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GEOTHERMAL TRAINING PROGRAMME

Geothermal Development Company

BIODIVERSITY, CONSERVATION AND LOSS: INTERNATIONAL LEGAL MECHANISM FOR MANAGEMENT

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ABSTRACT

Natural or biological diversity on earth is an important prerequisite for humans to exist, as it provides valuable ecosystem services. However, there are many threats to biodiversity, including loss of habitat, overexploitation, pollution, alien species and climate change. In order to reduce the rate of biodiversity loss significantly, the Convention on Biological Diversity was adopted at the Rio Conference 1992, forming the core of the international Regime on global biodiversity which is examined in this work. There are also other important conventions and protocols as the Cartagena Protocol on Biosafety, the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the 1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals and the 1991 Ramsar Wetland Convention that have facilitated biodiversity conservation efforts worldwide.

1. INTRODUCTION

There is worldwide concern that human activities such as pollution, habitat destruction, over-exploitation and foreign plant and animal invasions are resulting in the ever-increasing loss of the earth's biological wealth. The implications of this are considerable. If continued unabated, we stand to lose crucial life-support systems through the loss of important habitats; to undermine rural livelihoods, with the degradation of the natural resource base on which people depend; and to diminish economic opportunities, as options for developing medicines and foods are reduced and the natural resource base for tourism is damaged. Clearly, action is needed. However, if there is to be global cooperation to conserve biodiversity, recognition needs to be given to its uneven distribution around the world.

1.1 Defining and measuring biodiversity

The Convection on Biological Diversity (CBD) defines biodiversity as "*the variability among living organisms from all sources including,* inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*." It is the variety of life on earth at all levels, from genes to worldwide populations of the same species; from communities of species sharing the same small area of habitat to worldwide ecosystems.

Biological diversity can be measured in terms of different components (genetic, population/species, and community/ecosystem), each of which has compositional, structural, and functional attributes. *Composition* refers to the identity and variety of elements in each of the biodiversity components. *Structure* refers to the physical organization or pattern of the elements. *Function* refers to ecological and evolutionary processes acting among the elements.

Table 1 shows some of the different measurable attributes of compositional, structural and functional diversity for the three components of biodiversity with a focus on those measures that would be most useful in determining potential effects of human use on biodiversity.

TABLE 1: Indicators of attributes and components of biodiversity

Attributes/ components	Composition	Structure	Function
Genetic	Allelic diversity	Heterozygozsity, heritability	Gene flow, genetic drift, mutation rate, selection intensity
Population/ species	Species abundance, biomass, density	Population structure, dispersion, and range	Fertility, mortality, survivorship, life history, phenology
Community/ ecosystem	Relative abundance of guilds or life forms, proportions of exotic or endemic species	Spatial geometry and arrangement of patch types	Disturbance regimes, nutrient and energy flows, biomass productivity, patch dynamics

The basic elements in the table can be illustrated easily. Thus, *diversity of the genetic component* refers to the variability within a species, as measured by the variation in genes within a particular species, subspecies, or population. Composition of this component might be measured through allelic diversity; structure through heterozygosity; and function through gene flow. *Diversity of the population/species component* refers to the variety of living species and their component populations at the local, regional, or global scale. Composition of this component might be measured through species abundance; structure through population age structure; and function through demographic processes such as survivorship. *Diversity of the community/ecosystem component* refers to a group of diverse organisms, guilds, and patch types occurring in the same environment or area and strongly interacting through trophic and spatial biotic and abiotic relationships. Composition of this component might be measured through relative abundance of species and guilds within a community; structure through spatial geometry and arrangement of patch types; and function through disturbance regimes (e.g., fire and flood) and flows of water, nutrients, chemicals, and organic matter (MacNally et al. 2002).

2. FACTORS AFFECTING BIODIVERSITY

Natural or human-induced factors that directly or indirectly cause a change in biodiversity are referred to as drivers.

- Direct drivers that explicitly influence ecosystem processes. They include land use change, climate change, invasive species, overexploitation, and pollution.
- Indirect drivers, such as changes in human population, incomes or lifestyle, operate more diffusely, by altering one or more direct drivers.

Some direct drivers of change are easier to measure than others, for instance, fertilizer usage, water consumption, irrigation, and harvests. For other drivers, indicators are not as well developed and measurement data is less readily available. This is the case for non-native species, climate change, land cover conversion, and landscape fragmentation.

Changes in biodiversity are driven by combinations of drivers that work over time, on different scales, and that tend to amplify each other. For example, population and income growth combined with technological advances can lead to climate change.

2.1 Direct driver affecting biodiversity

Different direct drivers are critical in different ecosystems. Historically, habitat and land use change have had the biggest impact on biodiversity in all ecosystems, but climate change and pollution are projected to increasingly affect all aspects of biodiversity. Overexploitation and invasive species have been important as well and continue to be major drivers of changes in biodiversity.

- Natural disturbances (such as fires) or changes in land use (such as road construction) lead to the fragmentation of forests. Such habitat changes have a significant impact on biodiversity, as small fragments of habitat can only support small populations that tend to be more vulnerable to extinction.
- Invasive alien species that establish and spread outside their normal distribution have been a major cause of extinction. This has particularly affected islands and freshwater habitats and continues to be a problem in many areas, as effective preventive measures are lacking. In New Zealand, for example, plants have been introduced at a rate of 11 species per year since European settlement in 1840.
- Over the past four decades, excessive levels of nutrients in soil and water have emerged as one of the most important drivers of ecosystem change in terrestrial, freshwater, and coastal ecosystems. More than half of all the synthetic nitrogen fertilizers ever used on Earth have been used since 1985, and phosphorous uses are now three times what they were in 1960.

  The total amount of nitrogen made available to organisms by human activities now exceeds that from all natural sources combined. Excessive additions of nitrogen and phosphorous to freshwater or coastal marine systems can lead to excessive plant and algae growth (eutrophication) and a lack of oxygen as well as to other environmental problems.

2.2 Indirect drivers of biodiversity change

Five major indirect drivers that influence biodiversity are:

- *Change in economic activity:* Global economic activity is now nearly seven times what it was 50 years ago and it is expected to grow further. The many processes of globalization have been removing regional barriers, weakening national connections, and increasing the interdependence among people and between nations.
- *Population change:* World population has doubled in the past forty years, reaching 6 billion in 2000. The fact that more and more people live in cities increases the demand for food and energy and thereby pressures on ecosystems.
- *Socio-political factors:* The trend toward democratic institutions over the past 50 years has enabled new forms of management of environmental resources.
- *Cultural and religious factors:* Culture conditions individuals' perceptions of the world, and their priority setting, for instance in terms of conservation.
- *Science and technology:* The development and diffusion of scientific knowledge and technologies can on the one hand allow for increased efficiency in resource use and on the other hand provide the means to increase exploitation of natural resources.

2.3 How climate change will affect biodiversity

Recent changes in climate, such as warmer temperatures in certain regions, have already had significant impacts on biodiversity and ecosystems. They have affected species distributions, population sizes, and the timing of reproduction or migration events, as well as the frequency of pest

and disease outbreaks. Projected changes in climate by 2050 could lead to the extinction of many species living in certain limited geographical regions. By the end of the century, climate change and its impacts may become the main direct driver of overall biodiversity loss.

For example, while the growing season in Europe has lengthened over the last 30 years, in some regions of Africa the combination of regional climate changes and human pressures have led to decreased cereal crop production since 1970. Changes in fish populations have also been linked to large-scale climate variations such as "El Nino". As climate change will become more severe, the harmful impacts on ecosystem services will outweigh the benefits in most regions of the world. The Intergovernmental Panel on Climate Change (IPCC) project that the average surface temperature will rise by 2 to 6.4°C by 2100 compared to pre-industrial levels. This is expected to cause global negative impacts on biodiversity.

According to the projections:

- Climate change is likely to exacerbate the loss of biodiversity and increase the risk of extinctions.
- Water availability and quality will decrease in many arid and semiarid regions.
- The risk of floods and droughts will increase.
- The reliability of hydropower and biomass production in some regions will decrease.
- Diseases, such as malaria, dengue and cholera, are likely to become more frequent in many regions and so are other health problems linked to heat stress, malnutrition, and natural disasters.
- Agricultural productivity may decrease in the tropics and sub-tropics, and fisheries may be adversely affected as well.
- Changes in climate, in land use, and in the spread of invasive species will limit both the capability of species to migrate and the ability of species to survive in fragmented habitats.

2.4 Biodiversity change and extinctions

Today many drivers of extinction, such as land use change, emerging disease, and invasive species, are all occurring together and at a greater intensity than in the past. Because exposure to one threat often makes a species more susceptible to a second, and so on, multiple threats may have unexpectedly dramatic impacts on biodiversity.

Species have been going extinct since life began- extinction is a "natural event". The fossil record indicate that, on average, species have come into existence at a higher rate than they have gone extinct, so that biodiversity has been increasing over time. There are five periods in earth's history in which the extinction rate was very high. The most recent was about 65 million years ago when 10% of terrestrial and 15% of marine species went extinct. This was thought to have been caused by climate change effects.

3. WHY BIODIVERSITY IS IMPORTANT

Biodiversity supports many lives and livelihoods. It does this by providing essential services. Biodiversity is:

- A source of harvestable goods including food, medicines and building materials. Some species are renewable resources that we hunt and gather for food and fibre. Domesticated plant and animal species are basic inputs in agriculture, while wild species are important in the pharmaceutical industry.
- Essential for regulation of natural processes and the earth's life support systems, e.g., carbon sequestration, soil formation, waste assimilation and purification of water.

- Essential for pollination of commercially valuable crops and biological control of pests and diseases.
- A source of spiritual and religious enrichment and well-being.

Perhaps most important of all, biodiversity is the basis for evolution and adaptation to changing environments, making it essential for survival of life. Biodiversity values are often underestimated. They include:

- *Economic values*: biodiversity goods and products are sold for income or used as inputs to other economic activities, e.g., ecotourism. Replacement or substitution of the services provided by biodiversity (e.g., engineered flood defence to replace coastal protection by dunes or mangroves) often requires large financial investment.
- *Social values*: employment, health, quality of life, social security, appreciation.
- *Intrinsic values*: in many cultures and societies, all or some components of biodiversity have "intrinsic" value in their own right, irrespective of any material contribution to human wellbeing.

4. CONSERVATION POLICY

Biodiversity conservation can either be *In situ* or *ex situ* conservation. *In situ* conservation is the preservation of the species in their natural habitats, in the wild. It is what we think of when we talk of biodiversity, nature, or conservation. With increased pressure on habitats, and other threats to the survival in the wild, there is now considerable interest to conserve biodiversity in facilities constructed by man i.e. *ex situ* conservation. These include zoos, museums, botanical gardens/arboretums and gene banks.

4.1 Guiding principles for biodiversity conservation

Aim for Conservation and "No Net Loss" of Biodiversity: The biodiversity-related Conventions are based on the premise that further loss of biodiversity is unacceptable. Biodiversity must be conserved to ensure it survives, continuing to provide services, values and benefits for current and future generations. Take the following approach to help achieve no net loss of biodiversity:

- Avoid irreversible losses of biodiversity.
- Seek alternative solutions that minimize biodiversity losses.
- Use mitigation to restore biodiversity resources.
- Compensate for unavoidable loss by providing substitutes of at least similar biodiversity value.
- Seek opportunities for enhancement.

This approach can be called "positive planning for biodiversity." It helps achieve no net loss by ensuring:

- Priorities and targets for biodiversity at international, national, regional and local level are respected, and a positive contribution to achieving them is made.
- Damage is avoided to unique, endemic, threatened or declining species, habitats and ecosystems; to species of high cultural value to society, and to ecosystems providing important services.

Take an ecosystem approach: The CBD advocates an "ecosystem approach" because people and biodiversity depend on healthily functioning ecosystems that have to be assessed in an integrated way, not constrained by artificial boundaries. The ecosystem approach is participatory and requires a long term perspective based on a biodiversity-based study area and adaptive management to deal with the

dynamic nature of ecosystems, uncertainty and the often unpredictable nature of ecosystem functions, behaviour and responses. Biodiversity concerns are not limited to protected areas. Elements of natural systems remain in even the most urbanized cities and play an often important role in the quality of life in those cities.

Seek sustainable use of biodiversity resources: Use impact assessment to identify, protect and promote sustainable use of biodiversity so that yields/harvests can be maintained over time. Recognize the benefits of biodiversity in providing essential life support systems and ecosystem services such as water yield, water purification, breakdown of wastes, flood control, storm and coastal protection, soil formation and conservation, sedimentation processes, nutrient cycling, carbon storage, and climatic regulation as well as the costs of replacing these services. In a developing country context, this principle is likely to be a key priority i.e., for biodiversity to be conserved and protected in this context, it is essential that it is linked to the issue of securing sustainable livelihoods for local people based on biodiversity resources.

Ensure equitable sharing: Ensure traditional rights and uses of biodiversity are recognized in IA and the benefits from commercial use of biodiversity are shared fairly. Consider the needs of future as well as current generations (inter-generational needs): seek alternatives that do not trade in biodiversity "capital" to meet short term needs, where this could jeopardize the ability of future generations to meet their needs.

Apply the precautionary principle: Apply the precautionary principle in any situation where important biodiversity may be threatened and there is insufficient knowledge to either quantify risks or implement effective mitigation. Application of the precautionary principle requires that development consent should be delayed while steps are taken to ensure that best available information can be obtained through consultation with local stakeholders/experts and/or new information on biodiversity can be obtained/consolidated.

Take a participatory approach: Consult widely to ensure that all stakeholders have been consulted and that important biodiversity values are taken into account. Valuation of biodiversity can only be done in negotiation with the different groups or individuals in society (stakeholders) who have an interest in biodiversity. Use traditional and indigenous knowledge wherever appropriate. Work carefully with indigenous communities to ensure that knowledge of biodiversity is not inappropriately exploited.

5. GLOBAL LEGAL INSTRUMENTS FOR BIODIVERSITY CONSERVATION

They encompass the following international conventions which have been ratified by most states:

- Convention on biological diversity (CBD)
- Ramsar convention on wetlands of international importance
- Convention on conservation of migratory species of wild animals
- Convention on international trade for endangered species

5.1 Convention on biological diversity

The Convention on biological diversity (CBD) was opened for signing at UNCED in Rio de Janeiro in June 1992. It has since been ratified by over 180 states. The CBD addresses two distinct but related issues- the conservation of biodiversity and its use by biotechnology. The two issues have a north-south dimension which as clear in its stated objectives and principles.

The convention's objectives as stated in Article 1 are: 'The conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the

utilization of genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies and by appropriate funding.

5.1.1 CBD instruments

CBD establishes a process for its future development in the form of Conference of the Parties (COP). The mandate of the CBD COP is to review progress and to take further steps in the pursuit of the objectives as may be agreed to be necessary in the light of experience. It is also empowered to establish subsidiary bodies and to adopt protocols. Under the convention, parties are required to:

- Prepare national biodiversity conservation plans
- Integrate biodiversity conservation plans into national decision making, encourage in-situ plans.
- Identify biodiversity important for its conservation and sustainable use and to monitor such.
- Establish protected areas and conserve biodiversity in situ
- Control and prevent the influx of alien species that threaten ecosystems.
- Introduce appropriate procedures for impact assessment.

5.2 Convention on international trade in endangered species of wild fauna and flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was signed 1963, and currently it has been ratified by 168 parties. The main aim of the convention is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. It works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction of covered specimen has to be authorized through a licensing system.

5.2.1 CITES instruments

- *Appendix 1:* Includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.
- *Appendix 2:* Includes species not necessarily threatened with extinction, but trade must be controlled in order to avoid utilization incompatible with their survival.
- *Appendix 3:* Contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

6. CONCLUSION

A lot of effort has been put into the design of an international regime to prevent the loss of biodiversity with the hope that continued species extinction may be halted, however much of cooperation is required between different states/countries.

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