

Development and Environment

Editors

ZAHID HUSAIN and S. K. BARIK



DEVELOPMENT AND ENVIRONMENT

DEVELOPMENT OF GEOENERGY RESOURCES
AND ITS IMPACT ON ENVIRONMENT AND MAN
OF NORTHEAST INDIA

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Preface

North-East India Council for Social Science Research, the premier social science research organization of 30 years standing, held a seminar on Environmental and Sociological Implications of Mining of Coal, Limestone and Uranium and Exploration of Oil and Natural Gas in North East India on 5-6 June 2003. The present volume contains some of the selected papers presented to the seminar. North East India is endowed with huge mineral resources including limestone, coal, natural gas and uranium. Coal is found in all the states of North East India. But except in Assam and Meghalaya coal mining has not been undertaken elsewhere. Mineral resources are largely untapped. In Assam coal mining is done by Coal India Limited. In other states, coal mining is done by private mine owners in most unscientific way causing much environmental hazards, sociological damages and demographical imbalance in the mining areas. Hydrocarbon exploration is mostly done in upper Assam and in adjoining Nagaland and Arunachal Pradesh. Till now maximum petroleum explorations are conducted in the plain areas where geology is favourable. The exploration and exploitation of oil resources should be made in such a way that meet the present need without compromising the needs of the coming generations. Operational activities interact with the environment through long term physical, chemical and biological changes. Pollution control measures should be taken at every stage of exploration and exploitation of hydrocarbon resources of North East India.

Uranium is the basic raw material for the nuclear programme of the country. With the formulation of Atomic Energy Programme in 1948, the search for uranium had commenced. The exploitation of this valuable material is now being carried out by the Uranium Corporation of India Limited (UCIL). The technology

adopted by the UCIL is comparable with the best practiced any where in the world. Domiasiat Project in West Khasi Hills district of Meghalaya may bring about a positive development in the social and economic scenario of West Khasi Hills. The project is likely to generate economic opportunities for the people of Meghalaya. The adoption of state of the art technology with environmental monitoring mechanism adopted by the UCIL minimizes health hazards. Nuclear energy will stage as a major source of power which could be made safe and dependable source of energy of the future. But it has to be handled with care by strictly following the International Atomic Energy Agency regulations and as adopted by Atomic Energy Regulatory Board of the country.

We take this opportunity to thank His Excellency the Governor of Meghalaya Mr. M.M. Jacob, Professor G.D. Sharma, Vice-chancellor, Nagaland University, Dr. R. Gupta, Chairman Uranium Corporation of India, Mr. H.K. Mazhari and Dr. S.Q. Hoda, Regional Director, Atomic Minerals Directorate for Exploration and Research who contributed much to the success of the seminar.

We congratulate Dr. Zahid Husain and Dr. S.K. Barik for editing the volume and Regency Publications, New Delhi, for expeditious publication of this volume.

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B. Datta Ray
Secretary,
North-East India
Council for Social
Science Research

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Geoenergy Resources

Zahid Husain

This paper has been written for this volume to understand three points, viz., (i) the meaning and explanation of the term 'geoenergy' and its importance, (ii) the *geoenergy resources scenario*, and (iii) the theme of the book i.e., the predicament of development and environment, especially in terms of the *development of geoenergy resources and its impact on environment and man*. Hence, it is sort of a background paper to know the entire gamut of the problems discussed in the book by different authors.

(i) Geoenergy

By the term 'geoenergy' the author means energy produced from the earth's materials, which include the hydrocarbons and the atomic minerals. It simply means energy derived from the earth's materials like coal, rock/mineral oil, natural gas, uranium and thorium. Since these resources are mined from the earth and developed to produce energy, they are termed as *geoenergy resources*. The *geo* means the earth, whereas the Dictionary meaning of *energy* is — the power required for doing work, for action etc. For the time being, keeping the scope of the book in mind, *geoenergy* means the energy derived from the materials/minerals extracted from the earth, particularly from inside or subsurface. However, the comprehensive meaning of the term *geoenergy* shall include the heat of the earth's interior which is commonly known as geothermal energy. The term *geoenergy* is analogous to 'bioenergy' which means deriving energy from the

biotic products/materials, or 'solar energy' in which the solar radiation is converted into energy.

Nowadays, there is a welcome trend to prefix *geo* (without any hyphen) either to a discipline or a term to focus and study its relationship with the earth and its various attributes. For example, geoarchaeology, geobotany, geochemistry, geoenvironment and so on. This is also one of the reasons of using the term *geoenergy* to distinguish energy developed/produced from the resources mined from the earth than from any other sources like solar radiation, water, wind, plants etc.

Man has access to two different types of energy sources. The first is simply a diversion of the current flows of the earth's energy systems. Out of which the solar flux is the most important which is tapped in two ways — (i) directly through the medium of photosynthesis, and (ii) less directly through the action of falling water and wind. The inherent heat of the earth provides geothermal energy. These sources are termed *equilibrium* sources since the flows would be present even in the absence of man. The second type is referred to as *non-equilibrium* set of energy sources which comprise of human-procured release of stored energy. That 'would either not happen at all under natural conditions or would happen only at an infinitesimal rate compared with its discharge under the impetus of technology. In this category fall the fossil fuels (oil, coal, natural gas, oil shale and tar sands) which represent stored photosynthesis from the geological past and which yield energy upon combustion. Compared with the equilibrium sources they are very concentrated, a quality which liberates the energy contained in the nucleus of the atom. A measure of the significance of this concentration is the energy content of 1 g of uranium 235, 1826 kg of oil and 2700 kg of coal' (Simmons, 1981:238).

(ii) Geoenergy Resource Scenario

Energy is essential for life and work. Human societies are categorised by their access and amount of use of energy. Higher use of energy is an indicator of a developed society. The industrial revolution and industrialisation of the modern world owe a great deal to the fossil-fuels — oil, gas and coal. The primary source of energy on the surface of the earth is sun. In fact, coal, oil and natural gas are forms of stored solar energy. They are produced

by the plants buried in the earth for thousands of years, hence are known as 'fossil-fuels' or hydrocarbons. As it takes millions of years in their formation and replenishment, they are classified as non-renewable resources from human point of view. Though these geoenergy resources are easy to develop and cheap to use, but they have become major polluters of environment (Waugh, 1995). On the other hand, nuclear energy is not a fossil-fuel as it uses uranium. It is a non-renewable source of energy, for uranium is formed in quite long geological time period. Surprisingly, for the amount of fossil-fuel used in the world in a year it would have taken one million years to produce. This not only shows the rapidity with which the hydrocarbons are depleted but the long geological time required for their regeneration/reformation.

Hydrocarbons formed 87.4 per cent of the global energy used in 1990. Oil constituted 38.6 per cent of it, and the share of coal and natural gas was 27.2 and 21.6 per cent, respectively. Definitely, the world will continue to rely upon hydrocarbons as a major source of energy in the 21st century too. However, these geoenergy resources have different life expectations. Coal has about 200 to 400 years, gas 120 years, and oil 50 years. As a result, their use has to be reduced. Not only that, we have to discover new reserves and alternatives or non-conventional sources of energy to meet the growing demand of energy and avoid any energy crisis in future. This is because the modern society would not be able to afford any energy crisis, for it substantially depends on the sustainable supply of energy. In the beginning of the 1950s nuclear energy, with its slogan 'atom for peace' was seen by many to be a sustainable, inexpensive and clean energy resource. Contrary to this view, many considered it as a dangerous military aid and a threat to the environment. 'Although nuclear power stations produce fewer GHGs than thermal (coal-oil and gas fired) power stations, they do present potential risk in three main areas: routine emission of radio-activity, waste disposal and radio-active contamination accidents (Waugh, 1995).

Astonishingly, over a period of forty years, i.e., between 1950–1990, there was a four fold increase in the rate at which these energy resources were used to run the wheels of human civilisation. More heartening is the uneven distribution in the consumption of the energy resources in the world. Today 77 per

cent people of world living in the developing countries consume merely 30 per cent of the total global energy supply. While the 23 per cent population living in the developed world use 70 per cent of the global energy supply. Though the rate of consumption of energy has considerably slowed down in the developed countries, it has shown an increasing trend in the developing countries because of rapid population growth and their aspirations to raise their living standards. This led to the conflict of interest between these two groups of countries at Rio Earth Summit of 1992. The developed countries wanted to see the resources conserved and environment protected, while the developing countries considered it now their turn to utilise the natural resources (Waugh, 1995).

Another interesting point to be discussed here is that percentage share of the different energy sources has been changing over the decades (Table 1). The percentage contribution of coal to the total world energy supply has come down drastically from 94.2 per cent in 1900 to 27.2 per cent in 1990. Contrary to it, the share of oil has sky-rocketed from mere 3.8 per cent in 1900 to 47.6 per cent in 1974 and 38.6 per cent in 1990. The share of natural gas also shows the similar trend. Of course, the contribution of hydroelectric power and nuclear power has also increased, but to very limited extent.

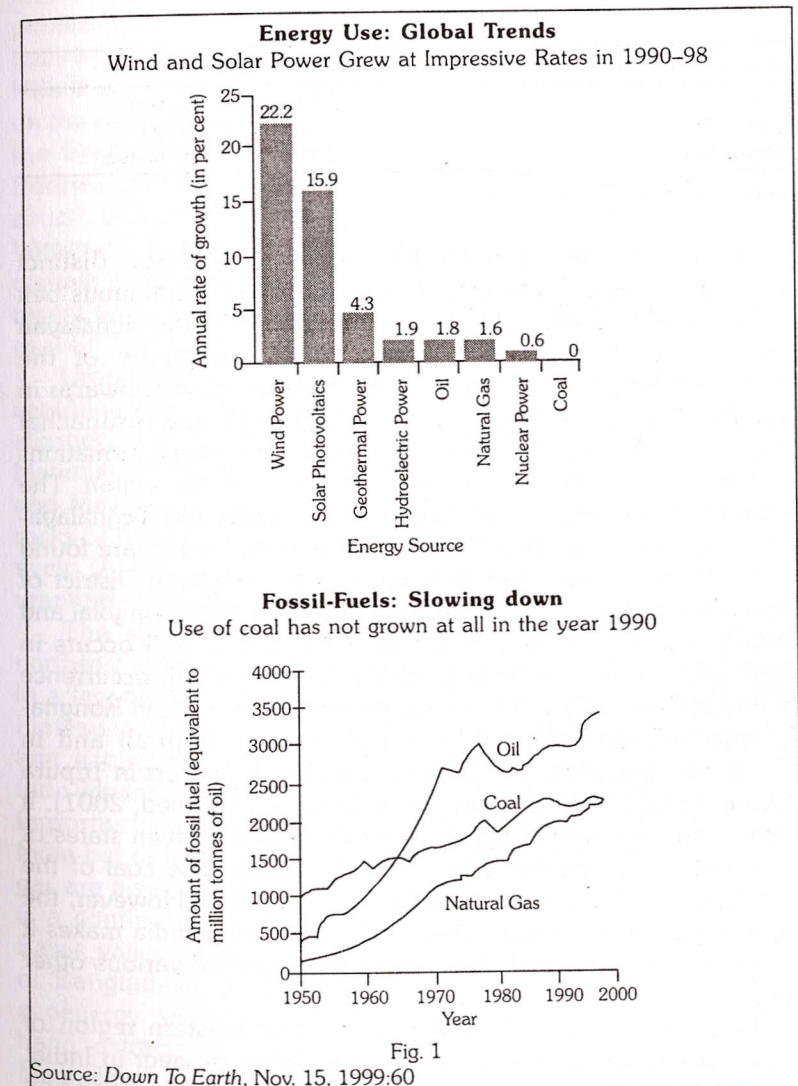
Table 1. Percentage Contribution of Main Fuels to Total World Energy Supply

Fuel	1900	1940	1965	1974	1990
Coal and Lignite	94.2	74.6	43.2	30.6	27.2
Oil	3.8	17.9	36.7	47.6	38.6
Natural Gas	1.5	4.6	17.8	19.6	21.6
HEP and Nuclear	0.5	2.9	2.2	2.4	N.A.

Source: Foley, 1976, and Lean and Hinrichsen, 1992.

Figure 1 clearly shows global trends of energy use during 1990-98 in which use of oil grew marginally, i.e., mere 2 per cent. Whereas coal did not grow at all (Vital Signs, 1999; cf. *Down To Earth*, Nov., 15, 1999:60). The second part of the Figure 1 depicts slowing down of the use of fossil fuels during the 1950

and 1990s. Though the use of oil during this period has increased tremendously, there have been fluctuations in its use due to geopolitical reasons. There has been a steady increase in the use of natural gas. However, the over all use of fossil fuels has slowed down on one hand; while on the other, use of non-conventional sources like wind and solar energy has increased phenomenally.



The geoenergy resources scenario of the Northeast India is quite satisfactory as the region is endowed with rich and varied geoenergy resources. The estimated reserves of the geoenergy resources of the northeast India are given in Table 2.

Table 2. Estimated Reserves of Geoenergy Resources in Northeast India

<i>Geoenergy Resource</i>	<i>Estimated Reserves</i>
Coal	893,000,000 tonnes
Natural Oil	876,000,000 tonnes
Natural Gas	114 billion cubic metres

Source: Taher and Ahmed 2001.

Coal deposits of northeast India lie in three distinct geotectonic units. These are: (1) the narrow discontinuous belt of Arunachal Himalaya disposed as thrust sheet in the Himalayan foothills, (2) the platform areas on the periphery of the Meghalaya-Mikir plateau, and (3) the pericartonic downwarps in Schuppen zone of Upper Assam, Nagaland and Arunachal Pradesh. Coal abounds in both the ancient Gondwana formations and the Tertiary sediments of the later ages of the region. The Gondwana coal is found in Arunachal Himalaya and Meghalaya-Mikir plateau. Coal deposits in the Tertiary sediments are found in the Namchik and Namphuk valleys of Changlang District of Arunachal Pradesh, and also in the contiguous Ledo-Borgolai and Makum areas of Assam. Whereas in Nagaland coal occurs in Nazira-Borjan area of Mon district and also a small occurrence in Jhanzi-Disai valley. The lignite deposits are found in Kongna-Waiphei village (about 32 km southwest of Imphal) and in Churachandpur district of Manipur. Lignite also occurs in Tripura (Dutta, 1982; De-Chaudhuri, 1999; Taher and Ahmed, 2001). It shows that coal and/or lignite is found in all the seven states of northeast India, though with varying quantity. The coal of the northeast has low ash and high vitrimite content. However, the presence of high sulphur in the coal of northeast India makes it unsuitable for industrial uses; hence it is used for various other purposes.

In case of oil and natural gas, the northeastern region of India has got the distinction of not only being pioneer in India, but the only producer before the discovery and extraction of oil

and gas in the western off-shore zone of India. Oil and natural gas is confined to the Tertiary sediments of upper Assam, Badarpur area of Cachar district of Assam, Karsang area of eastern Arunachal Pradesh, Mokokchung district of Nagaland and Tripura. The pioneer oil and gas fields of India are located in upper Assam. Natural oil and gas are found in two morphotectonic units in the region, viz., (i) a mobile belt covering Indo-Myanmar ranges from the Patkai Hills in the north to Mizo Hills in the south. The Digboi and Badarpur oil fields are located on the exposed structures, and (ii) an adjoining platform shelf in the Brahmaputra valley of Assam. The Naharkotia, Moran, Rudrasagar and other fields have been developed in the structures buried under the alluvium of the Brahmaputra river. Within the Tertiary, the sediments of the Oligocene and Miocene contain principal productive horizons of the basin. However, in recent times interesting finds have been made in Eocene strata as well (Visvanath, 1982; Taher and Ahmed, 2001).

Uranium is typically confined to the ancient rocks of the central-southern Meghalaya plateau. 'Significant uranium mineralization of 0.01% to 0.04% U₃O₈ grade was discovered in the Mahadek formation of Tarangblang-Pdengshakap, Gomaghat area and Mawkhyrwat and in the granitic and associated metabasic rocks of Anek in Jaintia, West Khasi and West Garo Hills, respectively (AMD, 1982). Of these, presence of economically viable uranium in Domiasiat of West Khasi Hills district is well known.

The spatial distribution of the geoenergy resources in northeast India clearly shows that these resources are concentrated in a few pockets of the region. Coal abounds in the Meghalaya Plateau and Indo-Myanmar ranges. Whereas the mineral oil and natural gas are confined to the Tertiary sediments of the Indo-Myanmar ranges, and along with the coal they form an important 'geoenergy resource zone' of not only northeast India but of India as a whole (Fig. 2). Isolated pockets of oil and gas are also located in the Tertiary sediments of Tripura, which is a continuum of the neighbouring oil and gas fields of the Barak valley of Cachar district of Assam and the Surma valley of Bangladesh. This forms an exclusive oil and natural gas geoenergy resource zone of the northeast India. On the other hand, extractable uranium occurs in the granites of the southern Meghalaya plateau (i.e., the western Khasi Hills). In this way, the

Meghalaya plateau with its coal and uranium deposits is an important 'geoenergy resource zone' of the region and India as well. Apart from these three unique geoenergy resource zones coal deposits are scattered all over the region. Moreover, new finds in future may change this scenario of geoenergy resources in the northeast India.

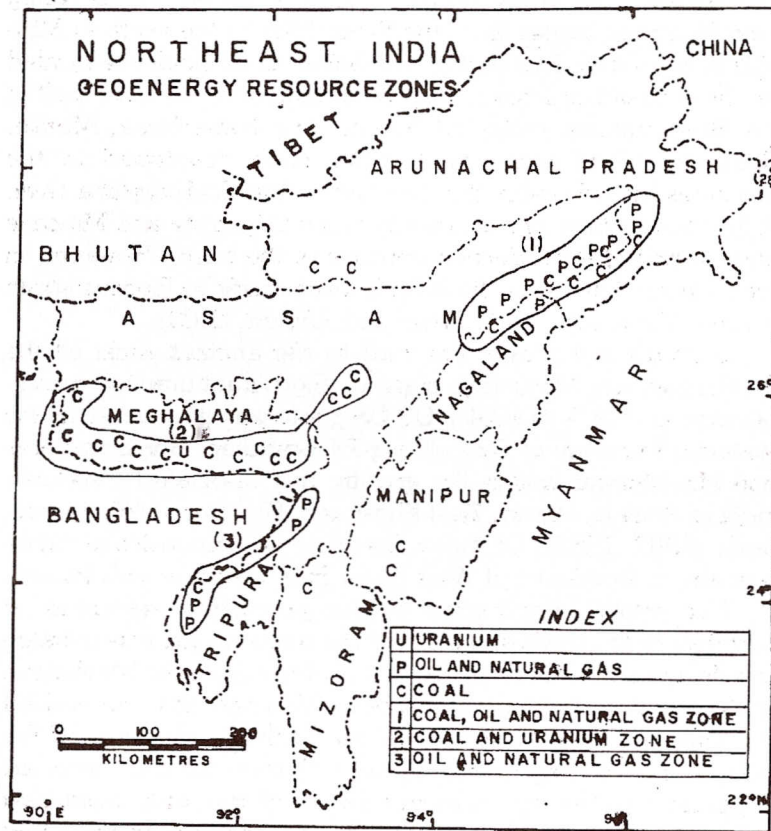


Fig. 2

(iii) Development of Geoenergy Resources and its Impact on Environment

First of all it would be necessary to explain the meaning of development of natural resources. In a simple way, it means recognition, extraction and use of a natural substance to serve human needs. All these involve a long series of steps and actions. The resource utilisation from ecological point of view may be understood as flow of energy from ecosystem to human system and then back to ecosystem. Firey (1960) has given a term — *resource process* for it, which means total flow of a material from its state in nature through its period of contact with man to its disposal (cf. Simmons, 1981). Though development of resources (including the geoenergy resources) is a base for the development and progress of human civilisation, it also has deleterious impact on environment and man in many ways. This is, in fact, a predicament caused by the conflict between 'development of natural resources' and 'health of the natural environment', where the former is invariably considered increasingly detrimental and thus opposite to other. As an overriding problem this has been bothering man for quite a long time. The gravity of the crisis is ever deepening and becoming more and more complex. Therefore, a serious thought has to be given to this problem to understand its intricacies and try to solve it, so that a healthy environment can be maintained for the survival of man and his civilisation. Concepts like 'development without destruction' have been proposed to strike a balance between development and environment, and to reduce detrimental effects of resource utilisation (on which the development depends) on the environment.

The development of geoenergy resources and its adverse impact on environment must be seen as a part of human impact on natural environment where man has deliberately or unknowingly brought great transformations in the environment. As a result, mankind faces basic questions regarding the future of the biosphere and the carrying capacity of the earth to sustain life. The ability of man to cause changes in natural landscape/ environment is an ancient phenomenon (Darby, 1956; Sauer, 1956; Meiggs, 1982), though it varies in time, space and extent. With the passage of time, faster population growth and establishment of a fossil-fuel-based industrial society the scales, rates and types of

environmental change have also undergone changes. For instance, till now the world has lost 8 million sq. km area of forest. Today man contributes 150 m tons of sulphur per year to the world's sulphur budget, which is equal to the natural influx of sulphur. It was negligible in the beginning of the twentieth century. The ever-growing role of man in the metamorphosis of the earth has also changed and it has transcended local, regional and international boundaries. That necessitated launch of global environmental campaigns. For example, the IGBP was launched in 1988 to have scientific study of the fundamental processes involved in the global environmental change *per se* (Turner II et al., 1993).

The technology, strategy and attitude, employed by man in the development of natural resources, have played crucial role in causing unprecedented (both in rate and extent) transformation in the natural environment. Headrick (1993) considers technology as 'a means whereby humans use nature for their own benefit'. He is of the opinion that 'the act of technological innovation is commonly divorced from any responsibility for its environmental impacts ... , technology has become so powerful that we now feel and measure the feedbacks in the form of resource depletion, environmental degradation, and threats to life itself, and contemporary environmental problems can be traced to the sudden acceleration in the rate and power of innovations that began with the industrial revolution in the late-eighteenth century England'.

According to Foell (1978), access to sources of energy entails the whole of man's relationship to the planet earth, particularly uses of all types of natural resources, because their extraction, conversion and transport may depend upon the control of large quantities of energy, (cf. Simmons, 1981:235).

Mining of energy resources has affected environment more than the mining of any other natural resource. The environment is adversely impacted right from its exploration to utilisation and disposal after use. Human society does need development and for that use of energy is a must. Thus, the predicament deepens. On one hand there is requirement of energy resources for human civilisation, while on the other there are adverse impacts on the environment due to the very utilisation of these resources.

The management (i.e., resource exploration, appraisal, extraction, utilisation and disposal of its waste) of uranium, coal, oil

and gas to meet the energy demands of the human society has not always been free from detrimental effects on the environment, which in turn affects the man himself. This is true world over, although there are spatio-temporal variations in the rate, degree and extent of environmental degradation associated with the mining and utilisation of geoenergy resources.

The developed countries have comparatively better tools, technology and strategy not only for the development of natural resources but also for solving the problems arising out of it. Contrary to it, the developing and under-developed countries adopt less advanced technologies in both the aspects. They neither damage the environment at the rate and extent the former do, nor the later have the capacity to rejuvenate the degraded environment as the former can do. This difference could be seen from another angle too to make the scenario clearer. No doubt with the sharpening of tools, technology and strategy, both the rate and extent of exploitation of mineral resources (including geoenergy resources) have expanded horizontally as well as vertically beneath the surface of the earth, but as a consequence the environmental degradation has also increased proportionately over time and space. The debate on environment and development will not be complete unless we discuss the following two points. First, most environmental degradation has taken place in the developed countries, and secondly they also have the adequate/appropriate tools, technology, expertise and funds for taking remedial measures for restoration of environment. Of course, how much of it they do (e.g., in case of controlling emission of GHGs as per the Kyoto Protocol), and how much of this remedial expertise and funds they transfer to the developing countries, is a matter of hot debate in the world today. But there is no doubt that the developed countries are the worst destroyer of the quality and quantity of the earth's environment on one hand, while on the other they have the capacity to restore/rebuild/recreate the degraded environment too. Unfortunately, instead of fulfilling their responsibilities they pass on the blame on the rest of the world. All these aggravate the problem and add to the already deep and perplexing dilemma of development and environment.

The intended or unintended detrimental impact of the mining and utilisation of geoenergy resources on environment and

man is relatively more than that of any other natural resource. The adverse effect is felt right from the exploration to utilisation and disposal after use. It is there while mining, storing/dumping, processing, using as fuel and throwing the waste after the use of the geoenergy resources. Of course, human society does need development and for that use of energy is a must, but that causes environmental degradation which is detrimental to man, other living beings and the physical environment as well. This is actually a vicious cycle, and that deepens gravity of the dilemma. On one hand, there is requirement of energy resources for the development of human civilisation (particularly the industries), while on the other there are adverse effects on the environment due to the very utilisation of these energy resources. As both are required by man, it is better to strike a balance between the development and environment. It means man should manage the natural resources in such a way that on one hand there is no adverse effect on the environment and man, while on the other sustainable supply of resources is maintained for the present and future generations of all living beings, and thus the planet earth is saved from any debacle.

The situation is going to worsen once the multinational companies (MNCs) have access to the natural resources of the developing and under-developed countries, because their ultimate motive is to earn money in which the local environment and people are the worst sufferer. Entry of MNCs in the mining sector of a country can be taken as doom for the environment and man. These views have been raised in recent times by different people and organisations as they have become crucial in the wake of the globalisation and liberalisation. To give impetus to the globalisation of mining and attract potential foreign investors, the 19th World Mining Congress was held at New Delhi (i.e., second time in the country) from 1–5 November 2003. However, the event was considered by the environmentalists and the activists as the plot to plunder the natural resources of India. For this purpose blatantly expansionists even used the phrase of 'sustainable development'. Moreover, opening of new mines will be at the cost of forests, as 60 per cent of the 90,695 hectares of the metal mining areas in M.P., Bihar and Orissa is under dense forests, and not many companies follow eco-friendly practices. Displacement of people from the mining

areas is another thorny issue. As per the Coal India Limited only 0.63 per cent of the 16.40 million people displaced due to coal mining during 1951 and 1990 have been rehabilitated so far (Gupta, 2003). Danger can be more serious as lax rules also draw multinationals to India. The people affected by mining have strong fear that the authorities may dilute the laws further as an investor-friendly (not eco-friendly) gesture. This apprehension is not unfounded because the government is keen to amend the Land Acquisition Act, which restricts private parties from acquiring tribal land. The tribal dominant northeast India can be more vulnerable in such a tragic situation. Similarly, the Himalaya Mountain has become hunting grounds for notorious mining activity to exploit its mineral resources following a research finding that advocates the possibility of finding huge quantities of sulphide ores of metallic elements, like zinc and gold, in higher mountain sediments (*Down To Earth*, January 15, 2004).

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