game animals, birds, and predators, leave these areas. More sedentary animals, like invertebrates, many reptiles, burrowing rodents, and small mammals, may be more severely affected. If streams, lakes, ponds, or marshes are filled or drained, fish, aquatic invertebrates, and amphibians are severely impacted. Food supplies for predators are reduced by the disappearance of these land and water species.

Many wildlife species are highly dependent on vegetation growing in natural drainages. This vegetation provides essential food, nesting sites, and cover for escape from predators. Any activity that destroys vegetation near ponds, reservoirs, marshes, and wetlands reduces the quality and quantity of habitat essential for waterfowl, shore birds, and many terrestrial species.

The habitat requirements of many animal species do not permit them to adjust to changes created by land disturbance. These changes reduce living space. The degree to which animals tolerate human competition for space varies. Some species tolerate very little disturbance. In instances where a particularly critical habitat is restricted, such as a lake, pond, or primary breeding area, a species could be eliminated. Surface mining can degrade aquatic habitats with impacts felt far from a mining site. For example, sediment contamination of rivers and streams is common with surface mining.

2.1.5.2 Habitat Fragmentation

Habitat fragmentation occurs when large areas of land are broken up into smaller and smaller patches, making dispersal by native species from one patch to another difficult or impossible, and cutting off migratory routes. Isolation may lead to local decline of species, or genetic effects such as inbreeding. Species that require large patches of forest simply disappear.
2.1.5.3 Illegal Killing of Animals
Some mining activities result in the killing of animals for food and trade of the skins, horns or other animal parts leading to threatened existence of important wildlife.

Figure 17: Destruction of Wildlife Habitat Due to Mining Activities. (a) Radiated Tortoise in Madagascar amid Destroyed Habitat (Monbiot, 2014). (b) Acid Mine Drainage Negatively Affects Turtle Habitat in South Africa (Reinders, 2015).

Figure 18: Coltan Mining Opens Up Habitat Forest Areas Negatively Impacting of Rare and Endangered Wildlife. (a) The Coltan Mining Areas of East DRC are Located in Forest Areas Inhabited by Rare and Endangered Mountain Gorillas (Edwards et al., 2014). (b) As Roads Cut into Previously Inaccessible Forests, They Pave the Way for Bushmeat Hunting – A Mountain Gorilla Killed in the Coltan Mining Area (Maier, 2011).

Figure 19: Wildlife Habitat Fragmentation Due to Mining Activities. (a) Fragmentation Due at Extraction Site and Supporting Infrastructure (Speakupforthevoiceless, 2013). (b) A Road Cutting Through the Yasuni National Park in the Amazon Forest to Access an Oil Field in Ecuador (Finer, Vijay, Pappalardo, & De Marchi, 2013)
2.2 Socio-Economic Impacts of Mining

Where communities feel they are being unfairly treated or inadequately compensated, mining projects can lead to social tension and violent conflict. Communities feel particularly vulnerable when linkages with authorities and other sectors of the economy are weak, or when environmental impacts of mining (soil, air, and water pollution) affect the subsistence and livelihood of local people. For example, during the exploration and mine development phases, land tenure and access, road construction, river diversion and the large influx of people from outside the mining area, such as foreign workers, can all contribute to disrupting the lifestyles of local communities and being a source of resentment. These issues are particularly intense in small-scale mining communities where the lack of well-defined concession boundaries and influx of people from other communities responding to lucrative mineral finds usually results in tension.

Several adverse social impacts of mining can be identified, which will include:

(i) Displacement of populations and resulting disruption of livelihoods;

(ii) Increased poverty—for example, through a degraded environment on which community subsistence may depend;

(iii) Increased internal economic inequalities—for example, between men and women, between those with jobs at the mine and those without and between communities receiving royalty payments and other benefits and resource rents and those who do not; and

(iv) Economic dependency as local economic activity is reorganized to meet the needs of the mine, leaving the community vulnerable to a typical “boom and bust” economy, especially when the mine closes down or experiences reduced profitability as a result of low commodity prices.

The SEIA process should enforce mechanisms that enable local communities to play effective roles in decision-making. Mineral activities must ensure that the basic rights of the individual and communities affected are upheld and not infringed upon. These must include the right to control and use land; the right to clean water, a safe environment, and livelihood; the right to be free from intimidation and violence; and the right to be fairly compensated for loss.

2.2.1 Involuntary Resettlements

Displacement and forced eviction or re-location are common features of mining operations. The displacement of settled communities is a significant cause of resentment and conflict associated with large-scale mineral development. Entire communities may be uprooted and forced to shift elsewhere, often into purpose-built settlements not necessarily of their own choosing. Besides losing their homes, communities may also lose their land, and thus their livelihoods. Community institutions and power relations may also be disrupted. Displaced communities are often settled in areas without adequate resources or are left near the mine, where they may bear the brunt of pollution and contamination. Forced resettlement can be particularly disastrous for indigenous communities who have strong cultural and spiritual ties to the lands of their ancestors and who may find it difficult to survive when these are broken.

Mining activities, including waste disposal sites, compete for space with other land uses such as farming, which can easily become a source of tension among the mine, farmers and local communities. Resolving this requires that compensation be given to those whose interests give way or are constrained by mining. Compensation may be in monetary payment, resettlement, the provision of job opportunities, training or alternative livelihood schemes. The adequacy of the compensation requires careful consideration through agreed-upon valuation methods. Disrupting livelihoods through forced resettlement to make way for mining operations has potential to create long-lasting tension between communities and mining companies.
Figure 20: Involuntary Resettlements by Mining Projects. (a) Poor Living Conditions After Involuntary Relocation for a Mining Project in Malawi (CCJP, 2014). (b) Making and selling charcoal is a common job for many women in Mozambique. This is one of the economic opportunities that women resettled to Mualadzi have lost. (c) Women and children sheltering from the heat after working their fields in Mualadzi. (d) People from Mualadzi sleep in temporary shelters by the side of the road to collect and sell stones (Lillywhite, Kemp, & Sturman, 2015).

Figure 21: (a) Children play in one of the new villages created on arid plots of land to house families who were relocated to make room for the African Minerals Limited iron ore mine near the town of Bumbuna, Sierra Leone (Peligal, 2013). (b) A medical centre was among the buildings demolished when a Belgian mining precipitated the bulldozing of hundreds of homes in the Democratic Republic of Congo (Amnesty International, 2014).
2.2.2 Mining and Human Rights

The exploitation of minerals has been associated with the violation of human rights, and it is one of the most prominent issues raised by mining-affected communities and civil society organizations working on mining issues. Indeed, most of the social impacts of mining are covered by human rights. Alleged human rights abuses within the extractive industry include the disappearance of people, violation of the right to a clean environment, arbitrary detention and torture, loss of land and livelihoods without negotiation and without adequate compensation, forced resettlement, the destruction of ritually or culturally significant sites without compensation or compensation and labour rights violations.

There have also been issues for the rights of indigenous people. An example is the Chad-Cameroon pipeline project and the Bagyeli people. These communities depend on the forest and its products for their subsistence. Less than 5 per cent of the affected Bagyeli are employed in the pipeline project, but the project’s impact on their social welfare has been considerable. Increased logging, the loss of water resources, noise and river pollution have damaged their hunting and fishing areas, while the destruction of surrounding forest and medicinal plants have caused cultural and health problems. In most parts of Africa the protection of indigenous rights has raised challenges, mainly because some African countries, for example Botswana, do not officially recognize any groups of people as being indigenous vis-à-vis the rest of the citizenry, despite historical evidence that the San groups of Botswana are in fact indigenous to that country.

A review of corporate human rights abuses presented by John Ruggie, the Special Representative of the UN Secretary-General (SRSG) on human rights and transnational corporations and other business enterprises, in 2006 showed that of the 65 cases worldwide covering 27 countries, the oil, gas and mining sector accounted for two-thirds of the abuse cases.

Mining and petroleum development usually occur in fairly under-developed areas with agrarian or pastoral populations. The large “footprint” of a mine can be extremely impactful, both positively and negatively. The SRSG has noted that “there is clearly a negative symbiosis between the worst corporate human rights related abuses and host countries that are characterized by a combination of relatively low national income, current or recent conflict exposure, and weak or corrupt governance”. In this light, it is not surprising that human rights protection has become important for the law and international frameworks seeking to regulate the conduct of business by mining companies.

Mining countries need to protect their citizens against human rights abuses and many African national constitutions contain extensive provisions on human rights that are binding on all natural and legal persons operating within their jurisdiction. The African Charter on Human Rights (OAU, 1981), ratified by 53 member countries, also sets out a framework of binding norms, relevant for human rights protection in the mining sector. Article 21.1 states that the right of people to freely dispose of their wealth and natural resources shall be exercised in the exclusive interest of people, and in no cases should they be deprived of it. Furthermore, the Charter makes provisions regarding the spoliation of wealth and natural resources and advocates for the right to adequate compensation.

Respect for human rights by companies is an important part of their social licence to operate, but the scope of the obligations imposed on them by international human rights law is limited and contentious, even as it is widely recognized that with the growth of global power and reach of corporations, domestic regulation is inadequate to protect human rights from corporate infractions. The development and adoption of the UN Protect, Respect and Remedy Framework in 2008 seeks to provide principles to guide states and businesses in protecting and respecting human rights. Developed by the SRSG, after extensive consultation with a broad range of stakeholder groups, the UN Framework establishes three pillars: the state’s duty to protect against human rights abuses by third parties, the corporate responsibility to respect human rights and greater access by victims of human rights abuses to effective judicial and non-judicial remedies. According to Ruggie (2010), the Framework is intended to work dynamically and no one pillar can carry the burden of resolving the governance gaps that exist. While it is a general framework that can be applied to any type of business, it seems to be particularly germane to the extractive industries’ sectors considering the statistics cited above on human rights abuses in the sector.
The UN Framework invites governments to see the protection of human rights against abuses by business entities as a comprehensive responsibility going beyond environmental impact assessment, approval and monitoring projects. The Framework proposes a number of ways that states can reinforce legal obligations aimed at strengthening protection of human rights on businesses, such as fostering a culture of respect for human rights among public institutions as well as businesses. For the latter, measures could include reporting requirements on companies—for example, in the Companies Code—to show how they are operationalizing their respect for human rights. Many times incoherence in the policies and practices of the state and its institutions has undermined the protection of and respect for human rights. The most dramatic instances of policy incoherence and lack of coordination have been in the negative impact of state action to increase foreign trade or to attract investment, such as signing investment or trade treaties and investment contracts with stabilization clauses—on its ability to fulfil its duty to protect human rights.

An investor dispute between El Salvador and a foreign mining firm illustrates the potential constraining impact of trade agreements on the state's ability to fulfil its duty to protect human rights. Basing itself on the Dominican Republic-Central America Free Trade Agreement, Pac Rim Cayman LLC, a US subsidiary of a Canadian mining company, sued the government of El Salvador for imposing a moratorium on mining permits, which affected its gold mine project. El Salvador in 2009 has the highest population density in the Americas and is also grappling with a serious water shortage.

A study by the IFC and the SRSG has established that certain types of stabilization clauses in contracts between investors and host states could constrain the state's ability to protect human rights. The study concluded that developing countries were more likely to "include social and environmental laws—even laws of general application on issues such as minimum wage, labour, health, safety, and the like—in a stabilization clause. From a geographic perspective, agreements from sub-Saharan Africa contained the highest percentage of the most constraining clauses. And the study found that extractive sector agreements contained the most constraining clauses. There are debates about the legality and enforceability of freezing clauses but their presence in contracts gives beneficiary companies the leverage to pressure governments to at least limit the application of new laws. Their potentially constraining effects on the state for human rights protection underline the need to incorporate the management of human rights into the contracting processes between states and investors. Fostering a culture of respect for human rights in public institutions could aid improvements in policy coherence for human rights protection.

In May 2011 the 17th Session of the UN Human Rights Council considered a proposal from the SRSG for 10 principles for integrating human rights risks into state-investor contract negotiations (UN, 2011). The principles cover such issues as ensuring that stabilization clauses do not compromise protection of and respect for human rights, planning adequately for addressing human rights implications of projects during negotiations protection, engaging the community effectively and creating grievance mechanisms for non-contractual harms to third parties and transparency of contract terms. Together, the terms cover the three pillars of the UN Framework and crucially reduce the possibilities for incoherence in the policies and actions of the state. The SRSG's study of stabilization clauses offers examples of cases where investment contracts were re-negotiated to remove constraints on the human rights responsibilities of both states and companies.

Mining firms are quick to proclaim their respect for human rights. Compliance with the laws of a country is an obvious way for a business to show its respect for human rights. In many situations in Africa where enforcement institutions and the culture of human rights protection are weak the institutional commitment of powerful mining firms to respect human rights is crucial. The UN Framework offers many ways through which firms can fulfil their responsibilities to respect human rights. They include identifying and responding to the particular human rights challenges that they face in their specific context, upholding core international human rights and International Labour Organization (ILO) conventions and monitoring their performance for human rights compliance. They also offer criteria by which to evaluate how mining firms respect human rights.

Victims of human rights abuses in African countries, not only those attributed to mining firms, face many obstacles in obtaining remedies. In general most citizens do not find judicial bodies accessible for various reasons, such as costs, physical distance, long delays due to heavy
workloads and tortuous procedures. Non-judicial processes such as human rights institutions and alternative dispute resolution mechanisms offer better prospects for speedy remedies for victims of abuses.

2.2.3 Impacts of Migration
One of the most significant impacts of mining activity is the migration of people into a mine area, particularly in remote parts of developing countries where the mine represents the single most important economic activity. This influx of newcomers can have a profound impact on the original inhabitants, and disputes may arise over land and the way benefits have been shared.

Sudden increases in population can also lead to pressures on land, water, and other resources as well as bringing problems of sanitation and waste disposal. Migration effects may extend far beyond the immediate vicinity of the mine. Improved infrastructure can also bring an influx of settlers.

2.2.4 Lost Access to Clean Water
Impacts on water quality and quantity are among the most contentious aspects of mining projects. Companies insist that the use of modern technologies will ensure environmentally friendly mining practices. However, evidence of the negative environmental impacts of past mining activity causes local and downstream populations to worry that new mining activities will adversely affect their water supply. Fears for water quantity and quality have triggered numerous and sometimes violent conflicts between miners and communities.
2.2.5 Economic and Livelihood Impacts

2.2.5.1 Livelihood Disruptions
When mining activities are not adequately managed, the result is degraded soils, water, biodiversity, and forest resources, which are critical to the subsistence of local people. When contamination is not controlled, the cost of the contamination is transferred to other economic activities, such as agriculture and fishing. The situation is made worse when mining activities take place in areas inhabited by populations historically marginalized, discriminated against, or excluded.

Proponents of mining projects must insure that the basic rights of affected individuals and communities are upheld and not infringed upon. These include rights to control and use land, the right to clean water, and the right to livelihood. Such rights may be enshrined in national law, based on and expressed through a range of international human rights instruments and agreements. All groups are equal under the law, and the interests of the most vulnerable groups (low-income and marginalized) need to be identified and protected.

Increased poverty and economic inequalities and dependencies can destabilize internal community power relations—and disrupt traditional social structures, resulting in increased gender inequality due to unequal access to jobs in the mine, the loss of male support for household work and women expending more energy accessing safe water and food because of degraded environments. At the national level, countries can get locked in an inequality trap, unable to diversify the economy in ways that reduce inequalities.

Increased poverty and economic inequalities and dependencies can also exacerbate social issues, such as increased alcohol and drug use, prostitution, gambling and loss of internal cultural cohesion. A large influx of outsiders or immigrant miners, not integrated into the local community or subject to its social constraints, compounds the problem. Such outsiders, for example, can potentially get into conflict with native residents due to different socio-cultural values as well as competition over limited local resources.

Poverty and economic deprivation can lead to a general loss of development choices and options, eroding power over community decision-making, and a loss of control over the future of the community and its assets. This challenge is best illustrated by the violence experienced in the Niger Delta, where youth violence and the existence of militias are partly attributed to feelings of loss of community assets and perceptions of exclusion from natural resources development. The United Nations Development Programme’s 2006 Human Development Report on the Niger Delta points out that the Niger Delta is the most volatile region in Nigeria. Although rich in oil resources, the Niger Delta was rated very low in the human development and human poverty indexes, reflecting the underdeveloped nature of the communities in the area.
2.2.5.2 Mining, Employment and Labour Rights

Large-scale mining played a pioneering role in creating the industrial labour force in mineral exporting African countries such as Ghana, South Africa, and Zambia until 1980s when the sector declined due to structural reforms. Across Africa the reforms enabling the creation of the current mining regimes involved the laying off of tens of thousands of mining workers as loss-making state-owned mining firms were dismantled or unbundled and sold off to foreign investors.

The upsurge in mining since the liberalization of the sector and resulting substantial inflow of foreign direct investment has created new direct and supporting jobs in old as well as new mining African countries. But the job-creating impact of the new mines has been limited because capital-intensive “large-scale mineral extraction generally offers limited employment opportunities”. According to UNECA & AUC (2011), studies show that in some cases considerations about the job creating value of new large-scale mines have to consider the rural jobs and livelihoods—such as those of farmers, artisanal miners and other rural economic actors—destroyed or severely disrupted by the establishment of the large mine and whose value in rural economy cannot be replaced by the highly-mechanized mine.

Employing casual and contract labour is a pervasive practice in the global large-scale mining industry. According to the Business Council of Australia, greater employment flexibility in the Australian mining industry has “delivered significant benefits”, and “[it] has supported innovation; greater accountability for performance; high levels of productivity as well as sustained, strong productivity growth; high levels of wages; and outstanding returns to shareholders”. For mining unions, however, “nothing is more likely to undermine the ILO’s ‘Decent Work’ philosophy than the expanding use of contract labour” because “almost universally, contractors—and their subcontractors—get away with providing few benefits such as pensions, medical insurance, death or injury benefits, sick pay, paid leave, maternity benefits, etc.”

In most mineral rich countries, mining remains a hazardous occupation in terms of the number of people exposed to risk, death, injury and disease. Workers’ health and safety are among the major concerns in the extractive industries. The occupational safety and health implications vary significantly between different mining activities and countries. In the working environment of a surface mine, for example, airborne contaminants such as rock dust and fumes, excessive noise, vibration and heat stress can create health problems for miner workers, who are subjected to frequent and prolonged exposure to them.

It is the responsibility of mining companies to observe the requirements of local labour laws and practices. They should also adhere to fundamental labour standards as set out in ILO Conventions and re-emphasized by the ILO Declaration on Fundamental Principles and Rights at Work of 1998. The ILO Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy calls on transnational corporations to respect, promote and uphold the principles concerning fundamental rights, irrespective of whether a country has ratified or implemented the ILO Declaration on Fundamental Principles and Rights at Work. It has been noted that the most common obstacle to implementing international standards and norms is a lack of domestic capacity in some countries as well as states being excessively cautious about potential conflict with large foreign mining companies over their labour practices.

Figure 25: Poor Labour Rights and Standards in Artisanal Mines (Woodman, 2014)
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Figure 26: (a) Low Wages are Often a Contentious Issue among Mine Workers Leading to Protests (Larmer & Laterza, 2015). (b) Striking Miners Chant Slogans Outside a South African Mine in Rustenburg, 100 km NW of Johannesburg, August 15, 2012 (Sapa-AFP, 2012).

Figure 27: Child Labour is Prevalent in ASM

2.2.5.3 Resource Productivity

The increasing scarcity of minerals that are relatively easy to extract, the recent period of high mineral prices, and the need to prudently manage the environment have prompted a high-level interest in the analysis of global mineral resource flows. There are initiatives targeted at addressing resource efficiency globally, regionally and nationally, and in both the public and private sectors.

In 2007 the United Nations Environment Programme set up an International Panel on Sustainable Resource Management. Its work is framed around issues of resource efficiency and sustainable
consumption and production. The premise of sustainable consumption and production is that there is (or may be) a critical minimum stock of “natural capital” required for providing ecosystem services, and that it is essential to incorporate its protection into production and consumption decisions and regulations. The objectives of the resource panel are expressed as being to “provide independent, coherent and authoritative scientific assessments of policy relevance on the sustainable use of natural resources and in particular their environmental impacts over the full life cycle” and “contribute to a better understanding of how to decouple economic growth from environmental degradation”. It situates its work in relation to other initiatives such as the Marrakech process, the 3R Initiative, the circular economy approach, the Global Environment Outlook and the Millennium Ecosystem Assessment. The metals and minerals sector is one of the areas in which it is concentrating its work. Its Global Metal Flows Working Group has published in 2010 its first of six reports focusing on metals, which will address the recycling of metals, environmental impact of metals, information available on the virgin reserves and resources of metals, future demand scenarios for metals and critical metals and metal policy options, among others.

2.2.6 Occupational Health and Safety and Impacts on Public Health

EIAs of mining projects often underestimate the potential health risks of mining projects. Hazardous substances and wastes in water, air, and soil can have serious, negative impacts on public health. The World Health Organization (WHO) defines health as a “state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity.” The term ‘hazardous substances’ is broad and includes all substances that can be harmful to people and/or the environment. Because of the quantity, concentration, or physical, chemical or infectious characteristics, hazardous substances may (1) cause or contribute to an increase of mortality or an increase in serious irreversible or incapacitating illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Frequent public health problems related to mining activities include:

(a) Water: Surface and ground water contamination with metals and elements; microbiological contamination from sewage and wastes in campsites and mine worker residential areas;

(b) Air: Exposure to high concentrations of sulfur dioxide, particulate matter, heavy metals, including lead, mercury and cadmium; and

(c) Soil: Deposition of toxic elements from air emissions.

Mining activities can suddenly affect quality of life and the physical, mental, and social well-being of local communities. Improvised mining towns and camps often threaten food availability and safety, increasing the risk of malnourishment. Indirect effects of mining on public health can include increased incidence of tuberculosis, asthma, chronic bronchitis, and gastrointestinal diseases.

Figure 28: Occupational Health and Safety is a Matter of Concern in Mining Operations. (a) Makeshift Opening Reinforcement of Mine Opening. (b) Collapse of Gold Mine in CAR Killing 25 Miners.
Figure 29: Occupational Health Concerns in Mines. (a) Tanzanite Miners at Mererani in a Barrel, With No Protective Gears (Boniface, Museru, Munthali, & Lett, 2013). (b) A Coal Mine Worker Without Any Form Protection (Pearson, 2008).

Figure 30: Accidents in Coal Mining Are Common. (a) Dynamite Is Used To Loosen The Coal For Collection By Powerful Electric Shovels – But in This Case the Coal Face Falls and Starts Moving the Transport Equipment. (b) Fire Erupts From a Coal Face at Blair Athol Coal Mine at Clermont, New South Wales, Australia (Countryman & McDaniel, 2004).

Figure 31: Health Issues Associated With Salt Mining. (a) Environmental and Health Impacts in Kenya Salt Mine Works (Ocholla et al., 2013). (b) Health Impacts in Saltpans Located at Marakkanam, Villupuram District of Tamilnadu, India (Raj6644, 2010).
Figure 32: Health Impacts of Exposure to Toxic Elements. (a) Artisanal miners around the world, including this 13-year-old Senegalese child, use elemental mercury to extract gold particles from soil (Lubick, 2010). (b) A Child Suffering From Lead Poisoning in Zamfara State, Nigeria awaits Treatment (Lo et al., 2012; Dooyema et al., 2012; Burton, 2012).

Figure 33: Hazards of Disused Mines. (a) Old mines present structural hazards such as the danger of collapse or accidental falls. (b) Acid burn — AMD seeps from St. Kevin Gulch near Leadville, Colorado, an area mined for gold, silver, lead, and zinc (Fields, 2003).
2.2.7 Impacts to Cultural and Aesthetic Resources
Mining activities can cause direct and indirect impacts to cultural resources. Potential impacts include:

(a) Complete destruction of the resource through surface disturbance or excavation;
(b) Degradation or destruction, due to topographic or hydrological pattern changes, or from soil movement (removal, erosion, sedimentation);
(c) Unauthorized removal of artefacts or vandalism as a result of increased access to previously inaccessible areas; and
(d) Visual impacts due to clearing of vegetation, large excavations, dust, and the presence of large-scale equipment, and vehicles.

2.2.8 Mining Militarization, Violent Conflicts and Resource Competition

Other social impacts of mining can result from militarizing mining areas to protect a mine’s assets, potentially in response to local protests against mining operations, existing conflicts with local militant groups or scavenging by poor communities. Militarization can generally lead to human rights abuses, especially those brought about by increased sexual violence and forced relocation.

In addition to conflict between a mine and community, mining can be the primary driver of severe conflict, with armed groups fighting for control over mineral spoils. The potential monetary gains can lure foreign rebel groups and mercenaries into the fighting and broaden existing conflicts. Methods used by armed groups to exploit minerals include extorting or “taxing” mining companies and intermediaries, directly operating mineral extraction sites and selling “future” concessions of mineral rights in anticipation of gaining control upon successful campaigns. Often serious human rights violations are involved such as using forced labour, targeting civilians.

Complex intermediary trade networks and inadequate documentation make tracking sources of conflict minerals difficult. Those minerals which are difficult to regulate and trace, easily extracted, valuable and easy to transport, are most susceptible to exploitation in conflict situations. Conflict situations not only can pose additional risks and costs for the mining industry, but also can encourage mining firms with higher risk tolerance and lower reputation concerns to be involved. Such firms are much more likely to have poor industry practice in environmental, human rights and fiscal performance. Well-known instances in Africa of wars in which minerals are at the core have occurred in Angola, Central African Republic, the Democratic Republic of the Congo, Liberia and Sierra Leone.

The four most prominent conflict minerals, for example codified in the U.S. Conflict Minerals Law, are:

- **Columbite-tantalite** (or *coltan*, the colloquial African term) is the metal ore from which the element tantalum is extracted. Tantalum is used primarily for the production of tantalum capacitors, particularly for applications requiring high performance, a small compact format and high reliability, ranging widely from hearing aids and pacemakers, to airbags, GPS, ignition systems and anti-lock braking systems in automobiles, through to laptop computers, mobile phones, video game consoles, video cameras and digital cameras. In its carbide form, tantalum possesses significant hardness and wear resistance properties. As a result, it is used in jet engine/turbine blades, drill bits, end mills and other tools.

- **Cassiterite** is the chief ore needed to produce tin, essential for the production of tin cans and solder on the circuit boards of electronic equipment. Tin is also commonly a component of biocides, fungicides and as tetrabutyl tin/tetraoctyl tin, an intermediate in polyvinyl chloride (PVC) and high performance paint manufacturing.

- **Wolframite** is an important source of the element tungsten. Tungsten is a very dense metal and is frequently used for this property, such as in fishing weights, dart tips and golf club heads. Like tantalum carbide, tungsten carbide possesses hardness and wear resistance properties and is frequently used in applications like metalworking tools, drill bits and
milling. Smaller amounts are used to substitute lead in “green ammunition”. Minimal amounts are used in electronic devices, including the vibration mechanism of cell phones.

- **Gold** is used in jewelry, electronics, and dental products. It is also present in some chemical compounds used in certain semiconductor manufacturing processes.

These are sometimes referred to as "the 3T's and gold", 3TG, or even simply the "3T's". Under the US Conflict Minerals Law, additional minerals may be added to this list in the future.

**Figure 34: Common Conflict Minerals (Ross, 2015)**
Figure 35: Forced Labour in Conflict Minerals (Campbell-Dollaghan, Gentleman, Bleasdale, & National Geographic, 2013). (a) A boy waits his turn for spoonfuls of rice and beans in Pluto. In some areas of eastern Congo up to 40 per cent of gold miners are children, often forcibly recruited by militias. (b) A child is put to work at a militia-run mine in Watsa. (c) Gold is now the most lucrative of conflict minerals. Illicit profits from tin, tungsten, and tantalum have dropped 65 per cent since 2010, when the campaign to link minerals with violence began gaining ground. (d) Already a soldier, a boy with an assault rifle pedals to base camp during fighting in the Ituri region in 2003.

Figure 36: Conflict Mining Sites and Negative Human Effects. (a) Kalimbi mine in DR Congo from Fairphone trip in 2013 with CFTI (Gerritsen, 2014). (b) A Kid With His Murdered Father — Coltan War, Congo, 1998 (Sile12, 2015).

2.3 Regulating the Environmental and Social Impacts of Mining

Many domestic legal systems and international law instruments contain provisions: protecting designated nature and cultural sites and limiting or prohibiting mining operations therein;
requiring impact assessments before permitting certain activities; setting standards such as those relating to air and water quality or prescribing limits on discharges into water or emissions into the atmosphere; imposing requirements for mine closure and imposing compensation requirements for disrupting other forms of livelihoods, including dislocation from land.

### 2.3.1 Protected Areas

The classification of protected areas by the International Union for the Conservation of Nature and Natural Resources (IUCN) is one of the most prominent systems for designating such areas. Mineral operations in protected areas have been controversial in Africa, particularly for forests. Elements of the controversy relate to forest area in which it is, or should be, classified as a strict reserve or one in which certain forms of productive activity are permitted—and, if so, what forms of mineral operations (if any) should be allowed. That immediate financial needs or desires of governmental authorities and the power of mining companies may override legitimate environmental concerns with long-term implications sometimes creates a charged context for decision-making.

### 2.3.2 Environmental and Social Impact Assessments

Internationally-accepted impact assessment tools have enabled mining companies to adequately factor in environmental and social considerations in investment decisions. Environmental Impact Assessments (EIAs) and Social Impact Assessments (SIAs) have become integral parts of investment assessment methodologies, previously focused largely on financial criteria. Increasingly, the impacts of assessments cover the effects on flora and fauna and on human health, as well as broad socio-economic impacts of mining both directly and indirectly. International finance institutions have developed methods to ensure that mineral industry investors adequately account for these environmental and social impacts in the project evaluation framework.

Developing discharge and emission standards, mine closure obligations to be applied to mining and mineral processing in Africa and a cadre of professionals with the needed skills to conduct impact assessments still presents challenges. The financial and human resource constraints in most African countries limit the capacity of institutions tasked with enforcing these requirements.

Post-closure issues, often ignored in mine closure planning, especially at the pre-mine planning stage, are generally categorized as monitoring, maintenance and remediation. Monitoring and maintenance issues include long-term water quality sampling, geo-technical inspections of tailings dams and waste rock facilities, and repair regarding dams, the slopes of waste dumps and re-vegetation, especially where primary seedling or planting has failed. Mining plans should include plans for post-closure monitoring, maintenance and remediation of all mine facilities, including surface and underground mine workings, tailings and waste disposal facilities. And they should include a funding mechanism for all these elements.

Other challenges in impact assessment relate to the adequacy of compensation packages for disrupting livelihoods and destroying property in the case of resettlement. As noted in Akabzaa (2009), unmet expectations for compensation can be a permanent source of tension between mining communities and project developers.

### 2.3.3 Public Participation

Public participation, an important part of regulating the environmental and social impacts of mining projects, has potential to ensure that the overall management of exploiting mineral resources is sustainable. Two key benefits can arise from public participation in the decision as to whether a project with potentially significant environmental and social impacts should proceed. First, local knowledge of the impacts often provides valuable information potentially missed by outside experts. Second, it legitimizes a project, thus reducing the costs emanating from the social tensions that can result from an externally-imposed project.

It is now standard for laws requiring environmental and social impact assessments to include a public participation component. Regulations in many African countries require that a project sponsor publish in local and official languages, through media accessible in the locale of the proposed project, an indication of where a copy of its environmental impact study may be inspected, as well as to whom and within what period representations about the project may be made. Some regulations, such as Uganda’s, require that the developer “take all necessary
measures to seek the views of the people in the communities, which may be affected by the project during the process of conducting the study”, as well as after its completion. The developer must publicize the project and its anticipated effects and benefits for a prescribed period in the mass media and in a language understood by the affected communities. And the developer must hold meetings after that with those communities regarding the project at such times and in such venues as are agreed with leaders of local government bodies. After the study’s completion, the general public must again be invited to comment on the study through notices in prescribed form and the media. A designated official is empowered to decide whether a public hearing should be held on the study.

The right to a clean environment is imbedded in most African constitutions. In fact, certain provisions in the constitutions of various African countries not only impose obligations on state organizations with respect to the environment but also give citizens rights to enforce them. The right to a clean environment expressed in Uganda’s Constitution, for instance, has been held to give standing to a non-governmental organization in an action against the government and its environmental authorities. Such provisions can found claims of a right in members of the public to be heard before decisions are made on projects that could have significant adverse impacts on them.

Lenders to mining projects increasingly require that project sponsors commit to and implement public participation processes. For example, World Bank Group safeguard policies relating to the environment, involuntary resettlement, indigenous people and information disclosure have a bearing on evaluating loan applications as well as on the covenants imposed on borrowers in loan agreements. Indeed, the strengthening of a borrower’s capacity to meet environmental, public participation and social obligations required by these safeguard policies is now frequently a significant aspect of lending decisions.

The fifth of the nine Equator Principles to which major commercial banks have subscribed requires that its adherents fund projects with potentially significant impacts only if “satisfied that the borrower or third party expert has consulted, in a structured and culturally appropriate way, with project affected groups, including indigenous peoples and local NGOs”, that the assessment report “or a summary thereof, has been made available to the public for a reasonable minimum period in a local language and in a culturally-appropriate manner” and that the project environmental management plan “will take account of such consultations”. Those “likely to have significant adverse impacts that are sensitive, diverse or unprecedented” (category A projects) must be subject to independent expert review.

2.3.4 Access to Information

The relationship between access to information and participation in decision-making is expressed in Principle 10 of the Rio Declaration, which states that “each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available” (UN, 1992). It is also expressed in the UN Economic Commission for Europe “Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters” (the Aarhus Convention) (UNECE, 1998), widely regarded as a model of a public participation regime.

South Africa’s legislative framework exemplifies an incipient trend in Africa of enacting freedom of information legislation with potential to pressure a bureaucratic culture of secrecy regarding even the most routine matters. Its constitution guarantees the right of every person to receive or impart information or ideas—and to have access to information held by the state as well as to “any information that is required for the exercise or protection of any rights”. Given the formulation of the right to a healthy environment, the right of access would cover information in private hands required for its exercise or protection. These rights are expressed to be subject to such limitation as may be provided in laws “of general application to the extent that the limitation is reasonable and justifiable in an open and democratic society based on human dignity, equality and freedom taking into account all relevant factors”.

Further to these provisions in the South Africans’ case, the Promotion of Access to Information Act (2000) and its regulations establish a scheme to facilitate access to information held by public and private institutions. The scheme involves mechanisms for publicizing the categories of
material held by different institutions, obligations to designate officials to handle access obligations, procedures for obtaining access to information protected from disclosure, time limits for disclosure, a prescription of the grounds justifying non-disclosure and avenues for redress in the decisions of the responsible officials and the institutions. The South African Human Rights Commission is assigned responsibility for monitoring and enhancing the implementation of the Act. Most African countries are still at the development stages in the legislative framework for access to information.

2.3.5 Addressing the Minerals and Conflicts Link
As discussed earlier, conflicts may arise from distributing mining revenues and lack of direct participation of communities in mining projects. Compensation for land and other rights can also be a source of long-term tension. Many legal systems provide that no one should be deprived of an interest in land or other property without arrangements for the prompt and effective payment of compensation. The challenge often is to protect the relatively vulnerable or not so powerful sections of society. With regard to resettlement, the IFC Performance Standards set out important objectives that offer criteria for developing and implementing plans:

(i) To avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs;

(ii) To mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons’ use of land by compensating for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected;

(iii) To improve or at least restore the livelihoods and standards of living of displaced persons; and

(iv) To improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.

Addressing conflict minerals situations such as those in the Democratic Republic of the Congo has involved initiatives that focus on strengthening governance capacity, transparency, certification processes, security reform and regulation of multi-national companies. Numerous international instruments and initiatives already exist including UN Security Council Resolutions 1856 and 1857 (2008) (UNSC, 2008a; UNSC, 2008b), the United Nations Organization Mission in the Democratic Republic of the Congo activities and the International Conference on the Great Lakes Region “Regional Initiative against the Illegal Exploitation of Natural Resources” (UNECA, 2013).

The Kimberley Process Certification Scheme (KPCS) is an example of a system established to track the production and marketing of diamonds in order to disrupt trade of those coming out of conflict zones. Trade in illicit diamonds has fuelled decades of devastating conflicts in several African countries. The KPCS, launched in 2002, is a joint control initiative by governments, industries and civil society to ensure that conflict and stolen diamonds do not enter the legitimate diamond value chain. The main KPCS monitoring tool is reviewing expert missions to participant countries, especially problematic ones. The KPCS imposes extensive requirements on its members to enable them to certify shipments of rough diamonds as “conflict free”. The KPCS is backed by various UN General Assembly resolutions, which provide participant states with the legal basis for trade restrictions that can be challenged based on World Trade Organization rules. This raises the question whether a certification scheme should be backed by UN resolutions to increase its international legitimacy.

Inspired by the KPCS, the International Conference on the Great Lakes Region has adopted the “Protocol on the Fight against the Illegal Exploitation of Natural Resources”. The protocol legally binds 11 member States to jointly tackle the illegal exploitation of natural resources through a tracking and certification system, which applies subregionally. And the system has borrowed heavily from the KPCS. Among the important borrowed principles is that a certification system must address problems of governance, development and ethical mining practices, prevent mineral commodities from non-certified mining areas entering controlled production streams, include independent third party audits and provide credible sanctions for non-compliance. In effect, the tracking system consists of discreet national tracking systems with national data submitted to a
regional database. This African-led initiative has been endorsed internationally—for example, by the G8 Summit in 2009. The International Conference on the Great Lakes Region tracking system is probably a model that needs to be explored for adaptation in other African regions.

### 2.3.6 Policy Implications

For mining to induce sustainable social and economic benefits to communities, the benefits have to be deliberately considered and pursued. As social risks are ultimately borne by communities and by workers, the implementation of mining practices, rooted in human rights and basic core labour standards, must take place with the full participation of all affected parties.

Environmental, economic, social, labour and developmental rights inherently require that democratic governance processes, institutions and systems are in place. Stable democratic institutions can help prevent central/local disputes from becoming violent, while new democracies are often unstable and face high risks of conflict. To avoid violent conflict in the extractive regions, governments, firms, and local communities should promote transparency, establish multi-stakeholder dialogues before project commencement and take special care to protect human rights and security.

Addressing the adverse environmental and social impacts of mining requires a multi-pronged approach, which can include designating protected areas, enforcing impact assessment requirements for all projects, enforcing regulatory standards, enforcing public consultation and public participation, before project implementation and enhancing transparent access to information. There are numerous international instruments and templates that address these key developmental changes and even at the local level, legislation exists in most countries.

The UN Protect, Respect and Remedy Framework offers a useful and comprehensive set of principles which can be applied to the duties of states and the responsibilities of mining forms in respect of a large range of the impacts covered by the chapter. In addition to its use, however, African states need to strengthen their legislative frameworks and the capacity of enforcement institutions. Minerals have been sources of conflict in some countries on the continent, and mechanisms to address these conflicts have included strengthening governance capacity, transparency in revenue collection and sharing, transparency in the allocation of mining licences, certification processes for minerals, security reform and regulation of multi-national companies. A strategic implementation of these initiatives tailored to specific regional contexts would be required. Despite often causing conflicts over mineral resources, mineral exploitation presents opportunities to facilitate peace and regional security and enhance regional integration through corridor development.

The African mineral policy architecture has to be holistic and consider the benefits (revenues, taxes, export earnings, jobs and so on) and costs (environmental and social costs). A creative approach is required in tackling environmental and social challenges to entrench the sector’s developmental role. The framework has to be supported by adequate institutional, human and legal capacity.

### 3. Artisanal and Small-Scale Mining in Africa

UNECA & AUC (2011) report that artisanal and small-scale mining (ASM) is widespread in Africa and goes beyond the borders of countries endowed with high-value minerals. ASM miners also mine and process industrial minerals, such as lime for agriculture. UNECA & AUC (2011) further argue that ASM makes a positive contribution to African economies and, more particularly, to sustaining rural livelihoods, yet it faces many challenges that prevent it from attaining its full potential as a potent force in socio-economic development.

The Africa Mining Vision (AUC, 2009) recognizes the positive role and potential and envisages nurturing ASM as a means of:

"Harnessing the potential of ASM to improve rural livelihoods, to stimulate entrepreneurship in a socially-responsible manner, to promote local and integrated national development as well as regional cooperation".
3.1 Definition
UNECA & AUC (2011) states that there is no consensus on what constitutes a small-scale mining operation; neither is the boundary between ASM operations clearly defined. In production terms, the United Nations places an “upper boundary” on ASM of 50,000 tons a year for underground mines and 100,000 tons a year for open-pit mines. Most small-scale mining operations have a limit on project finance of $5 million, while such operations are not expected to have more than 50 workers. These parameters are much lower for artisanal operations, which are more labour intensive and employ hand tools and very basic processing techniques. These artisanal methods are wasteful and result in poor mineral recovery. The mechanized form of ASM has higher throughput and better recovery, but in turn is more labour intensive than medium to large-scale operations. Despite differences in definition, common attributes stand out: most miners are seriously under-capitalized, rarely operate as proper business enterprises and lack appropriate and modern technology.

3.2 The Global Position
ASM is integral to the economies of many mining countries in the developing world. The commodities exploited are diverse, encompassing precious and semi-precious minerals, base metals, industrial minerals and construction materials. Yet the informal nature of many ASM operations often makes it difficult to estimate total global production from the sector or the sector’s contribution to national economies and mineral output. Most analysis relies on anecdotal evidence.

Yet analysts are unanimous that millions of people derive their livelihood from ASM. An estimated 13–20 million men and women in more than 50 countries worldwide are involved. Around half are women. Sadly, about 2 million children are also known to be involved. More than 100 million people therefore depend on ASM for their livelihood. It is also the main means of livelihood for some rural communities.

Further, despite the lack of reliable statistics, analysts agree that ASM is a significant contributor to both global production and consumption of some mineral products. Global production of gold from ASM sources is estimated to be as high as 330 tonnes a year. ASM contributes more in high-value minerals, such as gold, diamonds and tantalum, than in bulk minerals like iron ore and copper. ASM operators are also involved in winning sand and gravel.

![Figure 37: Typical Artisanal Mining in Africa. (a) Gold Panners in Zimbabwe (GLF Committee & Mukwakwami, Reuters, 2013). (b) Artisanal Prospectors Search for Gold at a Gold Mine Near the Village of Gamina, in Western Cote D’Ivoire (Gnago, 2015).](image)

3.3 Profile in Africa
ASM activities are widespread in Africa, employing a large number of people directly in mining and associated services, as well as supporting large numbers of dependants. The large numbers of miners are partly attributable to high unemployment in many countries and the sector’s low barriers to entry, especially artisanal extraction. This sub-sector is characterized by very low start-up capital, low levels of skills, limited infrastructure and ease of entry and exit, contributing to fluctuating numbers.
## Table 1: African countries with more than 100,000 ASM operators (UNECA & AUC, 2011)

<table>
<thead>
<tr>
<th>Country</th>
<th>ASM</th>
<th>Estimated dependants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>150,000</td>
<td>900,000</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>200,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>400,000</td>
<td>2,400,000</td>
</tr>
<tr>
<td>Chad</td>
<td>100,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>100,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Democratic Republic of the Congo</td>
<td>200,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>Eritrea</td>
<td>400,000</td>
<td>2,400,000</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>500,000</td>
<td>3,000,000</td>
</tr>
<tr>
<td>Ghana</td>
<td>1,100,000</td>
<td>4,400,000</td>
</tr>
<tr>
<td>Guinea</td>
<td>300,000</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Liberia</td>
<td>100,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Madagascar</td>
<td>500,000</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Mali</td>
<td>400,000</td>
<td>2,400,000</td>
</tr>
<tr>
<td>Mozambique</td>
<td>100,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>Niger</td>
<td>450,000</td>
<td>2,700,000</td>
</tr>
<tr>
<td>Nigeria</td>
<td>500,000</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>300,000</td>
<td>1,800,000</td>
</tr>
<tr>
<td>Sudan</td>
<td>200,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>Tanzania</td>
<td>1,500,000</td>
<td>9,000,000</td>
</tr>
<tr>
<td>Uganda</td>
<td>150,000</td>
<td>900,000</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>500,000</td>
<td>3,000,000</td>
</tr>
</tbody>
</table>

Owing to its high labour intensity, ASM is commonly acknowledged to create far more jobs per invested dollar than large-scale mining (LSM). The profile of jobs, however, is largely that of poorly remunerated unskilled labourers who have gone into mining to avoid poverty. The working environment generally has poor conditions. Employment in the sector is highly cyclical, especially reflecting harsh economic conditions, such as those induced by drought and economic restructuring. During periods of stable economic activity in other sectors, the pull of ASM falls and the sector contracts.

Many workers sell their minerals at lower than market prices to middlemen, some of whom sponsor their operations. The incomes of such miners are usually below the poverty line, further reinforcing their poverty cycle.

ASM operators are generally migratory. They move from site to site searching for easy to extract mineralizations and abandon sites once they find the ore difficult to extract. A combination of practical, economic and social factors accounts for this migratory behaviour, such as the life of the mine, the lure of high-value mineral strikes in other areas, displacement from mining areas (perhaps after their allocation to LSM companies) and the need to follow agricultural seasons. Since artisanal miners’ capital investment is low, the opportunity cost of moving is not a deterrent.

As in other regions, ASM exploits many minerals in Africa, ranging from diamonds and a variety of other gemstones, to precious metals such as gold and tantalite, to industrial minerals including limestone for aggregate and agricultural purposes, clays for pottery and other uses and many other non-metallic minerals. ASM thus not only contributes to national and continental economic activity: as part of overall development programmes, it can be an important opportunity for improving conditions in rural and remote areas, especially where alternative livelihoods are few.

### 3.4 Challenges in Africa

The multitude of challenges faced by ASM in Africa is well documented in the literature. They include inadequate policy and regulatory frameworks; limited technical capacity and access to appropriate technology (and consequent environmental degradation); lack of finance; inadequate access to exploration and mining areas; difficulties in accessing the market; issues associated with conflict minerals; and women and child labour concerns. The opportunity for ASM to be transformed into a tool for sustainable development, particularly in rural areas, can thus be realized only if these challenges are met holistically.
3.4.1 Policy Challenges
The absence of specific policy frameworks facilitating the emergence or growth of sustainable ASM operations is a major constraint in most African countries. In some countries, small-scale mining policy and regulations fall under general mining policy, which makes no distinction between LSM and ASM. Thus the peculiar challenges in small-scale mining do not receive the attention that they deserve. Even in countries with a separate small-scale mining policy, the procedures for acquiring licences are generally cumbersome, which becomes a barrier to formalization. Without specific frameworks, ASM operators face challenges in getting mining rights.

Even when operators have formal access, the mining rights rarely provide for security of tenure: their duration is short and the size of the licence area usually small. Several licence areas may lie across a single ore body, leading to conflict. When they lack security of tenure, ASM operators cannot use their mineral rights as collateral for borrowing. The permitted levels of mechanization associated with these rights are limited either by law or by limited resources available to the sector, and this can prevent ASM operations from developing beyond subsistence horizons.

The lack of appropriate institutional, financial and technical support mechanisms curtails ASM’s sustainability. The ASM policy and regulatory environment in most African countries is seldom adequately supportive in vital areas such as access to appropriate financing mechanisms, provision of geological information and services, technical and marketing support or facilities for upgrading miners’ skill levels. Even when there is such state support, its physical location may present problems for the mining communities.

The private sector could potentially provide some form of support with proper incentives, but LSM and ASM often have an acrimonious relationship. Trespassing by ASM operators on concessions and the eviction of informal indigenous miners by LSM companies lead to confrontation.

3.4.2 Technical Capacity and Access to Appropriate Technology
The technical challenges facing ASM operators often stem from their low education levels. They also usually lack knowledge of the legislative requirements on occupational health and safety, the environment, mineral rights and a decent work environment. In addition, they have virtually no knowledge of marketing, business development or mine planning, which are critical skills for sustainable business operations. Further, they generally lack access to appropriate and affordable technology. This is due to the prohibitive cost of plant and machinery, the overall lack of suitable small-processing technologies, the lack of local capacities to adapt traditional mining and mineral processing technologies to small operations and the weak capacity of ASM operators and communities to assimilate available technologies. All these deficiencies force miners to target easy-to-find ore, but as they immediately abandon prospects as soon as the easy ore is mined out, they sterilize important resources.

Poor mining methods are associated with poor safety, health and environmental practices. In small-scale underground mining, weak rock formations may be poorly supported, leading to frequent cave-ins and injuries or loss of life. Unplanned excavations are not rehabilitated and waste is indiscriminately disposed of, leading to water pollution and land devastation. Disposed mercury from gold-mining operations is particularly pernicious—and all the more unfortunate because the high level of mercury is unnecessary, as miners can use alternative and equally efficient extraction methods.

3.4.3 Lack of Financing
Access to finance is one of the biggest challenges facing many ASM operators. Among the many reasons is that mining is a capital-intensive business and much of the high-risk early-phase work, such as exploration and ore reserve estimation, is typically financed from equity. This phase does not attract other forms of finance, including that from mainstream financial institutions.

The above financial constraints mean that most ASM operators cannot become involved in this early phase and consequently, without quantified ore reserves, they cannot develop the robust and credible business plans that banks require.

ASM operators have few, if any, assets acceptable to banks and other lending institutions as collateral. Unlike their LSM counterparts, they cannot use their mineral rights (even where they exist) since the reserves are not quantifiable and their lack of a business plan forestalls risk
analysis by creditors. The migratory nature of many ASM operators also makes access to such finance problematic.

These factors place ASM operators outside the realm of formal financing institutions, leaving their scarce internal resources and concessionary government support as sources of finance.

Such lack of access makes ASM operators vulnerable to exploitation by predatory mineral traders, as seen, for example, in Sierra Leone's “supporter” system. Supporters are usually mineral buyers who try to ensure security of supply by financing mining operations, but as financiers of ASM operations, they extract unfair price concessions on the mineral products. Yet the miners have no option but to accept.

3.4.4 Inadequate Access to Exploration and Mining Areas
ASM policies in many countries provide for designation of land or areas for exploration and mining activities. If properly implemented, such policies have the potential to reduce tensions between ASM and LSM. Such designation might result in fewer conflicts over exploration and mining areas and could create space for beneficial collaboration by the two sectors. Among the many benefits could be a reduction in environmental degradation associated with haphazard mining.

Yet such land designation has so far failed to solve these problems, largely because few of the demarcated areas have been properly surveyed for ASM. Detailed geological information to prove their suitability for ASM is rare, weakening the relevance of “reservation policies” for ASM. The challenge for policymakers is to find ways to conduct or fund comprehensive exploration to determine suitable areas for ASM and then provide such information to the miners.

3.4.5 Difficulties in Accessing Markets
ASM has complex marketing arrangements that are often beyond the technical understanding of miners, especially for precious metals and gemstones. Some miners are tied to sponsors and providers of mercury (in the gold subsector) or providers of mining and processing tools. Prices rarely relate to market conditions because the sponsors set them. In this value chain, the miners are the least compensated. The lack of a transparent and well-developed end-user market (in jewellery, for example) further aggravates marketing challenges.

For industrial minerals and base metals, the paucity of local and regional markets reflects African economies’ level of development. Other than aggregates for construction and road building, and lime for construction and agriculture, few African countries have industries producing basic consumer goods (such as paper, paint or talcum powder) to absorb large volumes of industrial minerals. These economies cannot absorb base metals, minerals or other industrial mineral products from ASM, hence these outputs are exported as ore or sold to LSM companies in arrangements rarely benefiting ASM operators.

3.4.6 Conflict Minerals
The informal nature of much ASM makes it amenable to illegal dealings, especially in high-value minerals such as diamonds, gold and coltan. The value chain for such minerals, from mining, through processing, trade and transportation to external markets is often characterized by leakage, particularly in countries recovering from conflict where prolonged security issues are part of the background to informal operations.

The nexus between natural resource exploitation and conflicts in Africa is well documented, particularly for the diamond value chain. Conflict diamonds have been used by rebel groups to finance military campaigns against established governments.

As an informal activity with weak or non-existent legal protection, ASM is an easy victim of organized crime and paramilitary organizations. During civil strife in some countries (such as the Democratic Republic of the Congo and Sierra Leone) proceeds from artisanal mining have reportedly been appropriated by warlords and rebel movements to finance war. In this way, artisanal mining has contributed to armed conflict. Efforts to end conflict by preventing the flow of artisanal mining revenue to armed groups have been relatively successful for diamonds.

Wider efforts are afoot to build a more robust legal and institutional framework for artisanal mining that would improve its resistance to takeover attempts by armed groups. The most
important was coordinated by the Secretariat of the International Conference on the Great Lakes Region (ICGLR). In December 2010 the Heads of State and Government of the ICGLR signed the Lusaka Declaration. This tracking and certification mechanism seeks to address the persistent illegal exploitation of natural resources in the region and its linkage to the proliferation of armed groups. The declaration notes various transparency and certification initiatives in the minerals sector, among them the Kimberley Process, and emphasizes the need for a regional approach in curbing the illegal exploitation of natural resources.

The Southern African Development Community (SADC) has also developed a draft framework for tracking and certifying mineral products in or transiting SADC member countries. Its primary objective is to ensure that illegitimately acquired mineral products do not enter legitimate value chains, either in countries where mining and processing take place or in those through which the minerals transit. A secondary objective is to promote ethical practices in mining through transparent declarations of production and export figures.

The task of rendering artisanal mining less easy prey for armed groups has been heightened recently by political decisions stemming from reactions to atrocities in the Democratic Republic of the Congo. The US Financial Stability Act, passed in July 2010, requires US companies to submit an annual report to the Securities and Exchange Commission disclosing whether their products contain tantalum, tin, tungsten or gold sourced from that country or adjoining countries. The law entered into force on 1 April 2011. The effect of the US law is that minerals from the central African region that do not possess verifiable chain-of-custody data would no longer be acceptable in international markets. The EU is reported to be considering similar legislation.

The consequences if tantalum, tin, tungsten or gold sourced from those countries are no longer accepted by international markets cannot be overstated. In the Democratic Republic of the Congo alone, the number of artisanal miners exploiting these minerals is estimated at 150,000–200,000, and higher in neighbouring the United Republic of Tanzania. Many people there would suffer a heavy loss of income and source of livelihood—primarily among the very poor with few alternative sources of income.

Governments therefore need to see to it that artisanal miners have realistic, practical and affordable means of certifying production before they enforce such legislation.

3.4.7 Women’s and Child Labour Issues

Cultural practices and legal contexts continue to entrench the minority and disadvantaged status of women in ASM communities. An analysis of the ASM production chain shows that most women take part in the activities allocated to them by society (mainly men) and are barred from others because of cultural taboos. Key gender factors include the limited level of access to resources (exploration ground and financial resources) that would allow women to participate as miners. Women are generally disadvantaged in the ownership and possession of land, mineral rights, capital and equipment. In some countries, for example, land and mineral rights acquired when a woman is single pass on to her husband on marriage. In the relatively few instances that they have some access to resources, women do not control them or the resultant benefits.

Women benefit less from mining than men, but also suffer more from its negative impacts and the nature of the sector. For instance, environmental degradation affects women’s capacity to provide clean water for their families and to source firewood for energy. It undermines their role as care givers. Some heavy-duty machinery and equipment for mining such as jack hammers is not easily used by women. Further, the difficult working conditions in mining areas do not accommodate the special needs of women including health and safety, reproductive roles and hygiene.

Within ASM communities, children are often involved in mining, either for themselves or as part of the family. The UN Convention on the Worst Forms of Child Labour identifies mining as “work, which by its nature or the circumstances in which it is carried out is likely to harm the health, safety and moral of children”. The convention has been ratified by 41 African countries, and the legal framework precludes young people under 18 from working directly in mines. This is often just ignored.

Child labour is detrimental to children’s education, as well as their long-term physical and psychological development. While the hazards of ASM faced by children are the same as for adult miners, the risks to young bodies and minds are much more severe as coping mechanisms
develop with age. Some children, either willingly or forcibly, abandon schooling. This not only robs them of their future but diminishes the countries’ ability to achieve the Millennium Development Goals. In some poor communities, girls are more likely to be taken out of school to assist the family in livelihood activities than boys.

3.4.8 Self-Reinforcing Nature of Challenges
The challenges faced by ASM operators form a vicious circle and have a self-reinforcing effect on ASM activities. In particular, the lack of business and market knowledge, and lack of finance, can force them to sell to middlemen at low prices, perpetuating their poverty.

Artisanal miners are therefore kept in a poverty trap where their operations rarely graduate above subsistence and remain economically and environmentally-unsustainable. Hence there is a need for government support.

3.5 Addressing the Challenges: Some Country Initiatives
Many countries have reviewed their policy frameworks to facilitate the growth of ASM so that it can play its role in national development and reduce poverty. They have increasingly mainstreamed ASM into poverty reduction strategies. Some have passed legislation to simplify legal requirements, and others, such as Ghana and Zambia, have changed the law to improve the environment for ASM.

Some countries have taken steps to help ASM operators to market their minerals. Measures include liberalizing trade in ASM mineral products (for example, in the United Republic of Tanzania) through explicit licensing procedures, requiring well-structured documents indicating quantities bought and sold. In Ghana, the state-owned Precious Minerals Marketing Company as well as some private companies are authorized to operate as the market for precious minerals. These companies are allowed to appoint agents to undertake their purchases, which they may directly export with appropriate central bank and customs documentation.

In Ethiopia miners are required to sell their products to the central bank. The bank also allows the miners to deposit their minerals, which are held in trust for them, until they sell. This enables the miners to take advantage of favourable prices. In Mozambique, the Mining Development Fund, set up by the Government, plays a dual role in assisting (financially and technically) and promoting ASM, as well as acting as a gold buyer, particularly in remote sites where miners have little access to competitive markets. In these remote areas this fund is often the only legal buyer.

Nevertheless, illicit trade, particularly in precious minerals, remains rampant. One approach adopted by the Precious Minerals Marketing Company in Ghana, and previously implemented in Zimbabwe, is to offer guaranteed close-to-market prices, in order to cut the number of middlemen and predatory traders. Another avenue is for the authorities to establish an audit trail of purchases of precious minerals to individual (registered) mines before issuing an export permit. The ICGLR tracking and certification scheme and the Kimberley Process Certification Scheme are examples.

For its part, SADC has developed a draft framework on illicit mineral trade. Integrating this framework and the ICGLR scheme would greatly strengthen efforts to tackle illicit mineral flows across many more countries in Africa.

Financial assistance schemes for ASM that are run along business lines, such as revolving funds, assume the ability to pay back the borrowed funds, as perhaps demonstrated through business plans. The issue has always been, however, that ASM operators struggle to pay back loans, progressively reducing the funds available for other borrowers, usually leading to a collapse of the fund. Although a range of mechanisms, such as equity-based financial schemes, joint-venture partnerships, venture capital funds, investment bank funding, and unit trust or mutual funds, are also available in some countries, they impose conditions that ASM operators cannot meet.

Cooperation between small- and large-scale miners is another route for ASM operators to access finance and technical support, and could involve mentoring. An LSM company would, for example, adopt several small companies and provide technical and business support, including guaranteeing their borrowings from commercial institutions. The smaller companies are expected
Productive collaboration between ASM and LSM has not been fully exploited. Mentoring offers gains to both sides. For LSM, it boosts the corporate image and community acceptability, offers financial returns from sub-contracting out non-core functions and improves relations with small-scale mining companies. For ASM operations, it helps to transfer technology and skills (entrepreneurship and expertise) cheaply. Further, it allows small-scale miners access to working capital, promotes legal, environmental and regulatory compliance, and improves overall workings as miners adopt best practice.

Gender presents its own challenges, which are well recognized in regional frameworks. The African Union (AU) recognizes the equal rights of women in all aspects of human socio-economic endeavour and the principle of gender equality is stated in Article 4 (l) of the Constitutive Act, which has since been reaffirmed. The regional economic communities have protocols for addressing gender disparities (AUC, 2000). Yet African member governments need to improve the pace of domestication of the various regional, continental and international instruments on human and women’s rights. Gender analysis processes should be applied to mining projects, including gender-disaggregated data, to track improvements.

From a regulatory viewpoint, the provision of women-friendly facilities and technology in mining areas could be made mandatory and a legal requirement for issuing a mining permit or allocating mining rights. To the extent possible, mining equipment should be ergonomically-designed to be women-friendly. Training and gender advocacy campaigns need to be mainstreamed in mining areas incorporating the International Labour Organization (ILO) principles of a decent work environment that is gender sensitive and free of sexual harassment.

Schemes for providing financial and technical assistance should be sensitive to women’s needs. Sources of capital would require affirmative action principles to be applied in granting loans and credit. A proportion of funds for ASM should be reserved for women, to complement dedicated funds, such as the AU African Women’s Trust Fund. Information on these sources needs to be disseminated widely.

Policies on ASM need to address child labour. The ILO’s programme Minors out of Mining, launched in 2005, aimed to eliminate child labour in ASM completely within 10 years. It is a tripartite effort initiated by governments with support of the industry (companies and workers) and the ILO. African countries in the programme include Burkina Faso, Côte d’Ivoire, Ghana, Mali, Senegal, the United Republic of Tanzania, and Togo. The programme should form a fundamental aspect of strategies to keep children in school.

### 3.6 Policy Implications

The AMV foresees a mining sector that is safe, healthy, gender and ethnically-inclusive, environmentally-friendly and socially responsible. It aspires to harnessing the full potential of ASM in stimulating local and national entrepreneurship and in improving livelihoods. It also aims to promote an integrated approach to rural social and economic development. The AMV further emphasizes the aspirations of the Yaoundé Vision for ASM which was adopted in 2002.

Along this perspective, ASM policy has to be formulated and implemented as part of a broad rural development strategy, and should include:

(i) Regularizing informal ASM;

(ii) Simplifying and decentralizing procedures for acquiring ASM rights;

(iii) Providing a realistic implementation plan, including institutional capacity enhancement;

(iv) Assisting miners to graduate from subsistence to sustainable businesses;

(v) Assuring a legal regime that gives ASM rightholders enough land, duration of rights and security of tenure;
(vi) Providing accessible institutional, technical and financial support;

(vii) Encouraging support for ASM from the more established private sector (including LSM);

(viii) Expanding exploration work that leads to the designation and allocation of areas for ASM;

(ix) Ensuring regional and international cooperation to address the challenges of conflict minerals;

(x) Raising capacity locally to run tracking and certification schemes before enforcing bans on transporting non-compliant minerals;

(xi) Enforcing international norms prohibiting child labour;

(xii) Exploring and launching measures to redress discrimination against women, whether due to the law or operation in practice; and

(xiii) Promoting subregional cooperation in technology development, research, construction of appropriate plant and machinery, technical standards, compilation of a database of local capacity and generation of financial resources.

4. Sustainable Mining in Africa: The Africa Mining Vision

4.1 The African Mining Vision

The vision provides an inspirational statement (AUC, 2009):

“Transparent, equitable and optimal exploitation of mineral resources to underpin broad-based sustainable growth and socio-economic development”

The AMV seeks to foster “A transparent and inclusive mining sector that is environmentally and socially-responsible...which provides lasting benefits to the community and pursues an integrated view of the rights of various stakeholders...is essential for addressing the adverse impacts of the mining sector and to avoid conflicts induced by mineral exploitation. Public participation in assessing the environmental and social impacts and the enforcement of impact assessment requirements is important in tackling these challenges”.

The vision envisages:

(a) A knowledge-driven African mining sector that catalyses and contributes to the broad-based growth and development of, and is fully integrated into, a single African market through:

   (i) Down-stream linkages into mineral beneficiation and manufacturing;

   (ii) Up-stream linkages into mining capital goods, consumables & services industries;

   (iii) Side-stream linkages into infrastructure (power, logistics; communications, water) and skills & technology development (HRD and R&D);

   (iv) Mutually beneficial partnerships between the state, the private sector, civil society, local communities and other stakeholders; and

   (v) A comprehensive knowledge of its mineral endowment.

(b) A sustainable and well-governed mining sector that effectively garners and deploys resource rents and that is safe, healthy, gender and ethnically inclusive,
environmentally friendly, socially responsible and appreciated by surrounding communities;

(c) A mining sector that has become a key component of a diversified, vibrant and globally competitive industrialising African economy;

(d) A mining sector that has helped establish a competitive African infrastructure platform, through the maximisation of its propulsive local and regional economic linkages;

(e) A mining sector that optimises and husbands Africa’s finite mineral resource endowments and that is diversified, incorporating both high value metals and lower value industrial minerals at both commercial and small-scale levels;

(f) A mining sector that harness the potential of artisanal and small-scale mining to stimulate local/national entrepreneurship, improve livelihoods and advance integrated rural social and economic development; and

(g) A mining sector that is a major player in vibrant and competitive national, continental and international capital and commodity markets.

The AMV is a key indicator of Africa’s desire for a sustainable mining framework that takes into account the institutional, social, environmental and economic development dimensions. Through its African Minerals Development Centre (AMDC), A Country Mining Vision Guidebook was developed to facilitate the domestication of the Africa Mining Vision at the national level as a way of harmonizing mining operations in Africa (AMDC, 2014).

4.2 Actions to Promote Sustainability

The AMV highlights specific actions required to:

(i) Facilitate and nurture human resources development and skills formation in tandem with the development of resources technological clusters through the facilitation of research and development (R&D) and the building of knowledge networks and niches involving academia, industry, the government and other players;

(ii) Provide supporting infrastructure including roads, rail ports, energy and water and telecom;

(iii) Encourage the establishment of strong instruments of collaboration (industry/professional associations, Chambers of Mines, cluster councils, incubator/technology packs) and foster agglomeration effects and learning processes by the establishment of a critical mass of key similar, ancillary, related and associated industry players that share information, collaborate and compete to improve the initial factor advantages, enhance competency, reinvention, innovation, technology evolution and spillovers, and diversification;

(iv) Promote local beneficiation and value addition of minerals to provide manufacturing feedstock;

(v) Promote the development of mineral resources (especially industrial minerals) for the local production of consumer and industrial goods;

(vi) Establish an industrial base through backward and forward linkages;

(vii) Encourage and support small and medium-scale enterprises to enter the supply chain;
Increase private sector confidence and participation, and reduce entry barriers and operating costs to achieve external economies of scale;

Ensure compliance of industry players with the highest standards of corporate governance, and environmental, social and material stewardship;

Harness the potential of mid-tier resources that may not necessarily attract major international companies but high net worth individuals, including local entrepreneurs;

Establish the requisite enabling markets and common platforms for services (raising capital, commodity exchanges, legal and regulatory support, marketing support and know-how);

Harness the potential of Public Private Partnerships (PPPs); and

Promote regional integration and harmonization to facilitate factor flows.

5 Scope of Sustainable Mining Standards

5.1 Principles and Objectives of Standards Harmonization

The standardization of African Standards for tourism shall be based on the sustainability principles and criteria with the following broad objectives:

5.1.1 Institutional Framework

(a) Policy and Legal Framework for Large Scale Mining (LSM)
(b) Policy and Legal Framework for Artisanal and Small-Scale Mining (ASM)
(c) Guidance on Governance Aspects
(d) Guidance on Legal Compliance
(e) Environmental and Social Impact Assessment (ESIA)
(f) Environment and Social Impact Monitoring
(g) Protect, Respect and Remedy Framework
(h) Reclamation and Closure

5.1.2 Economic Guidelines

(a) Econometric Assessment of Mining Developments
(b) Revenue, Royalty and Rent Payments Transparency
(c) Transparent Marketing and Fair Pricing Practices for ASM Minerals
(d) Linkage Framework for Market Access by ASM
(e) Local Mineral Beneficiation and Mineral Separation Requirements
(f) Transparent Mineral Valuation Framework

5.1.3 Social Guidelines

(a) Community and Stakeholder Engagement
(b) Engagement with Indigenous People
(c) Fair Labour and Working Conditions
(d) Occupational Health and Safety
(e) Emergency Preparedness and Response
(f) Human Rights Due Diligence and Compliance
(g) Mining and Conflict-Affected or High-Risk Areas
(h) Security and Human Rights
(i) HIV/AIDS, Tuberculosis (TB) and Malaria
(j) Obtaining Community Support and Delivering Benefits
(k) Free, Prior and Informed Consent (FPIC)
(l) Cultural Heritage
(m) Resettlement

5.1.4 Environmental Guidelines

(a) Water Quality
(b) Water Quantity
(c) Mine Waste Management
(d) Air Quality
(e) Noise and Vibration
(f) Greenhouse Gas Emissions
(g) Protected Areas
(h) Conservation and Protection of Biodiversity
(i) Cyanide
(j) Mercury Management
(k) Environmental Impacts of Different Mining Processes
(l) End of Life Mine Reclamation/Closure Requirements

5.2 **Scope of Standards Harmonization**

1. CD-ARS-752, *Sustainability Standards — Glossary and basic descriptions*
2. CD-ARS-753, *General Principles and criteria for sustainability*
3. Sustainability criteria for mining
4. Sustainability criteria for artisanal and small-scale mining
5. Conformity criteria to sustainable mining
6. Draft standard for mineral valuation
7. Sustainable mining of radioactive minerals
8. Guide for Sustainable Surface Coal Mine Reclamation
9. Guidelines for Sustainable Hardrock Mining Reclamation/Closure
10. Guidelines for Sustainable Reclamation of Disused Mines

6. **Liaison Possibility**

In the harmonization work, liaison possibilities with the following initiatives will be explored:

(i) The Initiative for Responsible Mining Assurance (IRMA)
(ii) ISO/TC 82/SC 7 Mine reclamation management
(iii) Extractive Industries Transparency Initiative (EITI)
## Annex A

### Mineral Resources of African Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Precious Metals gemstones and semi-precious stones</th>
<th>Metallic Minerals</th>
<th>Industrial Minerals</th>
</tr>
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<tr>
<td>Algeria</td>
<td>Gold, silver</td>
<td>Mercury, wolframite, lead, zinc, iron</td>
<td>Phosphate, barite, kaolin, bentonite, diatomite, feldspar, gypsum, pozzolana, salt, marl, rhyolite, sulphur, fuller's earth</td>
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<td>Angola</td>
<td>Diamonds, gold, silver, PGMs</td>
<td>Uranium, nickel, chromium, bauxite, copper, lead, iron, zinc</td>
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<td>Benin</td>
<td>Gold</td>
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<td>Marble</td>
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<td>Gypsum, pozzolana, salt,</td>
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</tr>
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</table>

**PGM Platinum** group metals: iridium, osmium, palladium, platinum, rhodium & ruthenium

Source: UNECA & AUC (2011)
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