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Environmental Security between Technological Challenges and the Right to Development

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Abstract

Environmental security has emerged as a prominent concern at both international and national levels over recent decades, driven by remarkable technological developments that have been among the principal causes of new and evolving environmental challenges. These challenges increasingly threaten environmental security and violate human rights, notwithstanding technology's contribution to development and economic progress. Although human industrial and technological activities are intended to promote well-being, they have increasingly exposed people to violations of the rights to life and health—rights that cannot be effectively enjoyed in an unsafe environment contaminated by various chemical gases and electronic pollutants generated by technological activities. This confirms that pollution has, in effect, become the successor to the famines and epidemics that once threatened human life.

Keywords: Environmental security; technology; industrial development; chemical pollution; the right to development.

Résumé : La sécurité environnementale s'est imposée comme une préoccupation majeure, tant au niveau international qu'national, au cours des dernières décennies, sous l'effet de développements technologiques remarquables qui constituent l'une des principales causes de défis environnementaux nouveaux et évolutifs. Ces défis menacent de plus en plus la sécurité environnementale et violent les droits de l'homme, en dépit de la contribution de la technologie au développement et au progrès économique. Bien que les activités industrielles et technologiques humaines visent à promouvoir le bien-être, elles exposent de manière croissante les populations à des violations du droit à la vie et à la santé — des droits dont la jouissance effective est compromise dans un environnement non sécurisé et pollué par divers gaz chimiques et polluants électroniques générés par les activités technologiques. Cela confirme que la pollution est, dans les faits, devenue le successeur des famines et des épidémies qui mençaient autrefois la vie humaine.

Mots-clés : Sécurité environnementale ; technologie ; développement industriel ; pollution chimique ; droit au développement.

Introduction

The view that security is achieved simply through the absence of wars and military confrontations has been overtaken by events. This is demonstrated by the evolution of the concept of human security over recent decades, of which environmental security is one of the most important components. Harm to the environment has come to be regarded as one of the major threats to the dual objectives of international peace and security. Environmental security has therefore become a central subject in scientific, social and human-sciences research alike, since the environment is a variable examined by numerous disciplines and fields of specialisation.

Environmental concerns have gained prominence at the international, regional and national levels over recent decades as a result of remarkable technological developments. These developments have been among the main factors behind the emergence and crystallisation of environmental challenges that threaten environmental security and violate human rights, despite technology's role in achieving development and economic progress. In other words, although human industrial and technological activities are intended to secure well-being, they have increasingly led to violations of the rights to life and health. Those rights cannot be realised in an unsafe environment permeated by various chemical gases and electronic pollutants generated by technological activities. Pollution has thus become, in effect, the successor to the famines and epidemics that once threatened humankind.

All this has raised the problem of balancing the right to technology, the right to a healthy environment and, thirdly, the right to development, all of which are enshrined in international instruments and domestic laws. How, then, can human aspirations for technological and technical progress in pursuit of economic development—based on the exploitation of natural resources—be reconciled with the environmental challenges generated by industrial activities?

To address this research problem, this paper examines the following themes:

1. Theme One: The conceptual and legal framework of environmental security, the right to technology and the right to development.
2. Theme Two: The relationship between environmental security, technology and development.
3. Theme Three: The effects of technological development on environmental security.
4. Theme Four: Means of preventing environmental harm and protecting environmental security amid the demands of development and the challenges of modern technology.

I. The Conceptual and Legal Framework of Environmental Security, the Right to Technology and the Right to Development

Over recent decades, human rights have undergone notable development at both national and international levels. Among the rights that have received increasing legal attention are the right to development, the right to the environment and environmental security, and the right to technology. These are commonly classified as solidarity rights or third-generation rights. The following three parts explain the meaning of the right to the environment and environmental security (first), the right to technology (second), and the right to development (third).

1. The Right to the Environment

Concern for the environment increased during the final three decades of the twentieth century, as people became more aware of the grave dangers to which their environment was exposed. The human right to a clean environment consequently emerged as a newly recognised right that attracted broad attention and resonated at the international level. Before examining the meaning of the right to the environment, it is useful to consider the linguistic and terminological meanings of the term “environment”.

1.1. The Terminological Definition of the Environment

Although the term “environment” is widely used, neither legal scholarship nor legislation has agreed upon a uniform definition. It is one of those concepts that may appear easy to grasp yet prove difficult to define precisely. One scholarly definition describes the environment as “the framework in which human beings live, from which they obtain the essentials of life, including food, clothing, medicine and shelter, and within which they conduct their relations with other human beings.”

For Ibn Khaldun, the environment is the place in which human beings live and which contains all their needs, which they may exploit directly or indirectly through changes required by the circumstances of livelihood and civilisation. [1]

At the legal level, the 1972 Stockholm Conference adopted a broad understanding of the term “environment”. It came to signify more than natural elements such as water, air and soil, minerals, energy sources, plants and animals. Rather, it was understood as the stock of material and social resources available at a particular time and place to meet human needs and aspirations. [2]

The environment was thus recognised as a human right beginning with the 1972 Stockholm Conference and the conference held in Strasbourg in 1979. The right was also enshrined in several international agreements, including the Vienna Convention for the Protection of the Ozone Layer and its associated Montreal Protocol of 1985. [3] This right has also been expressly recognised in the constitutions of many countries, including Article 68 of the Algerian Constitution of 2016.

1.2. Environmental Security

Environmental security means protecting the environment and natural resources against depletion, extinction and loss resulting from hazards, pollutants and deliberate offences against the development of natural sources and resources, as well as against the disruption of ecological balance. It therefore encompasses the efforts undertaken by states and individuals to achieve well-being and social progress and to protect citizens from risks. In practical terms, this means protecting the surroundings in which people live, together with their resources, by stopping pollution, limiting environmental degradation and deterioration, and ensuring the optimal use of natural resources.

2. The Meaning of the Right to Technology

The term “technology” has become common in everyday life and is now used almost daily, owing to the remarkable development that technology has undergone. This is particularly evident in the demands of developing countries that they too should have the right to acquire technology and benefit from its advantages. In order to determine the meaning of the right to technology, it is first necessary to clarify the term “technology”.

2.1. The Terminological Meaning

The meaning of the term “technology” varies from one field to another. Technology as understood in legal sciences is not identical to technology in economics or in applied sciences, as explained below.

2.2. The Economic Meaning

Economists define technology as the application of knowledge throughout the stages of production, from the research stage through to the sale of basic components. Such knowledge may take different forms, ranging from scientific theory to the art of selling at the level of enterprise management. [4]

2.3. The Legal Definition

From a legal perspective, technology has not been defined in dedicated legislative provisions. It has, however, been addressed in international law because it has been the subject of transfers effected through contracts or agreements.

Dr Mohsen Shafiq defines technology as "a body of information relating to how a scientific theory or invention is applied", a concept commonly referred to as "know-how". [5] Technology may therefore be understood as "the organised effort to use the results of scientific research to develop the methods by which production processes are performed". The term has acquired a broader modern meaning. Under this understanding, technology is, in brief, "the totality of means used by human beings to exercise control over their surrounding environment, harnessing the materials and energy found therein to serve their needs—such as food, clothing and transport—and the various means that provide them with a prosperous, civilised and secure life". [6] Some Egyptian legal scholars regard technology as a new scientific approach based on the design and preparation of devices through which theoretical knowledge can be translated into practical application. [7]

The right to technology has also received international recognition. Article 13 of the Charter of Economic Rights and Duties of States, adopted in 1974, provides that "every State has the right to share in scientific and technological progress and innovation in order to accelerate its economic and social development".

3. The Concept of the Right to Development

Development has become one of the issues attracting the greatest global attention over recent decades, particularly among countries of the Third World, which have also aspired to provide their peoples with well-being and economic, social and cultural progress. Development has become an appealing theme in political discourse and slogans and a major focus of socio-economic reform projects. More than that, it has been recognised as a collective human right protected by international and domestic instruments. Accordingly, this section examines the definition of development and its status in international law.

3.1. Definition of Development

The concept of development overlaps with and is closely related to several other concepts, including evolution, progress, modernisation and even industrialisation, given that the countries that have achieved the highest levels of development are industrialised countries. [8] Development may therefore be defined as "a comprehensive economic, social, cultural and political process aimed at the continuous improvement of the well-being of all peoples without discrimination". [9] Development has also been defined as the revitalisation of the national economy and its transformation from a state of stagnation and stability into a dynamic phase, through a measurable annual increase in gross national product, accompanied by changes in production structures and methods, employment levels and greater reliance on the industrial and craft sectors, alongside a decline in traditional activities. This entails a transformation of the economic structure towards an industrial economy. [10]

Some scholars consider development, in its simplest sense, to mean "the elimination of underdevelopment". [11] Underdevelopment has multiple dimensions, and eliminating it in one field may cause or intensify underdevelopment in another. For example, overcoming technological backwardness may give rise to environmental hazards and health problems that are difficult to remedy, unless the environmental dimension is incorporated into technological and industrial processes.

3.2. International Recognition of the Right to Development

With regard to international recognition of the right to development, the United Nations, through its General Assembly, has given this right considerable attention. The Assembly adopted the Declaration on the Right to Development in Resolution 41/128 of 1986, which expressly states that "the right to development is an inalienable human right". However, this right did not feature on the agenda of international conferences until the 1990s, including the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 and the United Nations Conference on Development in Copenhagen in 1995. In 1997, the General Assembly voted to regard this right as complementary and equal to the rights contained in the Universal Declaration of Human Rights and the two international human rights covenants. It is therefore considered part of the supplementary body of human rights instruments. [12]

II. The Relationship between Environmental Security, Technology and Development

If development in all its dimensions represents the foremost aspiration of peoples and individuals, technology and industry are the principal instruments for creating and achieving it. At the same time, technology and industry cannot exist without an environment rich in natural resources and mineral wealth, which constitute the fundamental drivers of technological processes, particularly industrial ones. This indicates that environmental security, industrial and technological development, and development more generally are interconnected variables. It therefore raises the question: what is the nature of this relationship?

Human life began in a relationship with the terrestrial environment in which people initially sought to protect themselves from the environment's domination and harshness. As science developed and discoveries emerged, however, this relationship gradually changed in the opposite direction: human beings became the dominant force shaping and directing the environmental system. This eventually gave rise to calls for environmental protection [13] against the consequences of human activities, which have increasingly contributed to environmental degradation.

In light of the remarkable scientific progress taking place around the world, there is now broad agreement among scholars that technological progress is one of the most important factors responsible for economic growth, and perhaps the most important of all. [14] This technological and industrial development rests on mineral wealth, the depletion of which has steadily increased over recent decades because of the rapid pace of technological and industrial expansion. This trend has become a threat to both the environment and human beings and foreshadows scarcity for future generations, since these resources are non-renewable. [15]

The environment is therefore the source of the raw materials on which technological and industrial development depends. Industry and technology, in turn, are the principal drivers of development, which encompasses various dimensions of human life: economic, social, political, cultural and health-related. These dimensions cannot be achieved in an unhealthy environment permeated by pollutants, whether natural or industrial, in which human beings cannot live in good health. Since human beings are the primary beneficiaries and focus of development, the relationship between technology, environmental security and development is one of interdependence. There can be no development without technology, no technological progress without raw materials obtained from the earth as a component of the environment, and no environmental security that protects both human beings and their surroundings without the rational use of these resources—in other words, without environmentally friendly technology.

At its seventh special session, held in September 1975, the United Nations General Assembly decided that a United Nations conference should be convened in 1978 or 1979 on the application of science and technology for development. Its principal objectives were to strengthen the technological capacities of developing countries so that they could apply science and technology to their development, and to adopt effective measures for using scientific and technological capabilities to solve development problems of regional and global importance, particularly for the benefit of developing countries. [16]

With regard to industrial and technological development, two groups of countries may be distinguished. The first consists of countries that have exploited their mineral and environmental resources in technological activities and industrial innovation by using technological capacities and techniques that protect the environment; these countries have achieved development and economic progress. The second group consists of countries that have exploited their mineral wealth for technological activities without taking the environmental dimension into account. As a result, they have deepened their own underdevelopment and obstructed their development prospects. [17] In these countries, environmental degradation has increased and ecological balance has been disrupted because of the irrational exploitation of environmental resources and industrial and technological activities that entirely disregard the environmental dimension. Today, as awareness of the dangers of air and water pollution and other similar factors has grown, some leading physicians have advanced the theory of human ecological adaptation. This theory requires viewing the individual as part of an integrated system whose health depends on numerous external factors. [18]

In the present era of rapid technological and technical progress, with which people interact daily, it is impossible to deny technology's contribution to advancing development in many fields. Economic development has been among the greatest beneficiaries of this extraordinary progress, which has become increasingly difficult to control or halt. One study showed that approximately 50 per cent of the increase in per capita national income in Japan was attributable to technological progress in its broad sense, which Japan achieved over a relatively short period. [19] Nevertheless, technological and developmental progress has often affected the environment adversely, particularly in developing countries that have excessively relied on technology transfer in order to achieve economic development at the expense of the environment. This has led to the depletion of natural resources used as industrial raw materials, without regard for the rights of future generations to those resources. Such activities have also generated new forms of pollution. Industrial emissions, for example, have released toxic gases that damage human health. Development thus becomes an empty undertaking when its driving forces violate environmental security and the human right to a healthy environment.

Some may believe that environmental security and environmental protection are incompatible with the objectives of development and technological progress, given the environmental problems that have emerged during different stages of development. Developing countries have sometimes considered the allocation of resources, costs and programmes to environmental protection an obstacle to development. They have also viewed the conservation of natural resources as an attempt to keep developing countries at low levels of development. [20]

III. The Effects of Technological Development on Environmental Security

Technological development has brought people many benefits, increasing their well-being and generating material gains. At the same time, however, it has deprived them of comfort and exposed them to ailments and diseases by turning their living environment into an unsafe space filled with various forms of pollution. This has prompted specialists and concerned stakeholders to sound the alarm and call for measures to curb the expanding tide of industrial pollution.

Technology has not succeeded in overcoming environmental problems; rather, these problems have in many cases outpaced and overwhelmed technological solutions. [21] The following sections discuss the principal types of pollution that have accompanied the remarkable technological development experienced by humankind.

1. Electromagnetic Pollution

Electromagnetic pollution is a form of electronic pollution that has increased over recent decades as individuals have come to use electronic devices more frequently in almost every aspect of daily life.

This type of pollution results from electromagnetic waves that fill the air around us. Such waves originate in the electronic and electrical devices commonly used in households. They are also emitted by high-voltage networks that transmit electrical energy, including power and booster stations, transformers, motors and high-capacity generators in factories; radio and television transmission and broadcasting equipment and relay stations, whether on Earth or in space; satellites, spacecraft, radar systems and computers; and household electrical appliances such as radios, televisions, air conditioners, refrigerators and washing machines. [22] All these sources contribute to filling the surrounding atmosphere with electromagnetic waves. If we were able to see them, we would observe them intertwining everywhere around us, like fog or smoke, because of their abundance. [23]

Since most stimuli are transmitted through the nerves by means of specific electrical impulses, it is believed that such waves and fields may somehow interfere with brain function and affect the human nervous system as a whole. [24]

2. Electronic Waste

Manufacturing companies produce millions of electronic devices every day. As a result, people have become almost constantly engaged with electronic equipment that has come to dominate daily life. Although physicians have generally agreed that excessive use of these devices can harm human health, the danger increases when the devices reach the end of their useful life and become electronic waste. Electronic waste is defined as “all devices that operate through electric current or electromagnetic fields, such as computers and telephones, which are discarded either at the user’s choice, because they have become defective, or because their useful life has expired, and are then disposed of as waste”. [25] Professor Kamal Sharqawi Ghazali defines it as “all the hazards and harms arising from electronic devices”. [26]

Although industrialised countries are the primary sources of electronic equipment, it is regrettable that they dispose of electronic waste by exporting it to Third World countries at very low prices, claiming that this is a form of assistance. Their strict laws prohibit the uncontrolled disposal of this type of waste because of the environmental damage it causes. The waste is consequently exported aboard ships to countries in Asia and Africa, where it falls into the hands of workers in the recycling sector, exposing them to its hazards. [27]

This type of waste is among the most dangerous threats to environmental security because of the hazardous substances contained in electronic equipment. This is particularly true of mobile phones, which have become accessible to almost everyone, including young children, and are now among the electronic devices most frequently used by people.

One factor that has increased the risks associated with mobile phones is their use of coltan. [28] The extraction of this mineral from mines causes serious health and environmental problems. Several reports issued by the United Nations and the International Union for Conservation of Nature in 2001 and 2002 condemned illegal mining operations involving coltan in the Democratic Republic of the Congo. These reports drew attention to the high number of worker fatalities in the mines and to the role of such operations in destroying forests and streams, as well as in the slaughter of animals hunted by miners in their search for food. [29]

Coltan extracted from these sites is transported by aircraft and then sold to major transnational corporations in North America, Europe and Asia, without due regard for the serious risks caused by its extraction. In a report issued in 2001, the International Union for Conservation of Nature urged the governments of the world and the international community to refrain from purchasing coltan. [30]

Electronic waste also presents serious risks because small components of discarded devices may contain toxic substances such as lead and mercury. These substances remain in the soil for long periods, rendering land unsuitable for agriculture, and may enter the human body through the food chain. Glass, plastic, solid carbon and toxic chlorine gas—among the major components of such waste—are difficult to dispose of or recycle, making them a persistent source of environmental pollution. [31]

The 1989 Basel Convention, which sought to prohibit the transfer of electronic waste to poor developing countries, provided for protective legislation for workers in the electronic industries, particularly those involved in refurbishing or dismantling used electronic devices in developing countries. Surprisingly, however, most industrialised countries had not signed the Convention at the time described in the source study, and the problem consequently continued to worsen. A study conducted by an organisation known as the Basel Action Network found that at least 100,000 computers entered the Nigerian port of Lagos every month; approximately 75 per cent of these were televisions, computer processors and mobile phones that no longer worked—in other words, electronic waste. [32]

3. Chemical Pollution

Scientific and technological development has affected contemporary lifestyles. The use of electronic devices has increased extraordinarily across many fields, while lifestyles have also changed as people have come to consume a wide range of manufactured products containing chemical substances. These products may achieve their intended purpose in less time, but the convenience they provide is temporary and short-lived in view of the future risks posed by industrial chemicals, which increasingly harm both the environment and human beings. Chemical pollution has consequently become one of the most dangerous forms of pollution to attract attention in recent years. Industrial facilities contribute to the deterioration of ecosystems through the vapours, impurities and gases released from their chimneys. A number of chemical substances are highly toxic and relatively persistent, making them difficult to eliminate or to neutralise in terms of their harmful effects. These include the following:

3.1. Synthetic Detergents

Two types of detergents may be distinguished. The first consists of non-persistent detergents, which are easily oxidised and eliminated and are known as “soft detergents”. The second consists of persistent detergents, known as “hard detergents”, which resist decomposition and breakdown under normal conditions. They are therefore difficult to eliminate and cause substantial environmental damage because their effects remain for long periods, regardless of the degree to which they are diluted in river or sea water. Water containing synthetic detergents also contains phosphorus compounds, which are dispersed through laundry wastewater. According to a United States statistic, approximately 70 per cent of the phosphorus compounds found in the waters of many lakes and rivers originate in washing water containing synthetic detergents. [33]

3.2. Heavy Metals

Pollution by heavy metals such as mercury, lead and zinc represents a major problem. Mercury is the most widespread and most toxic of these metals. When some of these metals, or their compounds, seep into rivers and lakes through industrial wastewater, they cause considerable harm to the various organisms that depend on those waters. [34]

3.3. Chemical Pollution Resulting from Industrial Accidents

Despite advances in chemical-industry technology in the contemporary era, such advanced technology has not been able to eliminate the hazards arising from industrial chemicals, which pose a serious threat to the environment and to human health and life. The most famous incident in this regard is the Bhopal disaster in India, which resulted from the leakage of methyl isocyanate gas, used in the manufacture of pesticides. The incident caused the deaths of more than 2,000 people; the source manuscript also reports birth defects affecting 30 per cent of newborns and a mortality rate of 25 per cent among them. [35]

3.4. Pollution Caused by Petroleum Waste

The pollution of seas and oceans by petroleum oil is a relatively recent phenomenon, which human beings came to encounter during the second half of the twentieth century, following the widespread extraction and use of petroleum, which became one of the most important energy sources. There are several causes of oil pollution in seas and oceans. It may result from maritime accidents involving oil tankers or from accidents that sometimes occur during drilling operations to extract petroleum from offshore wells. Such pollution may also occur when oil tankers discharge waste and petroleum residues while sailing on the open sea.

3.5. Nuclear Pollution

Nuclear pollution is one of the new hazards to which humanity was exposed during the second half of the twentieth century. It threatens all elements of the environment as well as human life. People became aware of the devastating effects of nuclear radiation following the atomic bombings of Hiroshima and Nagasaki in Japan in 1945. [36]

Among the most dangerous sources of radioactive pollution are nuclear tests. Some major powers continued conducting such tests in order to develop their atomic weapons and increase their destructive capacity to the greatest possible extent. This resulted in the release of large quantities of radioactive dust containing fission products into the atmosphere over the areas where the tests were conducted. Winds also carried some of this radioactive dust, causing it to fall over many areas surrounding the test sites.

The proportion of nuclear dust in the atmosphere was notably high in the period before 1960, as many members of the nuclear club conducted tests to develop their nuclear weapons. This proportion subsequently declined considerably as a result of the work of certain United Nations bodies, including the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), which began its work in 1956 and succeeded in establishing a form of restriction on the conduct of nuclear tests from 1962 onwards.

3.6. Noise Pollution

Noise is a relatively new element of environmental pollution. It is not widespread everywhere, but is concentrated particularly in industrial areas and densely populated settlements where buildings are crowded together and population density is high.

Noise has many sources. One of its principal causes is the tens of thousands of cars and other means of transport moving along urban roads. Other sources include machinery used for excavation and construction, as well as noise generated by various commercial premises and small industrial workshops, such as carpentry shops, foundries and car-repair workshops. Although city residents can perceive air pollution and fear its effects on their health, they often pay little attention to the noise and din surrounding them.

Noise pollution differs from other forms of environmental pollution in that its effects cease as soon as the noise stops; that is, it does not leave a clearly identifiable residue in the environment. [37]

3.7. Acid Rain

Acid rain is considered one of the principal threats to environmental security. Its emergence accompanied the Industrial Revolution in the mid-nineteenth century. The British chemist Robert Angus Smith was the first to address it in a report in 1972, in which he linked factory chimneys in Manchester, England, to the acidity observed in rainwater falling in the surrounding areas. [38]

Acid rain refers to precipitation containing high concentrations of nitric acid and sulphuric acid. Human activities are the source of this phenomenon, particularly the burning of fossil fuels in coal-fired power stations, as well as industrial plants and motor vehicles.

Acid rain particularly affects lakes, rivers, wetlands and other aquatic environments. It increases the acidity of water, making it capable of absorbing aluminium, which then passes from the soil into lakes and streams. The water consequently becomes toxic to a number of aquatic animals. [39]

IV. Means of Preventing Environmental Harm and Protecting Environmental Security amid the Demands of Development and the Challenges of Modern Technology

The major scientific advances achieved by humankind over recent decades have exceeded expectations. People now interact with technology almost continuously, and the fields in which it is used have expanded alongside human activities, particularly as people increasingly aspire to achieve different forms of development, now regarded as a fundamental demand of societies. Yet the human obsession with development and excessive use of technology, sometimes without regard for the environmental dimension, have contributed to the worsening of environmental problems and hazards that threaten environmental security. People have come to recognise these dangers after finding themselves trapped in a vicious circle: they sought development through technology, but the irrational use of that technology has undermined their environmental and health rights. This has prompted a search for preventive and protective measures for the environment in light of current environmental, technological and developmental conditions, including the following:

1. Incorporating the Environmental Dimension into Industrial Processes

Electronic pollutants have become a major threat and concern for environmental security because of their adverse effects on ecological balance. Governments, states, civil-society organisations and individuals have increasingly recognised this problem and called for the environmental dimension to be incorporated into industrial activities. Manufacturing companies have consequently begun to introduce systems and programmes that contribute to environmental protection. Some industrial companies have taken positive steps in this field. For example, Dell, a computer manufacturer, recalled four million laptop batteries from the market after discovering that they could cause fires. Dell also took further steps to encourage consumers to return their old devices for recycling. In 2006, the company announced that it would begin accepting and recycling its old products free of charge, without requiring consumers to purchase new computers from Dell. [40] In the field of environmental protection, Dell has also worked to package its award-winning products using plastic waste recovered from the oceans, beginning on 30 April 2017. The company also added guidance information to its product packaging to raise global awareness and promote joint efforts to find solutions that protect the health of marine and ocean ecosystems. [41]

2. Adopting Cleaner Production Technology

Cleaner production means the continuous improvement of industrial processes, products and services in order to reduce the consumption of natural resources, prevent air, water and soil pollution at source, and reduce the amount of waste generated at source, thereby limiting the risks to humankind and the environment. [42]

The Kyoto Protocol is considered one of the most important agreements calling for cleaner production. It required 38 developed countries to reduce greenhouse-gas emissions by percentages that varied from one country to another over a specified period beginning in 2008 and ending in 2012. The reductions were set at 8 per cent for the European Union, 7 per cent for the United States and 6 per cent for Japan, relative to 1990 emission levels. [43]

3. Recovering and Adding Value to Recyclable Waste

Waste constitutes a mine of secondary raw materials, and its recovery and valorisation represent an economic necessity for our country. Failure to recover and valorise waste not only harms the environment but also causes economic losses. In this context, Article 7 of Law No. 01-12 enshrines this principle and treats it as an obligation incumbent upon the producer or holder of industrial waste. Such a person is legally required to ensure the valorisation of waste generated by materials that they import or market, or by products that they manufacture. This valorisation must comply with environmental conditions and standards, must not endanger human or animal health, must not pose a risk to water resources or living organisms, and must not diminish the value of significant landscapes and sites. [44]

4. Rational Use of Mineral and Energy Resources

The use of mineral resources must be economical and must take account of future generations' rights to these resources and minerals. Energy sources should also be diversified, including solar energy, wind energy, hydropower, and energy derived from tides and the movement of water in seas and oceans. It is now possible to obtain fuel from waste with a calorific value equivalent to half that of coal. The plants that produce such fuel are known as "materials recovery plants" and are now widespread in the United States. [45]

5. Reducing Industrial Noise

Industrial noise may be reduced by installing specially designed barriers at selected angles around machinery or by placing sound-insulating materials on the walls of premises so that they absorb part of the noise generated by the machinery. [46]

6. Promoting Environmental Awareness

Citizens should be educated about the importance of the environment and the need to protect it. This can be achieved by encouraging them to preserve used, damaged and empty tools, machines and containers and to send them to designated collection points, from which they can be transferred for recycling and reuse.

7. Integrating Environmental Thinking into Curricula and Educational Programmes

Environmental concepts should be incorporated into curricula and educational programmes, and environmental clubs should be established in educational institutions in order to instil an environmental culture in society and nurture a generation that lives in harmony with the environment.

8. Adopting the Principle of Environmental Kindness

Being considerate towards the environment means benefiting from it while also preserving it. The Arabic term used for this concept combines the meanings of benefit and gentleness. This reflects the Islamic conception of practical conduct in dealing with the environment.

9. Entrenching the Environment as a Social Value

The environment should be firmly established as a social value that must be preserved and regarded as a human necessity.

Conclusion:

Working to achieve environmental security does not in any way mean obstructing development or rejecting the acquisition of technology. In an era of extraordinary and accelerating technological progress, it has become difficult for any individual to keep abreast of every new development. Recent studies have shown that environmental security, development and technological progress have all become indispensable to the continuation of human life in well-being and prosperity. These three variables are interdependent. Technological progress cannot take place without an environment rich in natural resources. However, the exploitation of those resources must not reach the point of depletion; rather, they must be used rationally and prudently in order to implement development projects while ensuring that the environmental dimension is duly taken into account in those projects.

Findings:

1. Contemporary evidence demonstrates that environmental security, development, and technological progress form an indivisible, interdependent equation essential for the continuation of human life and prosperity.
2. Ensuring environmental security by no means implies obstructing development or rejecting the acquisition of technology; rather, it aims to establish a sustainable balance between them.
3. The excessive and irrational exploitation of natural resources—which support technological activities—inevitably threatens environmental security and depletes the resources of future generations.
4. It has become a necessity to integrate the environmental dimension as a core and fundamental element into all industrial and technological development projects to ensure their sustainability without harming the ecosystem.

Recommendations:

1. The necessity of utilizing natural resources rationally and prudently when implementing developmental and technological projects to prevent them from reaching the point of depletion or degradation.
2. Enacting national and international legislation that keeps pace with massive technological acceleration and obligates industrial institutions to comply with environmental protection and security standards.
3. Encouraging scientific research and studies that seek to develop clean and sustainable technologies (such as green technologies) that serve development without polluting the environment.
4. Establishing international and domestic oversight mechanisms to ensure that newly developed projects do not conflict with international obligations regarding the protection of environmental security and human rights.

Future Horizons:

Looking toward the future, the relationship between environmental security and technological advancement opens vital horizons for further legal and empirical research. As artificial intelligence, green technologies, and industrial automation continue to evolve at an unprecedented pace, future legal frameworks must anticipate emerging environmental risks rather than merely react to them. Establishing proactive international standards, strengthening global environmental governance, and integrating ecological safeguards into future technological treaties will be paramount to ensuring that human progress safeguards—rather than compromises—the planet's ecological balance for generations to come.

Notes

[1] Ibn Khaldun, The Muqaddimah, 6th ed. (Beirut, Lebanon: Dar al-Qalam), pp. 382, 389.

[2] The United Nations Conference on the Human Environment was held in Stockholm, Sweden, in 1972. Despite disagreements between developed and developing countries, the state of the environment, the future of development and human survival were considered to be at risk as a result of growing

environmental threats. The Conference adopted the instrument known as the Stockholm Declaration and is regarded as a historical turning point in the development of environmental protection. See Rashid Al-Hamad and Muhammad Saeed Sabarini, The Environment and Its Problems, The World of Knowledge Series, p. 24.

[3] Aisha Lazreq, International Economic Sanctions and Their Impact on Human Rights in Iraq, Master's thesis, University of Hassiba Benbouali, Chlef, Faculty of Law and Political Science, 2014–2015, p. 90.

[4] Ibid., p. 23.

[5] Ahmad Barakat Mustafa, Commercial Contracts and Banking Operations, 1st ed. (University Book Publishing and Distribution Centre, 2006), p. 176.

[6] Muhammad al-Sayyid Abd al-Salam, Modern Technology and Agricultural Development in the Arab World, The Encyclopaedia of Knowledge, 1982, p. 54.

[7] Nasira Boujemaa Saadi, op. cit., p. 23.

[8] Osama Abd al-Rahman, Oil Bureaucracy and the Development Dilemma: An Introduction to the Study of Development Administration in the Oil-Producing States of the Arabian Peninsula, The World of Knowledge Series, 1982, p. 98.

[9] Omar Saadallah, Human Rights and the Rights of Peoples (Algiers: University Publications Office, Ben Aknoun), p. 249.

[10] Osama Abd al-Rahman, op. cit., p. 14.

[11] Ibid., p. 19.

[12] Omar Saadallah, op. cit., p. 249.

[13] Ibid.

[14] Antonios Karam, The Arabs Facing the Challenges of Technology, The World of Knowledge Series, November 1989, p. 43.

[15] See Muhammad Fathi Awadallah, The Human Being and Mineral Wealth, The World of Knowledge Series, September 1988, p. 29.

[16] Muhammad al-Sayyid Abd al-Salam, op. cit., p. 76.

[17] Muhammad Fathi Awad, op. cit., p. 31.

[18] Saeed Muhammad al-Haffar, Biology and the Fate of Humankind, The World of Knowledge Series, p. 44.

[19] Antonios Karam, op. cit., p. 43.

[20] Ibid., p. 167.

[21] Rashid Al-Hamad and Muhammad Saeed Sabarini, op. cit., p. 136.

[22] Kamal Sharqawi Ghazali, Electronic Pollution: The Hidden Pollution, Scientific Culture Series, 2013, p. 92.

[23] Ahmad Fouad Basha, The Ethical Dimension of Contemporary Environmental Challenges, article published online.

[24] Ahmad Medhat Islam, Pollution: The Problem of the Age, The World of Knowledge Series, 1990.

[25] Al-Arabi Omar Dawaji, 'Electronic Environmental Security', paper presented at the National Symposium on Mechanisms for Defence against Major Natural and Technological Hazards in Algerian Law, Faculty of Law and Political Science, Chlef, 1–2 December 2014.

[26] Kamal Sharqawi Ghazali, op. cit., p. 19.

[27] A recent statistical report by an American university indicated that US companies dispose of approximately 50 million relatively old computers by exporting them to China, Pakistan and India, where a new industry for refurbishing obsolete computers has emerged. See Ahmad Fouad Basha, The Ethical Dimension of Contemporary Environmental Challenges.

[28] Coltan is used because of its high resistance to heat and corrosion, as well as its flexibility.

[29] Ahmad Fouad Basha, op. cit.

[30] Ibid.

[31] Article entitled 'An Environmental Determination of the Effects of Electronic Pollution', jesusch.yoo7.com (as cited in the original manuscript).

[32] Ahmad Fouad Basha, op. cit.

[33] Ahmad Medhat Islam, op. cit., p. 102.

[34] Ibid., p. 103.

[35] Ibid., pp. 117–118.

[36] Ibid., p. 163.

[37] Ibid., p. 176.

[38] Rashid Al-Hamad and Muhammad Saeed Sabarini, op. cit., p. 69.

[39] 'Acid Rain: What Is It and What Are Its Effects?', Syrian Researchers.

[40] Al-Arabi Omar Dawaji, op. cit.

[41] 'Dell Begins Shipping Its Devices in Packaging Made from Ocean Plastic Waste', article published on the website given in the original manuscript as: // www.webmaster4it.com.:http (URL reproduced as supplied).

[42] Al-Aliyah Manad, The Importance of Green Products in Environmental Protection: A Case Study of France, Master's thesis, Faculty of Economic, Commercial and Management Sciences, 2013–2014, p. 62.

[43] The Kyoto Protocol was signed on 16 February 1997 by 159 states and represented a qualitative step forward in environmental protection and the globalisation of environmental awareness. It established two groups of commitments: the first applied to all signatory states, while the second applied to industrialised and polluting states. The United States refused to ratify the Protocol in 2001, although it accounted for 21% of global emissions, arguing that the instrument was unfair to it and that China and India were implementing major industrialisation programmes and polluting the environment without being subject to the same obligations because they were developing countries. Ibid., p. 63.

[44] Muhammad al-Hajj Issa Ben Saleh, The Legal Framework for the Protection of Coasts from Industrial Waste under Algerian Legislation, Master's thesis, University of Algiers Benyoucef Benkhedda, Faculty of Law, 2009, page number not provided in the original manuscript.

[45] Rashid Al-Hamad and Muhammad Saeed Sabarini, op. cit., p. 140.

[46] Ahmad Medhat Islam, op. cit., p. 207.