

# Sustainable Development and Nonrenewable Resources— A Multilateral Perspective

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## Introduction

The link between sustainable development and nonrenewable resources appears at first glance to be inconsistent, because nonrenewable resources are finite. The concept of sustainable development has generated a great deal of debate and spawned a multitude of definitions since it was put forward by Malthus (1798) about 200 years ago. He argued that the fixed land base could not sustain the continuing growth in human population and, if people did not restrain their reproduction, the population would be controlled by war, pestilence, and starvation. This early thinking evolved to what we now accept as the fundamental premise of sustainable development as stated by the World Commission on Environment and Development (Brundtland, 1987, p. 8)—“development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The United Nations Development Programme (UNDP) believes that development must have a human face and coined the term “sustainable human development.” Its mission, therefore, is to help countries in their efforts to achieve sustainable human development by assisting them to build their capacity to design and carry out development programs in poverty eradication, employment creation and sustainable livelihoods, the empowerment of women, and the protection and regeneration of the environment, giving first priority to poverty eradication.

The idea of sustainable development in the context of nonrenewable resources, in particular mineral resources, may seem a contradiction if a one-dimensional view is taken. Mineral resource development is unsustainable only if we ignore the complex interaction of economic growth, social development, and the environment. It is not always self-evident that our present modern technological society requires an ongoing supply of minerals. Mineral production, although having environmental impacts, is and will continue to be an essential part of ensuring the economic well-being of our society. To satisfy the present global mineral needs without compromising the mineral resource needs of future generations, it is imperative that we approach mineral resource development

within a holistic framework comprising all components of the complex interaction between humans and the ecosystem on which they depend. By using nonrenewable resources for capital formation that will be reinvested in social, economic, and environmental activities, the concept of sustainability and mineral resource development would no longer seem to be a contradiction.

Since the establishment of the UNDP in 1965, the organization has supported mineral resources development activities, including exploration, feasibility studies, capacity building, and institutional strengthening of mining departments in developing countries. As a result of these activities, several important mineral deposits were discovered, including one of its earliest and largest discoveries, the Baja la Alumbrera copper deposit in Argentina. Today, UNDP’s direct involvement in the mineral sector is minimal, mainly because it is felt that this activity should be left to the private sector. However, the wealth of information that resides within UNDP archives could contribute to the global assessment of future sources of mineral supplies. A global mineral resource assessment is seen as a prerequisite to adequate planning for the sustainable use of these nonrenewable resources and as a contribution to the achievement of UNDP’s overarching goal of poverty eradication.

This paper discusses the evolution of the concept of sustainable development and the need to treat mineral resource development as one component in a complex interaction between humans and their environment. UNDP’s approach and contribution to fostering an enabling environment for global mineral resource development within the framework of sustainable human development are presented.

## Sustainable Development

### Evolution of the Concept

The concept of sustainable development can be traced back to the 18th century, when there was concern that the limited amount of land and resources would retard economic growth. Tahvonen (2000) traced the development of economic thought on sustainability and scarcity of natural resources by citing four main periods, as follows.

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## The 1st period

- 1798 Thomas Malthus (1798) believed that the fixed land base could not sustain the continuing growth of human population. He predicted that, if humankind did not make the moral decision to control the increasing number of people on the planet, populations would be held in check by war, pestilence, or starvation.
- 1862 John Stuart Mill (1862) emphasized that, while the limited amount of natural resources could in principle constrain increases in production, this limit would not be reached in any country over any meaningful timeframe.

## The 2d period

- 1890–1920 The U.S. conservation movement in its doctrine stated that economic growth has clear physical boundaries that cannot be avoided by technological development. Too rapid use of nonrenewable resources was considered a major threat to future generations. It was argued that, the lower the use of nonrenewable resources, the better.
- 1931 Studies by Hotelling (1931) proposed a theoretical model in which social well-being from nonrenewable resources was maximized over an infinitely long time period.
- 1963 Barnett and Morse (1963) questioned the pessimistic Malthusian view and the basic premises of the conservation movement. They found that, on the basis of price and cost time series data on minerals, agriculture, and renewable resources, (1) the price and production costs had fallen or remained constant during the period 1870–1957 and (2) only the price level of forestry had shown an upward trend. These findings were explained by technological development, which produced substitutes for scarce resources, decreased extraction costs of minerals, and expanded the size of economic reserves.

## The 3d period

- 1972 The “Limits to Growth” report for the Club of Rome by Meadows and others (1972), using the modeling method called “systems analysis,” predicted that the future world population level, food production, and industrialization would first grow exponentially but then collapse during the next century. The collapse would occur because the world economy would reach its physical limits in terms of nonrenewable resources, agricultural production, and excessive pollution. The study predicted that 11 vital minerals could be exhausted before the end of 2000.

- 1977 Wassily Leontief and others (1977), on request by the United Nations, applied equally pessimistic assumptions as the “Limits to Growth” report, except that they took into account that demand may respond to higher prices. Their results showed that only two minerals were in danger of being exhausted.

## The 4th period

- After 1974 *Presustainability from 1974 onward.*—Two economists, Partha Dasgupta and Geoffrey Heal (1974), asked whether an economy can maintain a positive consumption level forever, given that there is no technical development and that the production of commodities is possible only by using limited nonrenewable resources like oil. Their analysis revealed that it is possible to maintain a positive consumption level only if capital can be substituted for nonrenewable resources without technical difficulties.

The concept of sustainable development has evolved and gained global recognition since the report by the World Commission on Environment and Development (Brundtland, 1987) and the United Nations Conference on Environment and Development in 1992. The concept is complex, requiring a delicate balance among economic growth, environmental protection, and social development to secure the well-being of the increasing population on a sustainable basis.

## Defining Sustainable Development

The complexity of sustainable development has spawned a myriad of definitions. The most quoted definition is by the World Commission on Environment and Development (Brundtland, 1987, p. 8), which says that sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The concept is further elaborated therein by the statement, “In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.”

In 1991, “Caring for the Earth—A Strategy for Sustainable Living,” published by the International Union for Conservation of Nature and Natural Resources, United Nations Environment Programme, and World Wide Fund for Nature (Munro and Holdgate, 1991), defined sustainable development as, “improving the quality of human life while living within the carrying capacity of supporting ecosystems.” The Australia Ecologically Sustainable Development Working Group on Mining (1991) defined sustainable development as, “ensuring that the mineral raw materials needs of society are met, with-

out compromising the ability either of future societies to meet their needs, or of the natural environment to sustain indefinitely the quality of environmental services (such as climate systems), biological diversity, and ecological integrity.”

UNDP advocates sustainable human development, which is an approach that seeks to expand choices for all people—women, men and children, current and future generations—while protecting the natural systems on which all life depends. Moving away from a narrow, economy-centered approach to development, sustainable human development places people at the core and views humans as both a means and an end of development. Thus, sustainable human development aims to eliminate poverty, promote human dignity and rights, and provide equitable opportunities for all.

In addition to the several definitions of sustainable development, the concept is elaborated in principles 1, 4, 5, and 8 of the Rio Declaration (United Nations, 1992), as follows:

- Principle 1. Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.
- Principle 4. In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.
- Principle 5. All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.
- Principle 8. To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

Although several definitions exist, the three main elements—economic growth, social responsibility, and environment and natural resource conservation—are persistent in the definitions of sustainable development. There is an unquestionable global acceptance of the need for all nations to embrace the concept of sustainable development, which upholds the universal values of fulfilling basic needs and access to good health, wealth, dignity, knowledge, justice, equity, and peace.

## Nonrenewable Resources

At first glance, a nonrenewable resource seems to be incompatible with sustainable development. This is true

because the concept of a nonrenewable resource implies that, once a resource is used, since it cannot reproduce itself, sustainability is not possible. This one-dimensional view of nonrenewable resources seems to support the widely held view that the extractive industries cannot be supportive of the concept of sustainable development. A closer examination of the issue, however, reveals a different perspective.

Nonrenewable resources, in particular mineral resources, are necessary for the economic well-being of our societies. It is not always self-evident that without a supply of mineral products our living standards will be drastically reduced and the impact on the global economy will be disastrous. The modern conveniences, such as automobiles, building and transportation infrastructure, fertilizers for increased food production, television sets, computers, solar panels, aircraft, medical diagnostic and treatment methods and instruments, farming equipment, and cooking utensils, require mineral products. It is a truism that what is not grown must be mined. To have access to mineral resources, their extraction from the Earth and the environmental impacts associated with this activity are unavoidable.

In limiting the concept of nonrenewability to exhaustion and depletion in the case of mineral resources, we are ignoring the impact of technology. Advances in technology, new mineral discoveries, and limits on the material riches desired by our societies can minimize the possibility for exhaustion and depletion of the Earth’s recoverable mineral supply. Technology provides the possibility of finding ways to renew the supply of minerals through advances in exploration techniques, extraction processes, recycling, and substitution. In the case of some resources we think of as renewable, such as biological resources, the reality is that some bird and fish species have become extinct and, therefore, also can be considered nonrenewable. In viewing mineral resource depletion at the scale of individual mine sites, the limited perspective of nonrenewability can apply; on a global scale, however, given the untapped resources of the oceans and deeper parts of the Earth’s crust, we should consider a broader view of nonrenewability.

Given the important role that minerals play in our societies, it is necessary to view mineral development as one of the important components of continuing economic growth without impairing the capacity of future generations to enjoy the same or a better standard of living. Sustainability requires economic growth, environmental protection of our ecosystem, and social responsibility. The dynamic interplay of these three components is a prerequisite for achieving the goals of sustainability. Mineral development can be viewed as supporting the concept of sustainable development if the extraction of minerals takes place in a manner that minimizes the environmental impacts; equitably shares the benefits from the new wealth created; utilizes the capital obtained to provide adequate healthcare, education, and other social services; and reduces the level of waste through recycling and improved technologies to optimize recoveries.

In considering national and international mineral supplies, it is necessary to recognize the dynamic characteristics

of the minerals industry and to take into account the other factors apart from the economic and geologic ones. It is well accepted that the environmental and sociocultural aspects must be an integral part of the way the minerals industry operates.

## Sustainability of Mineral Supply

Although some authors predicted that the world would run out of some minerals, thus contributing to constrained economic growth, this pessimistic prediction has failed to materialize despite increasing consumption and population growth. The main reason for this failure was that projections of supply and demand models failed to take into account the dynamic nature of the minerals industry. Some minerals in use today were not in use 50 years ago, while others have been substituted for by plastics, composites, and other materials. For example, we are seeing an increased use of optical fiber replacing copper in the communications industry. It is possible that with new technologies the future uses of some minerals will require reduced quantities of the mineral raw material to be mined.

Dziobinski and Chipman (1999) presented an overview of the trends in production and consumption of copper, lead, and aluminum. They found that there will be no shortage of copper due to depletion of ore in the foreseeable future. The reserve base of copper will last for more than 40 years, and copper resources for more than 105 years. For lead, the reserve base is sufficient for 40 years, and identified resources for 500 years. For aluminum production, the primary raw material is bauxite. Reserves of bauxite will last for about 100 years, and estimated resources between 170 and 200 years. As can be seen, there is no evidence that these or other nonrenewable resources will be scarce due to extraction and depletion in the medium to long term. As technologies emerge for the development of resource substitutes, recycling methods, and improved exploration and mining methodologies, together with the potential for discovery of minerals not yet known, global mineral supply is in no danger of becoming scarce due to depletion of mineral resources.

## UNDP's Contribution and Role

Mineral exploration activities in the developing world have been supported by the United Nations (U.N.) and in particular by the UNDP for more than 40 years. This support was in recognition that the mineral wealth of a country was an engine of economic growth. The U.N. programs covered many aspects of mineral resource development in the developing countries, including the following:

1. Institutional strengthening of geological surveys and mineral resource departments and ministries.
2. Training of nationals in all fields of mineral resources.

3. Mineral exploration using geochemical prospecting, airborne and ground geophysics, analytical chemistry, and assaying.
4. Drilling.
5. Economic feasibility studies.
6. Mining and mineral processing—establishing mining and metallurgical institutes.
7. Mining legislation.

Exploration results have been positive in many of the exploration programs undertaken by UNDP. The discovery of the Cerro Petaquilla porphyry copper deposit in Panama (1965–71) attracted international mining companies that began exploration in Panama and neighboring countries for similar deposits in the circumpacific orogenic belt in the Americas. In Mexico, UNDP projects led to the discovery of La Caridad porphyry copper deposit and the Las Truchas iron ore deposit. In Asia, discoveries include the Mamut porphyry copper deposit in Sabah, Malaysia; offshore tin in Indonesia; and the Sar Cheshmeh copper deposit in Iran. In Africa, several deposits were found by UNDP mineral exploration programs; notably, lateritic nickel in Burundi and Tanzania, iron ore in Guinea, and gold in Burkina Faso.

Rapidly changing external and internal factors have necessitated a change in focus of the activities of the UNDP. Externally, there have been major global political changes such as the breakup of the Soviet Union. Several armed conflicts in the developing world have created a major refugee crisis requiring the intervention of U.N. peacekeeping teams. There have been important social changes, such as the emergence of global movements regarding women and indigenous people and regarding environmental and human rights. Internally, major reforms of the organization have taken place, resulting in the reorientation of programs to respond to the demands of these dramatic changes. The current development approach embodies all the elements of sustainable development, with a major focus on poverty elimination.

In response to the many changes, mineral exploration activities by UNDP declined and were replaced by an emphasis on processing and manufacturing activities. Examples of this new direction are (1) providing advice to governments in reforming their mining codes and their fiscal regimes, (2) providing policy advice in environmental matters, (3) promoting women's issues, and (4) providing assistance in the transformation of informal small-scale mining to a formal sector.

The stated mission of UNDP is to contribute to halving world poverty by 2015. To achieve this goal, the emphasis is on pro-poor and sustainable growth. It is recognized that sustained poverty reduction requires socially, politically, and environmentally sustained economic growth in all countries. The present activities in the natural resource sector focus on poverty reduction strategies, and because the private sector is better positioned to play a key role in the mineral sector, UNDP now concentrates on issues pertaining to good governance, capacity building, and the strengthening of institutions.



In the natural resources management cluster, emphasis is placed on water, sustainable agriculture and food security, and renewable energy and energy policy.

Although UNDP no longer is directly involved in mineral exploration activities, it continues to contribute to the mineral sector through implementation of the sustainable livelihoods (SL) approach to artisanal mining. As one of UNDP's five corporate mandates, SL offers both a conceptual and a programming framework for poverty reduction in a sustainable manner. Conceptually, livelihoods connote the means, activities, entitlements, and assets by which people make a living. Assets, in this particular context, are defined as not only natural or biological (that is, land, water, minerals, common-property resources, flora, fauna) but also social (that is, community, family, social networks, participation, empowerment), human (that is, knowledge creation by skills), and physical (that is, roads, markets, clinics, schools, bridges). The sustainable livelihood approach could be instrumental in tapping the vitality of mining to improve community livelihoods and contribute to poverty eradication.

## UNRFNRE's Role in Sustainable Development

In 1973, the U.N. Revolving Fund for Natural Resources Exploration (UNRFNRE) was established to respond to fears expressed about the future scarcity of mineral supply. The revolving fund acted as a catalyst in mineral resource development through its executing and financing mechanism, which promoted self-reliance and cooperation among developing countries. The creation of the fund was a cooperative attempt by the world community to expand the inventory of mineral resources at mankind's disposal for the future. Voluntary contributions made by donors both from developing and developed countries provided the high-risk capital for mineral exploration at no cost to the recipient governments. The only requirement was that, in the event that the fund was successful in discovering an economic mineral deposit that went into production, the government was obligated to make replenishment payments to the fund. The replenishment rate was 2 percent (1 percent for least developed countries) of the gross value of annual production for a period of 15 years, with a ceiling of 10 times the amount of the cost of exploration incurred by the fund. It was estimated that, after 25 years, the fund would be self-sustaining and not dependent on contributions from donors. The replenishment payments would be the pool of high-risk capital for developing countries to utilize for their mineral exploration activities. In this way, countries would share the risk and be self-reliant in financing their mineral exploration activities.

During its 26 years of existence, UNRFNRE has assisted developing countries to locate and define the economic mineral deposits within their borders. With a total expenditure of nearly US\$100 million, the fund has evaluated over 100 mineral prospects, carried out 34 mineral exploration projects, and discovered 10 economic mineral deposits with an in-place

value of approximately US\$3.4 billion. To date, deposits of gold in Peru and Ecuador and chromite in the Philippines have been mined. On August 3, 2000, one of the fund's projects, the Geita, Tanzania, gold mine, was officially opened; it will be producing 500,000 ounces of gold annually from a reserve of 5 million ounces and a resource of 12 million ounces.

The changed focus of UNDP to concentrate on processing and manufacturing activities, and the decision to phase out the activities of the fund by the end of 2000, brings an end to the mineral exploration activities within the UNDP. It is hoped that the new wealth created by the fund's discoveries will be reinvested in social, economic, and environmental activities in line with sustainable development objectives.

## Conclusions

Nonrenewable resource development and sustainable human development are inextricably linked, complementary, and multidimensional. Development is unsustainable if equity does not exist or where large numbers of people live in abject and degrading poverty. As a development organization, UNDP supports the development of national capacity in the participating countries through sustainable human development activities. The approach is holistic and multidimensional, recognizing the mutual dependency and complementary nature of the social, economic, environmental, cultural, civil, and political dimensions of development.

Although UNDP and UNRFNRE will no longer engage directly in mineral exploration activities, contributions to the mineral sector will continue through UNDP's four main areas of sustainable human development programming—(1) eliminating poverty and implementing sustainable livelihoods, (2) promoting the advancement of women, (3) protecting and regenerating the environment, and (4) developing capacity for good governance. All of these areas have dimensions pivotal to the development of nonrenewable resources in a sustainable manner.

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