

The Precautionary Principle in Environmental Law

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Abstract

Global warming is a reality. It is therefore important to take measures to limit greenhouse gas emissions. Then, the precautionary principle has been developed in order to maintain a healthy environment which implies taking adequate and proportionate measures: laws and regulations. The purpose of this study is to dissect the precautionary principle in environmental law in order to highlight its definition and its content before identifying its application. We highlight that this is a difficult principle to understand due to the divergences in its conception. As such, two opposing visions impact its implementation. Thus, the absence of absolute scientific certainty in the said principle poses a dilemma. This is a key characteristic of the precautionary principle. On the one hand, this principle would constitute a brake on economic progress, especially since the measures taken would limit access to the resources necessary for human activity. It therefore constitutes a brake on economic development. On the other hand, this principle allows the establishment of regulatory mechanisms aimed at aligning the interests of companies with those of society in a context where companies often do not have to pay the full costs of damage to the environment and human health. This will then allow us to correct the mistakes of the past. It is therefore about the search for balance between human activity and environmental protection. This therefore results in a differentiated application depending on the position taken, the choice made. This is why the comparative approach was essential for this study.

Keywords

Principle, Precaution, Precautionary Principle, Application, Environment, Law

1. Introduction

Human activities such as the burning of fossil fuels, the exploitation of tropical

forests and the raising of livestock are having an ever-increasing influence on the earth's climate and temperature (Edwards et al., 2019). These activities release huge quantities of greenhouse gases, which are added to those naturally present in the atmosphere, reinforcing the greenhouse effect and global warming.

In fact, certain gases in the earth's atmosphere act like the walls of a greenhouse: they allow solar energy to enter the atmosphere, but prevent it from escaping. Many of these gases are therefore naturally present in the atmosphere, but human activity increases the concentrations of some of them in the atmosphere, in particular: carbon dioxide (CO₂), methane, nitrous oxide and fluorinated gases.

According to the European Commission's study on climate action and the causes of climate change, "CO₂ produced by human activities is the largest contributor to global warming". By 2020, its concentration in the atmosphere had risen to 48% above its pre-industrial level (before 1750). Other greenhouse gases are emitted by human activities in smaller quantities. Methane is a more powerful greenhouse gas than CO₂, but has a shorter atmospheric lifetime. Nitrous oxide, like CO₂, is a long-lived greenhouse gas that accumulates in the atmosphere over decades to centuries. Non-greenhouse gas pollutants, including aerosols like soot, have different warming and cooling effects and are also associated with other issues such as poor air quality.

Natural causes, such as changes in solar radiation or volcanic activity are estimated to have contributed less than plus or minus 0.1°C to total warming between 1890 and 2010" (Causes of climate change (europa.eu)).

In response to this situation, characterized by scientific uncertainty and high stakes, the precautionary principle was introduced, designed to enable decision-makers to take swifter action.

The precautionary principle is one of the solution to address environmental issues.

The current big environmental issue is air pollution: in both developed and developing countries, as technology develops and innovative ideas come through, there is an even greater threat to the increase in air pollution (Gonzalez-Martin et al., 2021), deforestation: as a result of the urban sprawl and increased levels of pollutants, the environment is being damaged and human activities are pushing it towards a point beyond which there's no coming back (Lawrence & Vandecar, 2015), water pollution: the top causes of many life-threatening diseases is a polluted water due to dumping lots of chemicals and plastics in the water sources (Haseena et al., 2017), ozone layer depletion: the main cause of the rise in skin cancer all around the world and the direct contributor to the increase in the temperature of the Earth is ozone layer depletion (Norval et al., 2011), loss of biodiversity: the extinction of several species of plants, animals, birds, insects and other organisms. Since these species play a role in balancing the sustenance on Earth, this loss of biodiversity is creating a huge imbalance that further takes on a chain reaction. Then, the food chain and plant life threatens our ecosystem (Pimm et al., 2014).

First introduced in recent decades, the precautionary principle is still evolving, both in terms of definition and implementation.

It is a principle that is seen by some as an unscientific approach that hinders progress while paving the way for over-regulation. Others, on the other hand, believe that the precautionary principle makes it possible to protect human health and the environment in the face of complex hazards, and to encourage progress that is more respectful of people and their environment. The 1998 ruling by the European Court of Justice in the mad cow case illustrates this trend. The Court rejected the British government's challenge to the March 1996 embargo, stating that "it must be accepted that, where there is uncertainty as to the existence or extent of risks to human health, the institutions may take protective measures without having to wait for the reality and seriousness of those risks to be fully demonstrated" (Case C-180/96, United Kingdom of Great Britain and Northern Ireland v. Commission of the European Communities, 1998).

The debate on the precautionary principle has often been polarized by two opposing visions: on the one hand, "technological pessimism and the fear of sorcerers' apprentices", which would imply strong regulation of industrial activities; on the other, "technological optimism and faith in progress", which would suggest that all regulation is unnecessary.

2. Methods and Methodology

We use the exegetical method, which consists in interpreting legal texts, and the documentary method, which consists in consulting works that have focused on this principle, publications, periodicals and others.

Once we had gathered the relevant information, we had to turn to a comparative method. To better define the precautionary principle, we reviewed a number of international agreements, dissected the divergent positions of institutions such as the European Commission, UNESCO and the European Environment Agency, and highlighted opposing visions. This has set us on the road to applying the principle in the concert of nations, in United States of America, Europe and Burundi.

3. Analysis Results

The precautionary principle has been conceived in different ways by different authors, institutions and/or associations (groupings) of human beings. This is why there is no single definition of the precautionary principle.

Opinions differ as to the method to be used to determine whether precautionary measures should be taken. The precautionary principle does not provide for any measure of its application. This is why it is applied in different ways by different States, communities and/or organizations, whether national, regional or international. Its application presents many challenges, but also opportunities.

In Burundi, this principle is much more evident in legal texts such as the environmental, water and the forestry codes. It should be noted that, although the

legal arsenal exists, it is not enforced. Violations of these legal texts are commonplace, and cases go unpunished.

Nonetheless, there are a number of challenges to be overcome, notably in terms of hazard assessment, research into well-known chemical substances, while the research of emerging substances is still rare, regulations can be a source of legal uncertainty, hampering development, and early signs of dangerousness put companies in economic and financial dilemmas.

4. Discussion of the Results

4.1. The Origins of the Precautionary Principle

The precautionary principle was conceived in German law, under the term *Vorsorgeprinzip* (which can also be translated as “principle of foresight”), during the drafting of air pollution legislation in the 1970s. Since then, it has been taken up at other levels, and its application has been extended to areas other than environmental protection.

4.1.1. International Agreements

At international level, several environmental agreements have referred to the “Precautionary Principle” since the 1980s, starting with articles 2 and 3 of the Vienna Convention for the Protection of the Ozone Layer in 1985, the Ministerial Declaration of the Second International Conference on the Protection of the North Sea in 1987, the Ministerial Declaration of the Third International Conference on the Protection of the North Sea in 1990, and the Rio Declaration on Environment and Development in 1992, which makes “precautionary measures” one of the principles guiding forest management.

Others indicate that the absence of absolute scientific certainty in the said principle cannot be invoked to defer measures, as in the case of the United Nations Framework Convention on Climate Change (Rio Declaration) in its third article, paragraph 3. In France, for example, the French Environment Code (the 1995 Barnier law) specifies in a second formulation that “*the absence of certainty, given the scientific and technical knowledge of the time, must not delay the adoption of effective and proportionate measures aimed at preventing a risk of serious and irreversible damage to the environment at an economically acceptable cost*”. France has thus added the notions of proportionate response and economically acceptable cost to the Rio definition.

It wasn't until the 1990s that the precautionary principle was more or less explicitly enshrined in virtually all international treaties on environmental protection (the 1992 OSPAR Convention and the Helsinki, Convention on the Baltic Sea, the 1985 Vienna Convention and the United Nations Framework Convention on Climate Change, UNFCCC in acronym of 1992, the Fort Lauderdale Resolution of 1994 relating to the CITES Convention, the Convention on Biological Diversity and the United Nations Fish Stocks Agreement, the Revised Management Procedure adopted by the International Whaling Commission in 1994, the Bamako Convention of 1992 or the Helsinki Water Convention of

1992).

Contrary to the European Union's conception, the precautionary principle as a general principle of international law is disputed. Some authors believe that: "the precautionary principle is a non-binding political guideline that is not recognized in customary international law, based in particular on the legal weakness of the precautionary principle in international trade, particularly at the World Trade Organization".

On the other hand, international conventions state that the precautionary principle has been widely adopted at international level, particularly since its inclusion in multilateral treaties such as the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change, making it a general principle of international law¹. In the same vein, the European Commission considers that this principle has undergone a gradual consolidation in international environmental law, making it a genuine principle of international law of general application (Communication from the Commission on recourse to the precautionary principle, 2000).

4.1.2. Within the European Union

At European level, the precautionary principle was enshrined in the Maastricht Treaty in 1992, in article G, B. 3), k. The principle is now enshrined in article 191 of the Treaty on the Functioning of the European Union as one of the principles underpinning the EU's environmental policy. Like the other principles (the principle of preventive action; the principle that environmental damage should as a priority be rectified at source and the polluter-pays principle), it is not defined in the Treaty.

The same principle has been reaffirmed by the judges of the European Union as a general principle of Community law requiring the competent authorities to take appropriate measures to prevent certain potential risks to public health, safety and the environment, giving precedence to the requirements of protecting these interests over economic interests².

Aware that climate change is an important global issue if nothing is done to reduce global greenhouse gas emissions, the European Union has taken several measures:

- Measures to combat climate change and reduce greenhouse gas emissions are therefore a priority. In particular, European leaders are committed to transforming Europe into a highly energy-efficient, low-carbon economy;
- It has also set itself the target of reducing greenhouse gas emissions by 80% - 95% by 2050 compared with 1990 levels (Strategy for a long-term reduction of greenhouse gas emissions in the European Union (europa.eu)).

The EU's first climate and energy package was adopted in 2008, setting targets for 2020. The EU has made good progress towards these targets, but to provide greater certainty for investors, an integrated framework is needed for the period

¹(Article 3 of the Convention on Biological Diversity and Article 3 of the UNFCCC).

²(Artegodan judgment of November 26, 2002 (T-74/00), point 184).

up to 2030.

It's worth pointing out that the European Union and its 27 member states are signatories to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol as well as the new Paris Agreement on Climate Change. According to the Paris climate agreement approved on December 12, 2015, the agreement is intended to be differentiated, fair, sustainable, dynamic, balanced and legally binding.

4.1.3. In the Domestic Law

At national level, several member states of the Maastricht Treaty, in addition to Germany, have enshrined the precautionary principle in their domestic legal ordinances. Other countries, such as France in 2005, have incorporated the precautionary principle into their constitutions. Still others have enshrined it as a guiding principle of their environmental and public health policy, by including it in their environmental code. This was the case in Sweden, for example, in 1999.

The precautionary principle is also recognized by the courts of certain states, provided it has been enshrined in a specific law (Flemish Region Framework Decree of 05/04/1995, Federal Law of 20/01/1999, Regulation 178/2002, Flemish Region Decree of 18/07/2003). In other states, if the provisions in question stem from European legislation, the Courts and Tribunals base their decisions on the precautionary principle. These include countries such as Spain and the United Kingdom.

Apart from the European Union, other countries have formally incorporated the precautionary principle into their environmental policies, such as Australia in 1992 (Demaze, 2009). We'll come back to Burundi in the next few lines.

4.2. Different Institutional Positions on the Same Principle

The European Commission, UNESCO and the European Environment Agency (EEA) are just some of the institutions that have given their positions on the use or application of the precautionary principle. However, their positions diverge because of the different definitions they give to this principle.

4.2.1. Position of the European Commission

In early 2000, the European Commission adopted a Communication on the precautionary principle (Communication from the Commission on the use of the precautionary principle, 2000), in response to a request from the Council (European Council Resolution of June 28, 1999). In this communication, the Commission sets out to define:

- Its guidelines for applying the precautionary principle;
- Establish agreement on how to manage risks that science is unable to fully assess, and;
- Avoid any unjustified use of the precautionary principle as a disguised form of protectionism.

In its definitional approach, the Commission states that invoking or not in-

voking the precautionary principle is a decision taken when scientific information is incomplete, inconclusive or uncertain, and when there are indications that possible effects on the environment or on human, animal or plant health could be dangerous and incompatible with the chosen level of protection (Communication from the Commission on the use of the precautionary principle, 2000).

The commission also pointed out that the precise contours of this principle are a matter for political decision-makers, and ultimately for the courts. It also points out that recourse to the precautionary principle is not a discretionary decision, and presupposes the identification of potentially adverse effects and a scientific assessment of the risk, characterized by uncertainty.

What's more, according to the commission, precautionary measures should respect other principles, in particular:

- The principle of proportionality, particularly in relation to the level of protection sought;
- The principle of non-discrimination;
- The principle of consistency with similar measures adopted previously;
- The principle of cost-benefit analysis of action or lack of action;
- The principle of reconsideration in the light of new scientific data;
- The principle of capacity to assign to a player the responsibility of producing the scientific evidence needed to enable a more complete assessment of the risk (Communication from the Commission on the use of the precautionary principle, 2000).

4.2.2. UNESCO's Position

According to the report by UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), the practical definition of the precautionary principle is: When human activities risk leading to a morally unacceptable danger that is scientifically plausible but uncertain, measures must be taken to avoid or reduce this danger (The Precautionary Principle, World Commission on the Ethics of Scientific Knowledge and Technology, UNESCO, 2005).

In this report, the commission specified that if the hazard threatens human life or health, is truly irreversible, is unfair to future generations, or is imposed without due regard for the human rights of those who suffer it, it is considered morally unacceptable.

To do this, a scientific analysis submitted for review must determine whether the danger is plausible. Thus, the measures taken at the end of a participatory process must be proportional to the seriousness of the potential danger. Moreover, their positive and negative consequences, as well as their moral implications for human life or health, must be taken into consideration (The Precautionary Principle, World Commission on the Ethics of Scientific Knowledge and Technology, UNESCO, 2005).

4.2.3. Position of the European Environment Agency (EEA)

In its 2013 report on the precautionary principle, the European Environment

Agency proposes a definition.

The precautionary principle provides a justification for public policy and other actions in situations of scientific complexity, uncertainty and ignorance, where it may be necessary to act in order to avoid or reduce potentially serious or irreversible threats to human health and/or the environment, using an appropriate degree of scientific evidence and taking into account the advantages and disadvantages of action and inaction as well as their distribution (European Environment Agency, 2013).

It is important to point out that this definition is formulated in an affirmative way, unlike other definitions, notably that of the Rio Declaration. It is a definition that underlines the complexity of biological and ecological systems characterized by multi-causality, where scientific knowledge is uncertain or non-existent.

4.3. Opposing Visions of the Principle

There are two opposing views. On the one hand, the principle is useless because it is based on ideological values, and therefore unscientific. On the other hand, the principle is useful because it can prevent serious, even irreversible, dangers.

4.3.1. Arbitrary and Unscientific Principle

For some, it is a useless and potentially dangerous principle, arbitrary and unscientific (Marchant & Mossman, 2004). It is a principle that could paralyze and threaten human progress, because it is based on ideological but not scientific values.

In their view, the precautionary principle should not be elevated to the status of a principle for the following main reasons:

- The scientific uncertainty of the principle that could logically apply to any activity;
- Its strong conception could not only hinder progress by depriving society of useful products, but also deprive it of a source of knowledge;
- The precautionary principle could lead to the isolation of the European Union on the international stage, hinder world trade and considerably complicate international regulatory cooperation (Hannesson, 2014; Majone, 2002).

4.3.2. Pragmatic Principle

For others, the precautionary principle is a useful way of avoiding complex hazards and reducing serious and irreversible dangers to the environment and human health, including by learning from past mistakes.

Unlike those in the first category, their arguments are based on the following reasons:

- It is a principle that can enable the implementation of regulatory mechanisms aimed at aligning the interests of companies with those of society in a context where companies often do not have to pay the full costs of environmental and health damage;
- It enables a better balance to be struck in public health policies, and overcomes the difficulties associated with scientific demonstration before preven-

tive measures can be justified (Le Menestrel & Rode, 2013).

4.4. Application of the Precautionary Principle

4.4.1. Mechanisms for Taking Precautionary Measures

The precautionary principle does not require or advocate any particular action, even in its strict interpretation. Depending on the different conditions of scientific uncertainty, this principle calls for informed, transparent and responsible decisions. Its application can result in a reversal of the burden of proof, which, according to some authors, is one of its main characteristics. But other authors, more numerous in fact, indicate that such a reversal is a possible consequence of the interpretation made of the principle. In its communication on the precautionary principle, the European Commission took the same view as these second-rate authors (Communication from the Commission on recourse to the precautionary principle, 2000).

The following methods can be used to determine whether precautionary measures should be taken:

- Cost-benefit analysis, taking into account risk probabilities. In its communication, the European Commission states that the screening should include an economic cost-benefit analysis where this is appropriate and feasible, while specifying that other methods of analysis (e.g. socio-economic impact) and non-economic considerations (e.g. health) may be taken into account;
- Risk trade-off is another method sometimes used in administrative law in the United States. However, it has been criticized for overestimating the negative effects of regulation;
- Cost-effectiveness analysis, which aims to achieve, at the lowest cost, a tolerable level of risk previously set by political decision-makers, without however specifying how this level is determined.

In general, the precautionary principle is implemented wrongly. Initially, it is applied to situation where the risk is unknown but potential consequences are extremely grave. Then, it is applied most clearly when the consequences of a failure to act are so great that it may destabilize society or the whole ecosystem and lead to unacceptable permanent consequences. So, that description hardly applied to short term exposure to chemical residues that may provoke individual cancer risks (Guidotti, 2012).

4.4.2. Application of the Principle within the Concert of Nations

Article 3 of the UNFCCC states that, in the measures to be taken by the States Parties to the Convention to achieve the objective of the Convention and to implement its provisions, they shall be guided, inter alia, by the following:

- 1) Preservation of the climate system in the interests of present and future generations, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. It is therefore incumbent on the developed countries party to the Convention to be at the forefront of the fight against climate change and its adverse effects;

2) Consideration of the specific needs and special situation of developing countries: These include countries that are particularly vulnerable to the adverse effects of climate change, as well as developing countries to which the Convention would impose a disproportionate or abnormal burden;

3) Taking precautionary measures to anticipate, prevent or mitigate the causes of climate change and limit its adverse effects. Where there is a risk of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing such measures, it being understood that the policies and measures called for by climate change must be cost-effective, so as to guarantee global benefits at the lowest possible cost. To achieve this aim, such measures and policies should take account of the diversity of socio-economic contexts, be comprehensive, extend to all sources, sinks and reservoirs of greenhouse gases as appropriate, include adaptation measures and apply to all economic sectors. Initiatives to tackle climate change may be the subject of concerted action by interested parties;

4) Measures and policies to protect the climate system from climate change must be adapted to the specific situation of each country and integrated into national development programs, since economic development is essential for adopting measures to deal with climate change;

5) States Parties must work together towards a supportive and open international economic system that leads to economic growth and sustainable development for all Parties, in particular developing country Parties, to enable them to better address the challenges posed by climate change. Measures taken to combat climate change, including unilateral measures, must not be allowed to constitute a means of imposing arbitrary or unjustifiable discrimination or disguised barriers to international trade.

4.4.3. Comparative Analysis of the Application of the Principle in the United States and Europe

Prior to the emergence of the precautionary principle in Europe in the 1970s, the USA applied a generally more cautious approach than Europe. It was not until the 1990s, when Europe adopted a stricter approach than the United States, and enshrined the precautionary principle in the Maastricht Treaty, that the approaches of the two powers converged.

At this moment, there is no real difference in the application of precautionary measures on either side of the Atlantic, i.e. in the USA and Europe. In fact, the only difference lies in the specific subjects to which precautionary measures are applied:

- The European Union has a much more cautious approach to growth hormones in beef than the United States;
- while the United States has taken more precautions than the European Union with regard to mad cow disease. However, some U.S. laws, for example on food safety, apply the precautionary principle without naming it (Klass, 2005).

4.4.4. Application of the Principle in Europe

The precautionary principle is now enshrined in numerous European Union (non-) legislative acts, including Regulation 1907/2006 (REACH Regulation), the Directive on the cultivation of genetically modified organisms (Directive 2001/18/EC), the Regulation establishing the European Food Safety Authority (Regulation 178/2002) and the Regulation on plant protection products (Regulation 1107/2009).

In its reports on the application of the precautionary principle, the European Environment Agency has identified cases where the precautionary principle has been applied to varying degrees. These cases are often linked to chemical substances, effects on ecosystems, technologies or feed additives (European Environment Agency, 2013).

4.5. What about Burundi?

4.5.1. Application of the Principle by the Environment Code

As Burundi's environment is a common heritage, we place particular emphasis on environmental impact assessment.

According to article 21 of law no 1/010 of June 30, 2000 on the environmental code of the Republic of Burundi, in order to minimize or eliminate the short, medium and long-term effects on the environment of developments and works, it is compulsory for tender documents to include an environmental impact study.

Under article 22 of the same code, when developments, works or installations are likely, by virtue of their size, the nature of the activities carried out there or their impact on the natural environment, to harm the environment, the petitioner or project owner must draw up and submit to the environmental authorities an impact study assessing the project's direct or indirect impact on the ecological balance, the environment and quality of life of the population, and the impact on environmental protection in general.

Article 23 of the same code stresses that, without being exhaustive and without prejudice to other requirements that may be formulated by the administration, the following headings must be included in the environmental impact study:

- Analysis of the initial state of the site and its environment;
- an assessment of the foreseeable consequences of project implementation on the site and its natural and human environment;
- A statement and description of the measures envisaged by the petitioner to eliminate, reduce and, if possible, compensate for the harmful consequences of the project on the environment, and an estimate of the corresponding expenditure;
- The presentation of other possible alternatives and the reasons why, from an environmental protection point of view, the presented version of the project has been preferred.

While article 25 of the same code specifies that the environmental impact

study is carried out by the petitioner or project owner himself, or by a natural person or legal entity authorized by the petitioner and acting in the name and on behalf of the petitioner, article 26 reiterates that the environmental administration, in collaboration with the Ministry in charge, monitors the execution by the petitioner or project owner of the measures contained in the environmental impact study, in order to avoid its degradation.

Finally, as stated in article 27 of the same code, failure by the petitioner or project owner to comply with the measures contained in the environmental impact study authorizes the administration to issue a formal notice inviting the petitioner or project owner to comply with the aforementioned measures within a period not exceeding three months. Failure by the petitioner or project owner to comply with the formal notice within the set time limit entitles the environmental authorities either to order the suspension of the operations or works undertaken, or to withdraw the authorization.

It should be pointed out that no compensation can be claimed by the petitioner or the project owner for any loss suffered as a result of these sanctions, unless the irregular nature of the sanctions is reported to the competent court.

4.5.2. Application of the Principle by the Water Code

Article 39 of law no 1/02 of March 26, 2012 on the Water Code in Burundi specifies that, to protect water resources, it calls for preventive or precautionary measures.

The Burundian water code confuses the principles of prevention and precaution.

The matter is organized by articles 41 to 66 of the Water Code set out above.

With a view to protecting water resources, the State has a duty to ensure, in time and space, a balance between the availability of water resources, in quantity and quality, and the needs to be met according to the various uses and functions of water. The protection of water quality and quantity is the responsibility of the State, which may, if justified by the general interest, take special protection measures, in particular by establishing protection perimeters. The Ministry responsible for water management retains the right to order, at any time, any control measures designed to regulate the qualitative and quantitative evolution of water resources within the protection perimeters.

Without prejudice to the protection perimeters that may be required under article 41 of the Burundi Water Code, when water resources are threatened, from a qualitative or quantitative point of view, in one or more specific localities, the Minister responsible for water management may institute water resource protection zones, involving either absolute or relative restrictions on water-related activities, or prior authorization depending on the nature or location of the needs to be met. The purpose of the protection perimeter is to ensure the protection of water quality, whether it comes from groundwater, surface water, rivers or other watercourses.

Within the protection perimeter, deposits, installations and activities likely to

directly or indirectly harm water quality or render it unfit for consumption are prohibited.

The ban mainly concerns the following activities:

- 1) deposits of garbage, refuse and garbage;
- 2) spreading manure, watering, parking or raising animals;
- 3) deposits of hydrocarbons and all substances presenting toxicity risks, in particular chemicals, fertilizers and pesticides;
- 4) open-cast mining of quarries or other mineral substances;
- 5) installation of all types of wastewater pipes;
- 6) installation of cemeteries;
- 7) septic tank sludge disposal.

Qualitative protection must also be provided by means of a protection perimeter:

- 1) dams;
- 2) spring, well or borehole catchments;
- 3) water storage tanks;
- 4) vulnerable parts of the groundwater;
- 5) all bodies of water intended for human or animal consumption.

Furthermore, no abstraction or diversion of surface water that could temporarily or permanently alter its course, hinder its free flow or reduce its bed may be carried out without prior authorization from the Minister responsible for water management.

No one may drill wells or probe for groundwater without prior authorization from the Minister responsible for water management. The duly authorized driller or sounder must provide, at the request of the Minister in charge of water management, information and data relating to his activities.

Nor may any person discharge, dump or deposit water, directly or indirectly, in any manner whatsoever, or, more generally, engage in any act or deed likely to cause or increase pollution of surface or underground water, whatever its origin. The author of the pollution is required to pay compensation in an amount proportional to the degree of pollution caused, without prejudice to the related penal sanctions, especially under the provisions of the Water Code.

It is forbidden to dump corpses in water or bury them within five hundred meters of wells, fountains, public drinking troughs or water protection areas. In areas where the water table is less than two meters deep, it is forbidden to set up cemeteries, bury corpses, dig latrines, set up public dumps or bury waste in such a way as to pollute the water. It should be noted that: "Water resources likely to be polluted due to their location or suspicious activities or behavior in the vicinity are subject to periodic checks of their physical, chemical, biological and bacteriological characteristics.

Development projects and urban planning documents and plans must take into account the drainage and evacuation of rainwater, which are elements of the right to safety and a healthy environment. The design, execution and operation

of structures and buildings for residential or other use, installed in drainage zones or flood-prone areas, must respect the free flow of water. The Minister responsible for water management and the environment has the power to modify or remove any embankment, deposit of bulky materials, fencing, planting, construction or any other work likely to obstruct the flow of water, or to restrict in a harmful way the scope of flooding on the submersible parts of watercourses.

In addition, it is forbidden to build on flood protection dykes, to leave structures or obstacles of any kind on them, or to carry out activities on them that are likely to damage the dykes, hinder the flow of water or restrict the scope of flooding.

Hydraulic structures of national, regional or local importance are protected by the public authorities to prevent any threat to public safety, and are subject to periodic inspection.

Sanitation infrastructure works are subject to the environmental and social impact assessment procedure, and can only be carried out after authorization from the Minister responsible for water and environmental protection.

Domestic wastewater, including kitchen wastewater, black water and septic tank effluent, may not be discharged into storm water drains or sewers, or directly into watercourses and lakes.

4.5.3. Application of the Principle by the Forestry Code

Articles 5, 83, 86, 88, 91, 93, 95, 97, 101, 102, 104 and 106 of law no 1/07 of July 15, 2016 revising the forestry code implicitly return to this principle.

In this way, the protection and development of forests are ensured through rational and balanced management that contributes to the preservation of the environment.

Rational and balanced forest management is essentially based on the following principles:

- 1) Principle of sustainable management: this involves meeting the forestry needs of present generations without compromising the similar rights of future generations;
- 2) Participatory approach: this is based on the effective involvement of all management stakeholders, in particular the State, forest operators, planters, landowners, grassroots communities, non-governmental organizations, etc. These stakeholders are involved at all stages of the initiation, implementation and monitoring-evaluation of forest resource management programs and projects. These stakeholders are involved at all stages of initiation, implementation and monitoring-evaluation of forest resource management programs and projects;
- 3) “Who cuts, replants” principle: this implies that anyone who cuts a tree automatically replaces it with new trees, the number of which is calculated on the basis of the real value of the trees cut and of the same species;
- 4) Principle of responsibility: within the framework of sustainable forest governance, the principle of responsibility aims to ensure the responsiveness of the institutions in charge of the forestry sector and the performance of the processes

undertaken with a view to the sustainable management of forest resources;

5) Principle of equity: the different categories of population involved in the management of forest resources must be treated equitably; equity must be sought in the distribution of the benefits derived from the forest, in their economic use and in the provisions made for the protection and management of these forest resources;

6) The principle of transparency: in the field of sustainable forest governance, the ultimate goal is to be accountable to the public and to the various stakeholders;

7) Principle of good governance: taking into account the timing and risks of establishing and managing planted forests, as well as their use and marketing, the state facilitates a stable economic, legal and institutional environment to encourage long-term investment, sustainable land-use practices and socio-economic stability;

8) Principle of integrated decision-making and multi-stakeholder approaches: taking into account the multi-faceted interfaces of planted forests with community participation, agriculture, livestock, naturally regenerating forests and agroforestry land uses, policy-makers should encourage stakeholder-inclusive decision-making in the planning, management and use of planted forests;

9) Principle of effective organizational capacity: governmental, private-sector and other organizations require the capacity and skills to transfer knowledge, technology and other support services for sound management of planted forests at all levels;

10) Principle of recognition of the value of goods and services: planted forests, whether for production or protection, should be recognized for their provision of market and other benefits, including timber and non-timber forest products and social, cultural and environmental services;

11) Favorable investment environment principle: the State must create favorable conditions to encourage companies to make long-term investments in planted forests and produce a favorable return on investment;

12) Principle of recognition of the role of the market: to improve the likelihood of achieving acceptable returns, investors in planted forests, particularly those with production functions, should design their planning and management to respond to international and domestic market signals; the establishment and management of planted forests should be market-driven, not production-driven, unless they are established for environmental, protection or civic reasons;

13) Principle of recognition of social and cultural values: social and cultural values must be taken into account in the planning, management and use of planted forests, including the well-being and empowerment of communities, workers and other stakeholders;

14) Principle of maintaining social and cultural services: balancing competing objectives in forest plantation investments causes social and cultural changes; it is therefore necessary to adopt planning, management, use and monitoring mechanisms to avoid adverse impacts;

15) Principle of maintaining and conserving environmental services: the management of planted forests will have an impact on the provision of ecosystem services; planning, management, use and monitoring mechanisms must therefore be adopted in planted forests in order to minimize negative impacts, promote positive impacts and maintain or improve the conservation of environmental services;

16) Principle of biodiversity conservation: planners and managers of planted forests must incorporate biodiversity conservation at the stand, forest and landscape levels;

17) PRINCIPLE of maintaining forest health and productivity: agreements are needed at national and sub-national levels to ensure that planted forests are managed in such a way as to maintain and improve forest health and productivity and reduce the impact of destructive abiotic and biotic agents;

18) Principle of landscape management for social, economic and environmental benefits: in planted forests that interact with and impact local uses and livelihoods and the environment, integrated planning and management approaches must be adopted on a landscape or watershed basis to ensure that upstream and downstream impacts are planned, managed and monitored within acceptable social, economic and environmental standards.

In Burundi, the forest estate is protected against any form of degradation or destruction, notably as a result of mining and quarrying, illegal logging, over-exploitation, over-grazing, fires and slash-and-burn operations, as well as abusive clearing and deforestation. In particular, all acts of deforestation in protected areas, areas at risk of flooding and land with a slope of 35% or more are prohibited. What's more, the introduction of exotic forest species into the national territory is subject to prior authorization by the Minister responsible for forests, following an environmental impact study and the opinion of the national forestry commission.

It should be noted that any clearing of forest land owned by the State, local authorities, public establishments or private individuals whose surface area exceeds half a hectare is subject to a clearing permit. The granting of a clearing permit is subject to an environmental impact assessment.

All forest and brush clearing is prohibited within 25 meters of the banks, water bodies and tributary rivers of Lake Tanganyika. For the country's other rivers, this activity is prohibited within 5 meters on either side of the banks. Any clearing must be accompanied by reforestation equivalent in quality and area to the initial afforestation.

Before excavating, quarrying or mining, opening or straightening a road, or building on a State, municipal or public forest estate, or on a private forest estate of at least half a hectare, any natural or legal person is required to:

- 1) Obtain authorization from the Minister responsible for forests and, where applicable, a logging or clearing permit;
- 2) Take all protective and conservation measures to ensure that its activities do not cause or aggravate erosion, degrade soil or damage vegetation around

work sites or operations, alter water quality or disrupt watercourse flows;

3) Restore excavation, extraction or construction sites to their original condition once prospecting and mining work have been completed.

Forest and bush fires are prohibited, with the exception of early fires in wildlife parks. It is also forbidden to herd or graze animals on burnt pastures. Domestic animals may not roam in State, municipal, public or private forest areas.

In order to protect forests, woodlands and woodlots subject to the present law from wildfire, forestry officers must, wherever useful:

1) Periodically carry out preventive fires, either inside or on all or part of these estates, or outside them, on a perimeter strip whose width does not exceed one hundred meters for nature reserves and parks and six meters for other forests and woodlands;

2) Build structures in the same areas to prevent the spread of these fires.

It is also forbidden to carry or light fires outside dwellings and farm buildings, and within 500 meters of forests, woodlands and woodlots, whoever owns them.

4.6. Challenges and Opportunities

Applying the precautionary principle presents many challenges. Dangerous effects on human health and the environment most often manifest themselves as interactions within complex systems influenced by multiple risk factors and causes. For example, the heightened vulnerability of certain sub-groups (e.g. children and the elderly) increases complexity and leads to differences in acceptable exposure thresholds.

There are a number of challenges involved in hazard assessment, not least the tension between false positives and false negatives. False positives occur when a study concludes, for example, that a substance is dangerous when it is not. Conversely, false negatives occur when a study concludes that a substance is not dangerous when it is. Many authors agree that scientific studies are designed to minimize false negatives, for the simple reason that science requires a solid foundation on which to build knowledge.

Several authors deduce that, in the field of environment and health, this means that the odds in favor of the environment or health are kept deliberately low. Furthermore, the method generally used to determine whether observed data are statistically significant is criticized for its weaknesses (Nuzzo, 2014), does not always allow conclusions to be reached in a timely manner (Taylor & Gerrodette, 1993).

In the field of research, too, the application of the precautionary principle highlights a number of challenges. An analysis of scientific articles published between 2000 and 2009 reveals that academic research into environmental hazards focuses on a small number of well-known chemicals such as heavy metals, while research into other widely-used substances, let alone emerging chemicals, remains rare. The author adds that, traditionally, research has focused on a single topic, which has the advantage of addressing a single factor in specific cir-

cumstances, but makes it ill-suited to apprehending the complexity of environmental hazards, where causes can be multiple and cumulative (Grandjean, 2013).

For companies, applying the precautionary principle can present two main challenges:

- On the one hand, a change in regulations in the name of the precautionary principle can be a source of increasing costs and legal uncertainty for companies, and thus slow down their development or even jeopardize their existence;
- On the other hand, when companies discover early signs of danger posed by their products, they face economic and ethical dilemmas.

However, the application of the precautionary principle can also be a source of opportunities. A report by the Organization for Economic Co-operation and Development, or OECD for short, points out that the costs to society of inaction can be considerable, in some cases placing a heavy burden on economies (OECD, 2008).

Applying the precautionary principle can help reduce these costs, even if it is not easy to estimate potential future costs, so that they can be compared with the costs of regulatory action. The precautionary principle can also help to correct certain market failures that arise when society has to bear the costs of environmental and health damage externalized by economic actors.

It can also help avoid lengthy legal proceedings for compensation that can drag on for decades. In a context of economic transition towards greater sustainability as envisaged by European policies (7th general environmental action program adopted by the European Parliament and the Council in 2013 and Soer, 2015), the precautionary principle can help avoid dangers in highly complex and uncertain situations.

In environmental and health research, the precautionary principle may provide an opportunity to revise strategies to take account of societal needs for information on little-known hazards, methodologies to extend knowledge, and ways of communicating about risks to facilitate judgments on the potential scale of possible environmental hazards (Grandjean, 2004).

5. Conclusion

The first part of our work consisted in examining the origins of the precautionary principle, its various conceptions by different authors, institutions and/or associations (groupings) of human beings, the references to it in international treaties on environmental protection, and the definitions elaborated by different institutions.

The precautionary principle enables decision-makers to take measures to protect the environment when scientific evidence of a danger to the environment or human health is uncertain and the stakes are high. This principle is the subject of opposing views, as some see it as useless, potentially dangerous and opposed to progress, while others consider it a useful principle for protecting human health and the environment in the face of complex hazards. It should be noted

that there is no universally accepted definition of the precautionary principle. It is therefore conceived differently by different institutions, depending on the degree of scientific uncertainty at which action by the authorities is still possible. The European Commission, UNESCO and the European Environment Agency have each proposed a definition of the principle.

The second part deals with the application of this principle by States, communities and national, regional and international organizations. Indeed, its application is also subject to different interpretations. Most experts agree that the precautionary principle does not require specific measures, such as a ban or a reversal of the burden of proof. The application of the precautionary principle presents many challenges, particularly in terms of dealing with complexity, hazard assessment, research and economic activities. However, it should also be noted that the precautionary principle is a source of opportunities, particularly with regard to a possible reduction in the overall costs to society, and in research into the environment and human health.

It would be risky to claim to have exhausted the subject. For example, we have not been able to compare the precautionary principle with other closely related principles, such as the principle of prevention. Nevertheless, we hope to have made our contribution, however modest, to environmental law research in Burundi. We invite other researchers to delve deeper into the subject.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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