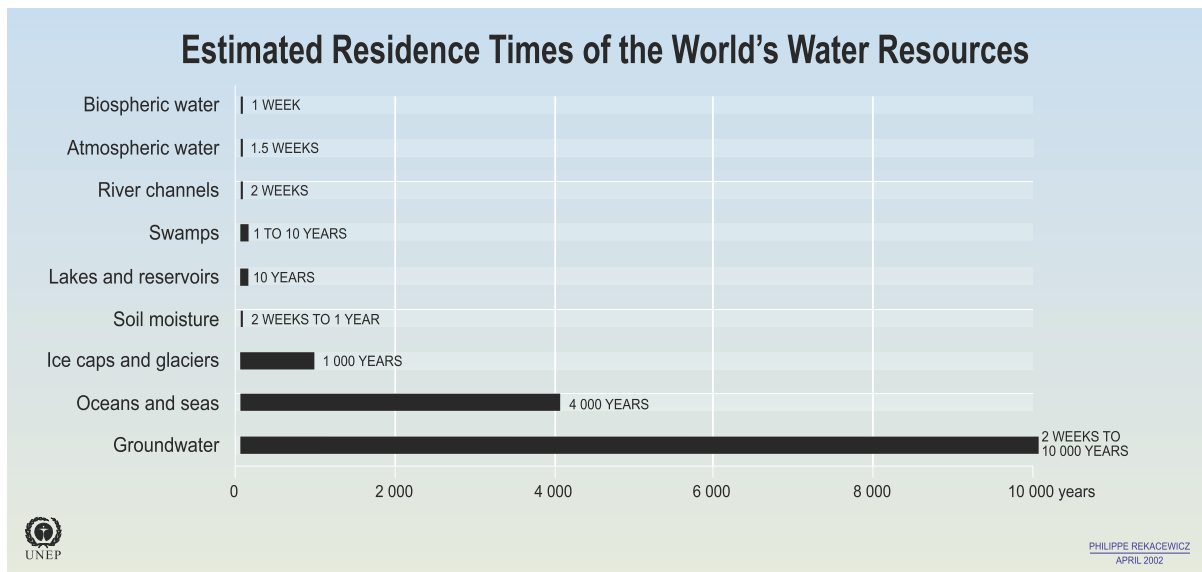
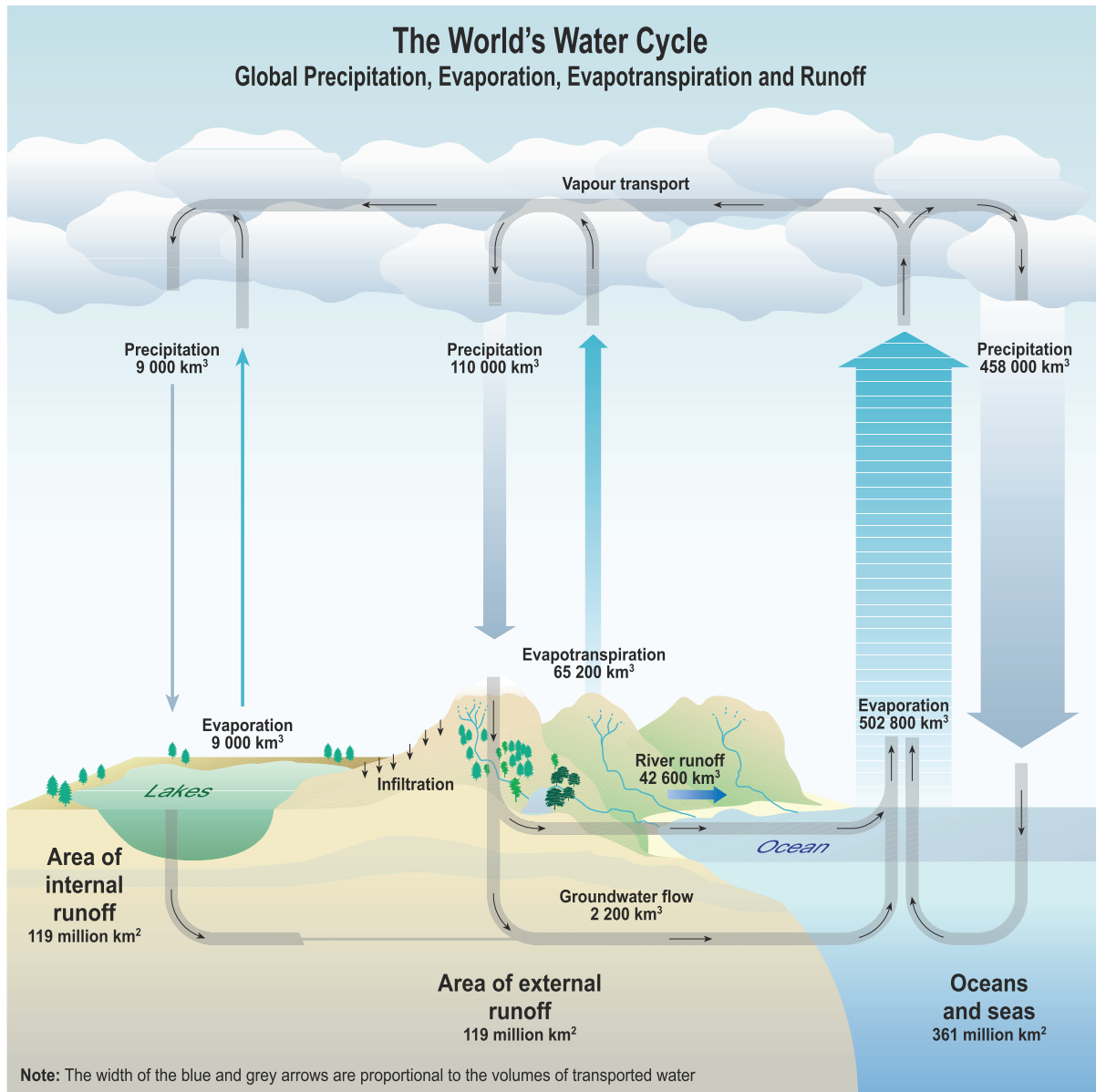


18. FRESHWATER RESOURCES

I. Introduction

1. Water is essential to human and other forms of life. Therefore, attention should be paid not only to regulating the exploitation of water and diminishing or halting pollution of single water bodies, but also protecting and preserving the entire ecosystems of which water resources constitutes integral part. For example, deforestation in a watershed can affect its streams, which in turn can affect fish and other aquatic life and lead to flooding. The cascade of social and economic consequences that can flow from the loss of healthy ecosystems demonstrates that freshwater ecosystems should not be seen as something separate from human society and well being. They are, in fact, an integral part of a country's economy and should be both protected and enhanced accordingly.
2. This chapter focuses on the protection, conservation and management of freshwater resources, both at the international and national level. Freshwater resources have been the object of regulation long before the emergence of environmental protection and sustainable development concerns. International rules and principles, as well as national regimes, have been developed to regulate their navigational and other uses. These regimes, perhaps with the exception of sanitation standards, mostly treated water as an economic resource, and dealt largely with the quantitative aspect of water resources.
3. The emergence of environmental protection obligations and of the principle of sustainable development, as well as the increased awareness that water resources have to be managed in a holistic approach, have highlighted the need to integrate existing water regulation regimes with rules and principles concerning the environmental aspects of freshwater resources, and to regulate the quantitative and qualitative aspects in an integrated manner. Therefore, in order to reflect the evolution of the law in this area and the interlinkages between the regulation of the use of water and the protection and conservation of water resources and their ecosystems, this Chapter will also address the issue of water allocation rights, falling under what is traditionally referred to as water law.
4. Most freshwater on Earth is in constant motion in the hydrologic cycle. (See table, above). This expression refers to the process whereby water evaporates into the atmosphere and returns to Earth's surface through condensation and precipitation. Evaporation may occur from any wet surface. Most water evaporates from the oceans, since they cover about 70% of the planet, but also from other bodies of water, such as lakes, reservoirs and rivers, as well as from moist soil and other surfaces. Considerable amounts of water vapour enter the atmosphere through transpiration and evaporation from vegetation in a process referred to as evapotranspiration. Thus crops, trees and other vegetation act as virtual "pumps," transferring water from the ground into the atmosphere. Therefore, large-scale elimination of vegetation can affect local and regional climate patterns.
5. When water returns to land through precipitation, it may either remain on the surface, as standing water or as runoff, or soak into the ground through infiltration. Runoff flows into streams, lakes and other forms of surface water, generally finding its way into the ocean. Water entering the ground through infiltration may be held in the soil, to eventually return to the surface through capillary action and evaporate, or may percolate downward to become groundwater. The area on the land surface where infiltration occurs is called the recharge area. This may lie a considerable distance from the place where groundwater is withdrawn or emerges naturally, for example, by flowing into a river, or emanating from the ground in the form of a spring. The underground geologic structures containing water are often referred to as aquifers. These porous, permeable water-bearing formations are composed of such material as sand, gravel or limestone. The water contained in these aquifers is called groundwater. The upper surface of groundwater is the water table. Water moves not only from Earth's surface to the atmosphere and back again, but also from the surface into the ground and back again to the surface. For example, considerable water seeps from streams through their beds into the ground, changing from surface water to groundwater. This groundwater may later rejoin the stream, emerge as a spring or flow underground into a lake or the ocean. However, there are certain aquifers containing what is sometimes called confined groundwater, or fossil water, that do not interact with surface water or other aquifers, but these are highly exceptional.

1. The Hydrological Cycle



Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999; Max Planck, Institute for Meteorology, Hamburg, 1994; Freeze, Allen, John, Cherry, *Groundwater*, Prentice-Hall: Engle wood Cliffs NJ, 1979.

6. It is estimated that over three-quarters of all freshwater on Earth is frozen in polar ice-caps and glaciers and is inaccessible as a practical matter. Approximately 97% of the remaining water consists of groundwater, while surface water accounts for a surprisingly small percentage of the total of freshwater on earth. Therefore, a high percentage (about one-third) of the global population depends upon groundwater, much of which is drawn from shallow aquifers, which are more subject to pollution than deep aquifers.

2. Water Scarcity

7. Although water has been the same for billions of years, as it neither grows nor diminishes over time, concerns about its scarcity derive largely from intensified human demand for a finite supply and deterioration of its quality caused by human activities. Intensified human demand largely due to rapid population growth. If about one-third of the global population lives today in countries under moderate-to-high water stress, studies have estimated that by the 2015, nearly half the world's population will live in countries lacking sufficient water.
8. Water quality is an important consideration for its intended use. Therefore, water quality and quantity are interrelated: water resources may be plentiful but unsuitable for human use because of contamination. This problem is becoming more serious, particularly in urban areas where the need to provide adequate and safe supplies of water and dispose of the increasingly large quantities of wastewater in a safe and environmentally sound way is becoming an increasingly pressing concern.
9. An additional factor that may have profound effects on water supplies is global climate change, whose consequences, as estimated by the Intergovernmental Panel on Climate Change ("IPCC") created by the WMO and UNEP to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation) include not only higher temperatures but also rising sea levels, altered precipitation patterns, and an increase in extreme climatic events and storm surges, among other effects. All of these factors will impact on the availability and quality of freshwater resources and be exacerbated by human demand for freshwater.
10. The world's water is unevenly distributed. Some geographic regions have more water than they can possibly use while others do not have enough. Governments have sometimes responded to this phenomenon by transferring water from places

where it is abundant to those where it is scarce. While water transfers may address needs of the present and short-term future, they may also have unforeseen and harmful longer-term effects on ecosystems and even human populations.

3. Water Pollution

11. Principal sources of freshwater pollution include untreated sewage, agricultural run-off and discharge of chemical substances. These affect all forms of freshwater and marine water in coastal areas, degrade associated ecosystems and threaten the health and livelihoods of people dependent upon them.
12. The lack of adequate sanitation is the primary cause of water contamination and water-related diseases, such as cholera, dengue fever, diarrhoea and typhoid fever. Some 2.3 billion people are afflicted with these diseases each year. Children are particularly vulnerable since their immune systems are not fully developed. The poor are the most likely to have inadequate sanitation facilities and to suffer consequent adverse effects on their health and environment.
13. Substances deposited on land surfaces (for example, fertilizers, pesticides and other chemicals used in agriculture), may filter into groundwater, which could be affected by other sources of pollution affecting streams that eventually replenish the aquifer. Once contaminated, groundwater is very difficult to purify unless it is extracted and treated which process would be experience as well.
14. The quality of groundwater in coastal areas may also be affected by over-pumping, or mining. Mining of groundwater occurs when withdrawals exceed the average rate of replenishment. Because coastal aquifers are often geologically connected with the adjacent ocean, these withdrawals can cause sea water to be drawn into the aquifers, increasing the salinity of the freshwater and making it unfit for many uses.

4. Water Uses

15. Humans use freshwater in a wide variety of ways. Nevertheless, it is possible to identify several broad categories of uses for convenience: domestic uses; industrial uses; agricultural uses; recreational uses; navigational uses; waste-disposal uses; and in-stream uses (such as fishing, conservation of fish and other aquatic life, recreation, safeguarding aesthetic values and preservation of aquatic ecosystems). These categories may be further

subdivided. For example, domestic uses include the use of water for drinking, washing, food preparation, sanitation and subsistence farming, among other uses.

16. It is important to bear in mind the potential for different uses of water to come into conflict with each other. Thus, for example, the use of water for drinking would conflict with any other use, for instance waste-disposal use - that made the water unfit for drinking.
17. Conflicts between uses of land and water must also be confronted. For example, deforestation can increase runoff, causing erosion of soil which can lead to increased turbidity of streams and sedimentation of their beds; sedimentation can, in turn, cause flooding and decrease infiltration of water from streams into aquifers. Agriculture may result in the direct or indirect discharge of pollutants into water sources and affect the extent to which those sources are available for other uses. More broadly the interest of the international community in environmentally sound management of water resources is to provide a framework of peaceful cooperation and avoidance of conflicts that could jeopardize peace and security among countries sharing the resource. Conflict resolution mechanisms are at all times at the core of underlying cooperation.
18. The relationship between fresh, coastal and marine water resources must also be borne in mind. Nearly one-third of the world's population lives in coastal zones. Since most watercourse systems eventually reach the sea, coastal residents bear the effects of freshwater management practices in the relevant basins. Thus, freshwater systems, wetlands, and coastal and marine waters should be managed holistically.
19. Estuaries, partly enclosed aquatic zones where seawater mixes with freshwater from rivers, deserve special protection, as they provide sanctuaries, breeding and feeding grounds for many important species and serve as nurseries for half of the living organisms in the world's oceans. Also marshes and wetlands serve critical ecological functions, by regulating water regimes, and by providing habitats for flora and fauna as well as important water purification services. They are often relied upon by local populations for food and even shelter.

II. The International Framework

1. Major Developments in the Field of Cooperation on Freshwater

20. The issues of water availability, use, management, and conservation, with all their implications, are at the centre of concern at national and international levels. In the past decade, water has been at the center of international conferences and initiatives as well as the object of international cooperation, including through the development of legally-binding agreements.
21. The International Conference on Water and the Environment, a meeting of water specialists held in Dublin in 1992, adopted the Dublin Statement on Water and Sustainable Development and a set of four Guiding Principles. The first of these principles reads: "Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment." The other principles concern the need for a participatory approach to water development and management, the central role of women in the provision, management and safeguarding of water, and the need to recognize water as an economic good.
22. At the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, Governments adopted a detailed plan of action, Agenda 21, whose chapter 18 outlines the action needed at the national level to safeguard freshwater resources. Agenda 21 adopts the concept of integrated water resource management, based on the idea that water is "...an integral part of the ecosystem, a natural resource and a social and economic good..." and that "Freshwater is a unitary resource" and the "complex interconnectedness of freshwater systems demands that freshwater management be holistic (taking a catchment management approach) and based on a balanced consideration of the needs of people and the environment." It also contains useful recommendations on activities and means of implementation with regard to the impacts of climate change on water resources.
23. At the Millennium Summit, held in 2000, the General Assembly adopted the Millennium Declaration (UNGA Resolution 55/2 of 8 September 2000), by which states resolved to reduce by half the proportion of people without sustainable access to safe drinking water by 2015. World leaders also agreed to adopt in all

environmental actions a new ethic of conservation and stewardship and, as a first step, to “stop the unsustainable exploitation of water resources by developing water management strategies at the regional, national and local levels, which promote both equitable access and adequate supplies. (See Paragraph 23 of the Millennium Declaration). These commitments have been translated into the Millennium Development Goal 7: Ensure environmental sustainability.

24. Water was at the centre of several international conferences, such as the Bonn International Conference on Freshwater (December 2001) and the Second (March 2000) and Third (March 2003) World Water Forums.
25. Furthermore, one of the major priority areas at the World Summit on Sustainable Development (“WSSD”, Johannesburg 2002) was water. In the Johannesburg Plan of Implementation states not only reaffirmed the Millennium Development Goal mentioned above, but additionally committed to halving the proportion of people without access to basic sanitation services within the same period. They also called for the development of integrated water resources management and water efficiency plans by 2005. The United Nations Commission on Sustainable Development decided at its eleventh session (April 2003) to monitor progress and promote the further implementation of the water agenda in the first cycle of its new multi-year programme of work.
26. At the eighth special session of the Governing Council / Global Ministerial Environment Forum of the United Nations Environment Programme held in Jeju, Republic of Korea in March 2004, Ministers and other heads of delegations engaged in a dialogue on the priority environmental dimensions of the water related themes and associated targets stemming from the Millennium Declaration and the World Summit on Sustainable Development, and in particular on integrated water resource management, water and sanitation and water, health and poverty. The summary of the discussions held is known as the Jeju initiative.

2. Freshwater Regulation at the International Level

27. Water is one of the most widely shared resources of the planet. Rivers often constitute the border between states or flow across different countries and lakes often lie on the territory of different states. Therefore water can be a factor for competition as well as a reason of cooperation among states. Disputes for the control of water resources have a long history. Also major water development projects (e.g. the construction of a dam) have caused violence and civil strife.
28. But shared waters can also be a source of cooperation: throughout history, states have manifested their interest in cooperating for the management of water resources and have recognized the need to establish rules and principles for a peaceful cooperation.
29. The body of rules and principles that have been developed to respond to similar situations is impressive, due to the extensive state practice in this field, both in terms of agreements and other forms of rules of conduct. Historically, rules and principles of international law relating to international watercourses first developed in the field of navigation. One of the first European agreements relating to shared water resources, the Final Act of the Congress of Vienna (1815), stipulated that there was to be freedom of navigation on all navigable rivers. However, other uses of shared water resources, such as irrigation, the generation of hydroelectricity and waste disposal, have become increasingly important. The practice of states sharing freshwater resources has led to the development of general rules and principles concerning the non-navigational uses of international watercourses. This body of law finds its most recent and authoritative expression in the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (“International Watercourses Convention”).
30. The International Watercourses Convention is based on preparatory work done by the United Nations International Law Commission (“ILC”), whose objective is the progressive development of international law and its codification. The ILC’s work on international watercourses was based on a wide variety of sources, including treaties and other forms of state practice, and the work of international organizations. One of these organizations, the International Law Association (“ILA”), adopted an unofficial but influential draft in 1966 entitled the Helsinki Rules on the Uses of the Waters of International Rivers, which helped to clarify the law in the field.
31. While the International Watercourses Convention is not yet in force, a number of the rules it contains reflect customary international law, which is binding on all states. Of these rules, the three most fundamental include:
 - Obligation to utilize an international watercourse in an equitable and reasonable manner;

- Duty to prevent significant harm to other riparian states; and
 - Obligation to provide prior notification of planned measures that might affect other states sharing a watercourse.
32. The fundamental nature of the principle of equitable utilization was underscored by the International Court of Justice (“ICJ”) in its 1997 judgment in the *Gabcikovo-Nagymaros Case*. In that decision, the ICJ referred to what it called a state’s “basic right to an equitable and reasonable sharing of the resources of an international watercourse”.
33. Two other obligations, which have begun to receive attention only relatively recently, may be added to the three just mentioned:
- The emerging substantive obligation to protect international watercourses and their ecosystems against degradation; and
 - The procedural duty of riparian states to cooperate with each other in their relations concerning shared freshwater resources, a duty that encompasses a variety of forms of cooperation ranging from sharing of data and information to cooperation in the joint management of shared water resources.
34. Considering the authoritative character of the International Watercourses Convention as a codification of basic principles of international watercourse law, states sharing freshwater resources have referred to it as a source of standards governing their relations and as a model for ad hoc agreements regulating specific water bodies. In view of the Convention’s influence and because it conveniently summarizes the generally applicable principles, the following section examines the content of this instrument in more detail.
- a) The 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses**
35. The Convention on the Law of the Non-Navigational Uses of International Watercourses (“International Watercourses Convention”) originated from the work of the International Law Commission, mandated by the General Assembly in 1970 to “take up the study of the law of international watercourses with a view to its progressive development and codification.” The ILC adopted a complete set of draft articles in 1994, which was submitted to a Working Group for its finalization in the form of a multilateral agreement. As a result of this process, the International Watercourses Convention was adopted by the General Assembly on 21 May 1997, as an annex to Resolution 51/229. The Convention is not yet in force; it will enter into force when it has been ratified by thirty-five states (article 36). As of November 2005, sixteen states have signed and fourteen are parties to the Convention.
36. The International Watercourses Convention defines the term “watercourse” (article 2) as “a system of surface waters and ground waters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus” and an “international watercourse” as a watercourse “parts of which are situated in different States.” This definition takes into consideration the reality of the hydrological cycle and suggests the need for states to take into account the physical unity of interconnected surface water and groundwater when managing shared freshwater resources. However it does not apply, strictly speaking, to groundwater that is not connected in some way with surface water, so-called “confined” groundwater. Nevertheless, the ILC annexed a Resolution on Confined Transboundary Groundwater to the set of draft articles it adopted in 1994, recommending that states be “guided by the principles contained in the draft articles” in regulating confined transboundary groundwater. Subsequently the ILC took up the study of the law applicable to confined transboundary groundwater. Its work is ongoing at the time of this writing.
37. Part II of the International Watercourses Convention contains a number of general principles. The first of these principles is the principle of equitable utilization and participation (article 5), which provides:

**Convention on the Law of the Non-Navigational Uses
of International Watercourses
(Article 5)**

“1. Watercourse States shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse States with a view to attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse.

2. Watercourse States shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.”

38. The principle of equitable utilization, as set forth above, is chiefly concerned with apportionment, or allocation, of water between states sharing an international watercourse. It therefore relates primarily to water use, and thus to water quantity, rather than to water quality. However, as is clear from that text that equitable utilization incorporates the concepts of sustainable use and adequate protection of the watercourse. The ensuing paragraph expresses the duty of states to participate equitably in the use, development and protection of an international watercourse.
39. The International Watercourses Convention sets forth (article 6) a non-exhaustive list of factors to be taken into account by a state to ensure that its utilization of an international watercourse is equitable and reasonable. These factors include:
- Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;
 - Social and economic needs of the watercourse states concerned;
 - Population dependent on the watercourse in each watercourse state;
 - Effects of the use or uses of the watercourses in one watercourse state on other watercourse states;
 - Existing and potential uses of the watercourse;
 - Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; and
 - Availability of alternatives, of comparable value, to a particular planned or existing use.

The weight to be given to each factor “is to be determined by its importance in comparison with that of other relevant factors”. In determining what is a reasonable and equitable use “all relevant factors are to be considered together and a conclusion reached on the basis of the whole.”

40. Another fundamental principle governing states’ conduct in relation to international watercourses is the obligation not to cause significant harm, set forth in article 7 of the Convention. According to paragraph 1 of that provision, states sharing a watercourse must “in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse States.” Paragraph 2 provides that

**Convention on the Law of the Non-Navigational Uses
of International Watercourses**

Article 7(2)

“Where significant harm nevertheless is caused to another watercourse State, the States whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures...to eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation.”

41. As mentioned above, the cornerstone of relations between states sharing water resources is cooperation with regard to specific watercourses. This is captured in article 8, according to which states sharing a watercourse must “cooperate on the basis of sovereign equality, territorial integrity, mutual benefit and good faith in order to attain optimal utilization and adequate protection of an international watercourse”, and “may consider the establishment of joint mechanisms or commissions...to facilitate cooperation on relevant measures and procedures in the light of experience gained through cooperation in existing joint mechanisms and commissions in various regions.”
42. Another form of cooperation is provided for in article 9, according to which states sharing a watercourse should regularly “exchange readily available data and information on the condition of the watercourse” and related forecasts, in particular those relating to the hydrological, meteorological, hydrogeological and ecological nature of the watercourse, including its water quality. If the required information is not readily available, the requested state should “employ its best efforts to comply with the request,” although it may condition compliance upon payment of the reasonable costs of collecting and processing the data or information.
43. The conventions established (article 10) that none of the different categories of uses of the watercourses (e.g., navigation, irrigation, hydroelectric power production, industrial uses and so on) has priority over other kinds of uses in the absence of an agreement or custom to the contrary and it provides that, whenever different uses of an international watercourse conflict with each other, such conflict “shall be resolved with reference to [the principles of equitable and reasonable utilization and participation and obligation not to cause significant harm], with special regard being given to the requirements of vital human needs.” According to a “statement of understanding” adopted by the states that negotiated the UN Convention, “in determining

‘vital human needs,’ special attention is to be paid to providing sufficient water to sustain human life, including both drinking water and water required for production of food in order to prevent starvation.”

44. According to the International Watercourses Convention, a riparian state must provide timely notification to other watercourse States of planned measures which may have a significant adverse effect upon them. These measures may include, for instance, new irrigation schemes, dams, plants discharging their waste into the stream, etc. to the other riparian states. This will allow the other riparian states to synchronize their existing uses with the new use or to determine whether the new use will cause them harm or will be inequitable. In the latter case, the states concerned will have an opportunity to reach an appropriate resolution before the plans are implemented and it becomes more difficult to do so. Articles 11-19 of the Convention establish detailed notification procedures for such cases.
 45. The International Watercourses Convention contains a general obligation and several specific ones relating to the protection and preservation of international watercourses. The general obligation, set forth in article 20, provides as follows: “Watercourse States shall, individually and, where appropriate, jointly, protect and preserve the ecosystems of international watercourses”.
 46. The specific obligations related to pollution, alien species, and the marine environment include that States must “prevent, reduce and control the pollution of an international watercourse that may cause significant harm to other watercourse States or to their environment, including harm to human health or safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse...” (article 21). This may be seen as a specific application of the general obligation to prevent harm reflected in article 7. Furthermore, states are to “take all measures necessary to prevent the introduction of species, alien or new, into international watercourses” (article 22) and to take all measures with respect to an international watercourse that are necessary to protect and preserve the marine environment, including estuaries...” (article 23).
 47. The International Watercourses Convention also contains provisions on the prevention and mitigation of harmful conditions and emergency situations (articles 27 and 28 respectively), dealing with the prevention of such harmful conditions as floods, ice hazards, water-borne diseases, erosion, salt-water intrusion, drought and desertification, and with emergency situations that may be brought on by such phenomena as floods, landslides and industrial accidents.
- ### 3. Freshwater Regulation at the Regional and Subregional Levels
- a) **The 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes**
 48. The rules governing shared watercourses have also been established in regional contexts, and have resulted in several conventions, protocols and agreements, which represent the reference point for states which share watercourses and intend to cooperate in their conservation, management and use.
 49. An important example of regulation of transboundary water resources at the regional level is the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (“Helsinki Convention”), which was concluded under the auspices of the Economic Commission of Europe (“UNECE”) at Helsinki. The Convention entered into force on 6 October 1996, with 26 signatories and 35 parties as of November 2005.
 50. The Helsinki Convention deals with the prevention, control and reduction of transboundary impacts relating to international watercourses and lakes, with a strong emphasis on pollution prevention. It establishes a framework for cooperation between the member countries of the UNECE on the prevention and control of pollution of specific transboundary watercourses by ensuring rational use of water resources with a view to sustainable development. Transboundary waters are defined as any surface or ground waters that mark, cross or are located on the boundaries between two or more states.
 51. Under the Convention, the Parties shall take all appropriate measures:
 - To prevent, control and reduce pollution of waters causing or likely to cause transboundary impact;
 - To ensure that transboundary waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection;
 - To ensure that transboundary waters are used in a reasonable and equitable way, taking into particular account their transboundary character, in the case of activities which cause or are likely to cause transboundary impact;
 - To ensure conservation and, where necessary, restoration of ecosystems.

52. Actions designed to deal with water pollution must address pollution at source, and measures adopted on this basis must not result directly or indirectly in a transfer of pollution to other parts of the environment.
53. The Helsinki Convention establishes that parties must be guided, in their actions, by the following fundamental principles:
- The precautionary principle, according to which action to avoid the release of hazardous substances must not be postponed, despite the lack of a proven causal link between the substances and the transboundary impact;
 - The “polluter pays” principle, according to which the costs of pollution prevention, control and reduction measures must be borne by the polluter; and
 - Water resources must be managed so that the needs of the present generation are met without compromising the ability of future generations to meet their own needs.
54. The Convention also establishes obligations in the field of monitoring, research and development, consultations, warning and alarm systems, mutual assistance, institutional arrangements, and the exchange and protection of information, as well as public access to information.
55. Two Protocols were adopted under the Helsinki Convention: the Protocol on Water and Health and the Protocol on Civil Liability and Compensation for Damage caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters. The main aim of the Protocol on Water and Health, adopted in London on 17 June 1999, is to protect human health and well being by better water management, including the protection of water ecosystems, and by preventing, controlling and reducing water-related diseases. It is the first international agreement of its kind adopted specifically to attain an adequate supply of safe drinking water and adequate sanitation for everyone and effectively protect water used as a source of drinking water. To meet these goals, the parties are required to establish national and local targets for the quality of drinking water and the quality of discharges, as well as for the performance of water supply and wastewater treatment. They are also required to reduce outbreaks and the incidence of water-related diseases.
56. The Protocol on Civil Liability and Compensation for Damage caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters was adopted and signed by 22 countries in Kiev, Ukraine, on 21 May 2003, under both the Helsinki Convention and the ECE Convention on the Transboundary Effects of Industrial Accidents. The Protocol is open for ratification by parties to one or both Conventions, but any other Member state of the United Nations may accede to the Protocol upon approval by the Meeting of the Parties. The Protocol on Civil Liability will enter into force once 16 states have ratified it.
57. The Protocol on Civil Liability allows individuals affected by the transboundary impact of industrial accidents on international watercourses to bring a legal claim for adequate and prompt compensation. Companies can be held liable for accidents at industrial installations as well as during transport via pipelines. The liability covered by the Protocol includes physical damage, damage to property, loss of income, the cost of reinstatement and response measures. The Protocol contains provisions ensuring non-discriminatory treatment of pollution victims, by ensuring that victims of the transboundary effects cannot be treated less favourably than victims from the country where the accident has occurred.
- b) Protocol on Shared Watercourse Systems in the Southern African Development Community**
58. The Southern African Development Community (“SADC”) is a regional economic community that has the goal of promoting the integration of the regional economy and poverty alleviation, food security and industrial development. It was established in 1992 and comprises fourteen countries: Angola, Botswana, the Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. It is based on a treaty that is supplemented by sectoral protocols.
59. The first SADC Protocol on Shared Water Course Systems (“SADC Protocol”), developed with the assistance of UNEP, was signed in 1995, and ratified in September 1998. Following adoption of the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses in 1997, a revised Protocol was developed, in line with the provisions of the UN Convention. The Revised Protocol was signed on 7 August 2000, and entered into force on 22 September 2003. At the time of writing, the following countries had ratified the Protocol: Botswana, Lesotho, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Malawi and Tanzania.

60. Overall objective of the Revised Protocol is:

**Protocol on Shared Watercourses Systems in the
Southern African Development Community
(Article 2)**

“[...] to foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilisation of shared watercourses and advance the SADC agenda of regional integration and poverty alleviation.”

61. In order to achieve this objective the Protocol seeks to:

- promote and facilitate the establishment of shared watercourse agreements and Shared Watercourse Institutions for the management of shared watercourses;
- advance the sustainable, equitable and reasonable utilisation of the shared watercourses;
- promote a co-ordinated and integrated environmentally sound development and management of shared watercourses;
- promote the harmonisation and monitoring of legislation and policies for planning, development, conservation, protection of shared watercourses, and allocation of the resources thereof; and
- promote research and technology development, information exchange, capacity building, and the application of appropriate technologies in shared watercourses management.

62. The Protocol introduces the principle of “unity and coherence of each shared watercourse” which implies the need to harmonize uses of the water in the interests of sustainability and regional integration. It requires member states to undertake to respect and apply the existing rules of general or customary international law relating to the utilization and management of the resources of shared watercourse systems and, in particular, to respect and abide by the principles of community interests in the equitable utilization of those systems and related resources.”

63. The Protocol also requires member states to establish appropriate institutions necessary for the effective implementation of the provisions of the protocol, which include, among others, River Basin Commissions between Basin States and River Authorities or Boards in respect of each drainage basin, with the following objects:

- Develop a monitoring policy for shared watercourse systems;
- Promote the equitable utilization of shared watercourse systems;

- Formulate strategies for the development of shared water course systems; and,
- Monitor the execution of integrated water resource development plans in shared watercourse systems.

c) Agreements concerning Specific Watercourses

64. The international regimes described previously in this Chapter establish general rules to be followed by states sharing freshwater resources. States will therefore normally be guided by those rules in the management of such shared resources, and on their basis they will develop mechanisms for cooperation, often in the form of legally binding agreements regulating the specific water bodies, containing the rights and duties of the respective states and relevant institutional arrangements.

65. Riparian states are becoming increasingly aware of the need to cooperate with other riparian states for the management of shared water resources at the basin level, based on the recognition that the hydrological linkage between land, freshwater river basins and coastal waters does not allow for the management of these resources in isolation. From this perspective, for certain water systems not only states whose territory directly adjoins the water body but also all those whose water resources contribute to or are affected by such a water body should be involved in any cooperative arrangement, whether legally binding or not.

66. In the case of the Nile basin, for instance, ten countries (Kenya, Tanzania, Uganda, Sudan, Egypt, Burundi, Rwanda, Ethiopia and the Democratic Republic of Congo) are involved in the Nile Basin Initiative, which was established in 1998 as a dialogue to create a regional partnership to facilitate the common pursuit of sustainable development and management of Nile waters and in the context of which a number of significant steps have been taken towards closer and more stable cooperation.

67. Based on the recognition of this widespread form of cooperation and considering the high number of basin organisations existing in the world, an International Network of Basin Organizations was established in 1996, with the following objectives:

- Establishing a network of organizations interested in global river basin management, and facilitate exchanges of experiences and expertise among them;
- Promoting the principles and means of sound water management in sustainable development cooperation programmes;

- Facilitating the implementation of tools for institutional and financial management, for programming and for the organization of data banks;
- Promoting information and training programmes for the different actors involved in water management including local elected officials, users' representatives and the executives and staff of member organizations;
- Encouraging education of the population, the young in particular; and
- Evaluating ongoing actions and disseminate their results.

68. Although there exist many examples of basin-wide cooperation, of the more than 260 international water basins existing today, more than 150 still lack any type of cooperative management framework. Furthermore, the majority of those basins enjoying some form of cooperation do not have comprehensive agreements including all the riparian states in the basin. And among the existing agreements, the majority lack the tools necessary to promote long-term holistic basin-wide resource management. Therefore, much work still needs to be done before adequate legal regimes are developed throughout the world.
69. Although the general rules on cooperation and management of shared water resources are provided in the International Watercourses Convention as well as, when applicable, in relevant regional and subregional instruments, each river basin has its own characteristics, and it is therefore difficult to provide a brief overview of the existing agreements regulating specific watercourses. Anyone interested in a specific arrangement has to check that instrument directly.

III. National Implementation

70. Not all river basins are international, and not all aspects of international river basins are regulated at the international level. Indeed, nearly every state in the world has set in place a legal regime regulating the use of water resources in their territory. Many existing legislations have not been updated to take into consideration environmental protection and sustainable development considerations that have been integrated in national policies and legislation relatively recently where water policies have been developed followed by new consolidating Water Acts and regulations. Hence, many countries are undertaking a process of integration of such considerations in their respective water laws, or developing additional legislations dealing with the environmental aspects of water management. Many countries are also working to ensure that the institutions responsible for water management and

the environment collaborate so as to ensure that environmental considerations are taken into account when decisions are made that concerns the use and management of national waters. Rather than reviewing specific recent Acts (such as Kenya, 2002), major trends and lessons learnt are outlined below. Diversity in conditions and circumstances in different regions and countries necessitate such treatment, thus leaving it to an interested party to critically examine the situation in their own country and other countries they may be interested in.

1. Major Trends in National Legislation

71. Governments have taken several different approaches to the protection and conservation of freshwater resources. The two most prominent approaches are water quality standards and effluent limitations. The first approach prescribes a specific quality standard for a particular watercourse, effectively proscribing pollution that would cause water quality to fall below that standard. The second approach sets the quantity of pollutants that may be legally discharged from a specific source. While the two approaches are fundamentally different, they may be combined, as some states have done. Thus, it is possible, for example, to rely principally upon effluent limitations but to calibrate them according to what is needed to meet overall water quality standards.
72. While law, policy and the literature concerning the protection of freshwater have traditionally focused on the control of pollution of water in rivers, lakes or aquifers, many experts have become convinced that it is essential to include the entire freshwater ecosystem in protection and preservation programmes. Various uses of land may affect water quality. The United Nations General Assembly has recognized the urgency of developing and implementing water resource protection approaches based on the principle of integrated watershed management, that recognize the interrelationship between water and land and provide for the preservation of aquatic ecosystems. Similarly, Agenda 21 identifies the maintenance of the integrity of aquatic ecosystems, and their protection from degradation on a drainage basin basis, as the primary objective of freshwater management. In summary, the protection of freshwater from pollution and the preservation of aquatic ecosystems are not ends in themselves. They are not objectives appropriate only for rich countries. They can actually sustain and increase the quantity of water available for a variety of uses, from domestic to agricultural and industrial. Safeguarding water supplies is a key objective of water resources management in today's world.

73. There are several important trends and issues in national water policies and legislation. The most obvious and significant trend is the incorporation of sustainable development into legislation concerning freshwater resources. Sustainable development may appear explicitly in relevant statutes or may be incorporated implicitly through an emphasis on the need to strike a proper balance between economic development and environmental protection. Other aspects of sustainable development, including a participatory approach to water management, transparency in public decision-making, and the need to ensure that minorities, women and children are not subject to discrimination, also feature in this trend.
74. An increasingly important aspect of the trend toward incorporation of sustainable development into national water legislation is the conservation of freshwater resources. The rapidly declining supply of freshwater on a per capita basis, coupled with increasing pollution and other forms of degradation, as well as the impact of global climate change, are leading governments to emphasize the need to conserve precious water resources and protect them against contamination.
75. Another important trend is integrated water resources management. Countries are increasingly deciding to manage basins holistically. This entails conducting an inventory of available water resources and of the ecosystems within which they are situated and the uses that are made of the watercourses and the surrounding land. Surface and groundwater are then used and managed conjunctively and water systems themselves are managed as an integral part of their drainage basins rather than as a separate resource. This avoids problems and inefficiencies created by separate and often conflicting regulatory regimes for different uses of water, and for uses of land and water.
76. A crucial aspect of environmental protection and natural resource management is impact assessment. The notion of Environmental Impact Assessment is widely recognized as an indispensable element of legislation in these fields at regional and national levels. See chapters 3 and 21 herein. This is an important part of the preventive approach to environmental protection. Impact assessments are often broadened to consider effects other than those on the environment, per se, such as those on groups that may be affected by the planned project or activity. The World Commission on Dams final report advocates for a new decision-making framework based on a rights and risks approach.
77. Finally, many governments are moving in the direction of various forms of water pricing and privatization of water service, seeking for greater efficiency and as a mechanism for generating the financing needed to solve public health problems caused by inadequate water supply and sanitation systems.

2. Lessons Learned

78. A wealth of lessons has been learned over the past several decades concerning the management of freshwater resources and legislative approaches to regulating the management, use and protection of this vital resource. Some of these lessons derive from past experience, which has revealed the kinds of approaches that work well and those that have not performed up to expectations. Other lessons are based upon a better understanding of both the functioning of natural systems, of which water forms a critical part, and of how these systems serve to support human life and contribute to economic development. These latter lessons are thus based not so much on experience with actual water legislation, as on knowledge that did not exist when a number of water laws were drafted.
79. Manage freshwater for sustainable development: The World Commission on Environment and Development has defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Sustainable development includes not only equity between generations (inter-generational equity) but also equity among members of Earth’s, and individual countries,’ present populations (intra-generational equity). More generally, sustainable development entails taking care in managing freshwater resources to ensure that efforts to raise living standards do not compromise the sustainability of those resources and associated ecosystems over time. Economic development that degrades the resource base on which it directly or indirectly depends will be short-term development only. Degradation of freshwater will threaten the livelihoods of many, if not all, and especially the poor.
80. Manage freshwater in a holistic manner: an ecosystem approach. In the words of Agenda 21, “Freshwater is a unitary resource. Long-term development of global freshwater requires holistic management of resources and a recognition of the interconnectedness of the elements related to freshwater and freshwater quality.” Management of water resources is holistic when it is done on a catchment or drainage basin basis. This includes

both land and water resources, since land use can have significant impacts on freshwater and related ecosystems. A holistic approach also implies that water resources management will be integrated. Integrated Water Resources Management takes into account not only the ecosystem of which water forms an integral part but also the many different human activities, both existing and proposed, that use and affect freshwater resources. It also has a technical component (i.e., the optimal operation of a watershed or a region's entire system of water diversion, storage, conveyance, treatment and discharge works). Holistic water management is a cornerstone of sustainable development because without it, gaps, overlaps and conflicts among different sectoral management and regulatory efforts are bound to occur, impairing their effectiveness. A holistic approach also means that the different aspects of water management (i.e., its qualitative and quantitative aspects) should be managed and regulated in an integrated and consistent manner because they are strictly interdependent. This approach, also known as the ecosystem approach, is gaining consensus at the international level and is increasingly followed in many national contexts.

81. Ideally, treat all matters concerning freshwater in a single, integrated water law. The lessons that have already been discussed have shown that sustainable development and holistic water management require an integrated approach to the stewardship of freshwater resources. Following such an approach in a coherent manner may be difficult if the relevant laws are contained in scattered statutes. Therefore, as far as practicable, all aspects of water use and protection should be dealt with in a single piece of legislation. There is a tendency in some recently enacted water legislation to follow this approach. The greater the integration of law, the greater the facilitation of holistic management, since all aspects of water regulation may be harmonized in one document. It also helps the drafter to avoid gaps, overlaps, inconsistencies and conflicts in the statutory scheme.
82. Several countries have gone beyond the integration of water resources statutes into a single law by enacting laws that address the sustainable development of multiple resources (e.g., water resources, forestry resources, land use, biological communities), in a single law. The same benefits that come from integration of all the laws governing a particular resource into a single law may be multiplied by the integration of all the laws governing multiple natural resources into a single law.
83. Conserve water through rational urban development policies: There are well-known examples of large population centres that are located in arid areas, far from sources of freshwater. These cities have, typically, experienced fast growth and inadequate local water supplies, and have therefore been forced to transport water over long distances. This usually results in losses of water through evaporation and seepage, and often works to the serious detriment of ecosystems and even populations at the water's source. While there are well-recognized limits on the authority of governments to control where people live, this sort of situation should be anticipated and avoided wherever possible.
84. Build in ways to collaborate with stakeholders: A participatory approach to freshwater resources management should be ensured, one that includes all stakeholders in relevant decision-making processes that provides opportunities for meaningful collaboration between water planners and managers, and interested public and private sector stakeholders. By harnessing the interest, the knowledge, the financial and staff resources, and the political support of stakeholders, water planning and management authorities can leverage their own limited ministerial resources. Among other benefits, such an approach allows those with knowledge of specific local needs and conditions to inform planning and management processes, helping to forestall potential future difficulties. This approach also fosters a sense of legitimacy of those processes and hence of ownership of the results they produce. Ultimately, it can help ensure a more robust solution to planning and management challenges in a given area.
85. Inclusion of environmental impact assessment in project approval processes: Many countries today have legislation requiring the assessment of environmental and other impacts of proposed projects. Impact assessment is an integral part of the preventive approach to environmental protection and thus, sustainable development.

86. Groundwater and surface water should not be treated separately: While there are differences between surface and groundwater that make some provisions applicable only to one water body and not the other, water codes should treat surface and groundwater as parts of a unified planning and permit system. This is especially important for aquifers that are hydrologically connected with a surface watercourse. In such circumstances, groundwater extraction and surface water diversion can have mutually reinforcing effects.

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Resources

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INTERNATIONAL NETWORK OF BASIN ORGANIZATIONS available at www.riob.org

INTERNATIONAL YEAR OF FRESHWATER 2003 available at www.wateryear2003.org/en/

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PATRICIA WOUTERS, THE LEGAL RESPONSE TO INTERNATIONAL WATER SCARCITY AND WATER CONFLICTS: THE UNITED NATIONS WATERCOURSES CONVENTION AND BEYOND available at www.thewaterpage.com

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19. DESERTIFICATION

I. Introduction

1. In all countries of the world, land is a critical resource and the basis for survival. Its degradation, therefore, threatens not only economic but also the physical well-being. Soils in drylands are particularly vulnerable to degradation because they are deficient in moisture, humus and nutrients. New soils in these habitats are formed over long periods of time, from a few thousand to millions of years. A single centimetre of soil may take from twenty to a thousand years to form. Yet, this centimetre can be, and is often destroyed or lost within seconds when the land is mistreated through chemical pollution, over-irrigation, or eroded by water or wind.
2. This chapter discusses desertification, a negative transformation that results primarily from man's over-dependence, overuse and/or mismanagement of inherently fragile lands, especially dry lands. Land degradation, which result from the poor land use practices is of global occurrence, leaves no continent unaffected. UNEP has estimated that globally, about fifty-one million square kilometres is threatened by desertification, which supports one fifth of the world population. There are over 110 countries, including more than 80 developing countries affected by desertification. In Africa alone, some 36 countries are seriously affected by desertification. Globally, there are over 250 million people who are directly affected by desertification.
3. This chapter reviews and discusses the problem of desertification: what it is, its causes, manifestations, effects and scope. It proceeds to provide an overview of international law that has been developed to address desertification and the attendant ecological and socio-economic problems, primarily by examining the scope of the 1994 United Nations Convention to Combat Desertification in Countries experiencing Serious Drought and/or Desertification, particularly in Africa ("Convention") and the applicability of non-legally binding instruments for prevention and control. In establishing rules and regulations to address a particular environmental problem, international instruments, including the Convention, require parties to enact and implement laws at national level and examples of national laws to implement the Convention.

II. International Context

1. The Problem

4. Desertification is defined as the reduction or loss of biological or economic productivity of land resulting from land use or from processes such as water or wind erosion. The United Nations General Assembly coined the term desertification when it decided to convene a conference on the subject in the wake of several years of harsh drought and famine in Africa, particularly in the Sahel region. Desertification does not refer to the expansion of existing deserts. The Convention defines desertification as, "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities." The Convention is also concerned with dryland areas, which are susceptible to desertification.
5. Dryland areas are conventionally defined in terms of water stress so that the *ratio* of mean annual precipitation ("P") to the mean annual potential evapotranspiration (PET) is less than 1.0. The P/PET for arid, semi-arid and dry sub-humid drylands falls within the range of 0.05 to 0.65. (See also article 1(g) of the Convention). The hyperarid regions (true deserts) where P/PET is less than 0.05, as well as areas that lie within humid ecosystems with P/PET of more than 0.65, are excluded from the Convention areas of concern although they may also be affected by land degradation.
6. The arid, semi-arid and dry sub-humid areas cover 6,150 million hectares, or about 47% of total land area in the world. Drylands are ecologically fragile areas; they are characterized by low rainfall that is also seasonal, high rates of evapotranspiration that exceed the rate of precipitation, highly variable rainfall and high potential for water logging and salinization, especially of irrigated lands.
7. Drylands are particularly vulnerable to desertification because they recover slowly from disturbance. With a limited supply of water, new soils form very slowly; salts once accumulated tend to remain where they are; and soils that are dry, poorly held together, and sparsely covered by vegetation are susceptible to erosion. Infrequent rains are particularly erosive, especially where vegetation cover is sparse. Despite the harsh environmental conditions prevailing in the drylands, they still provide much of the world's grain and livestock and constitute critical habitats that support much of the game animals including large mammals and migratory birds.

2. Causes and Consequences

8. Desertification is the result of complex interaction between physical, chemical, biological, socio-economic and political factors of local, national and global nature. The main causes of desertification include: deforestation, clearance of marginal lands for cultivation, poor management of arable land including over use of fertilizers and pesticides, poor irrigation practices, uncontrolled dumping of wastes, deposition of pollutants from the air, encroachment of desert sands onto croplands and poor land-use planning. Such human activities degrade soil fertility and other useful components, loosen soil structure and reduce vegetation cover, thereby exposing land to erosion by rain and wind. Landslides also occur easily.
9. Similarly, maintaining large numbers of livestock leads to overgrazing and to soil compaction due to constant trampling of the ground by animals. The impact loosens the soil structure, affects the health of plant communities, and exposes soil to erosion by wind and water. These ultimately render the land useless.
10. Climate change could also affect agriculture by causing long-term changes in agro-ecosystems through increased frequency and severity of extreme weather events, such as heat waves, droughts, flooding and cyclones, all of which could exacerbate soil erosion and affect patterns of plant diseases and pest infestation.
11. Another factor is chemical degradation of soils, which causes loss of nutrients and/or loss of organic matter, salinization, pollution and acidification. The physical processes involved include compaction, sealing and crusting, waterlogging, and subsidence of organic soils. The other agents of soil degradation include rising sea-level due to either subsidence or climate warming, flooding of valleys for hydroelectric purposes, tourism development of long beaches and in the mountains, and expansion of urban and industrial areas.
12. In addition, international trade patterns can lead to short-term exploitation of land resources for export purposes, leaving negligible profit at the community level for land rehabilitation. Similarly, the development of an economy based on cash crops results in the distortion of local markets and promotes overexploitation of land.

3. Scope and Magnitude of the Problem

13. The three examples (Chile, China and Africa) below demonstrate that the processes of land degradation leading to the loss or reduction of fertility and productivity of land are not limited to one country or continent. They have continued, and continue to take place, in varying degrees, all over the world, making desertification a global problem in terms of occurrence. Besides occurrence, the problem of desertification is global in many other respects. For example, there are close linkages between desertification and poverty, which has implications for global humanitarian assistance.
14. In Africa, an estimated 500 million hectares of land have been affected by soil degradation since 1950, including 65% of the regions agricultural land. In Latin America, land degradation affects 300 million hectares of land as a result of soil erosion, loss of nutrients, deforestation, overgrazing and poor management of agricultural land. In Europe, approximately 12% of the land (115 million hectares) is affected by water erosion. In North America, about ninety-five million hectares are affected by land degradation mainly due to erosion. In Asia, out of a total land area of 4.3 billion hectares, the region contains some 1.7 billion hectares of drylands.
15. Desertification problems raise a number of environmental issues requiring effective laws at the international and national levels to provide basis for joint and individual actions to address them. These issues include:
 - Recognizing that some lands are ecologically fragile and require proper management to avoid turning them into deserts;
 - Controlling of human activities on ecologically fragile lands to prevent desertification;
 - Creating regulatory control of deforestation and soil erosion, among others, to reduce and prevent land degradation;
 - Controlling population growth to prevent and reduce negative population impacts on fragile lands;
 - Rehabilitating desertified lands and lands experiencing impacts of drought that might eventually lead to desertification;
 - Acting to address socio-economic impacts of desertification and drought in affected areas;
 - Integrating the development of lands in environmentally sensitive areas to sustainable development of the areas; and
 - Encouraging of diversification of cropping

systems as well as the adoption of appropriate agricultural technologies, among others, to halt and reverse land degradation.

III. National/Regional Examples

1. Chile

16. Part of Chile, which lies between the Pacific Ocean to the West, Argentina to the South and Atacama desert to the North, is arid. It receives rainfall for short periods in the winter and experiences long dry periods of eight to nine months. Its topography consists of many rugged ranges. These features make the land fragile. As a result of mining activities in the region, large areas were cleared and agricultural activities and livestock raising were intensified by the local people, especially in the short wet periods to meet demands of the increasing populations, without proper soil management measures.
17. Over time, human activities led to massive loss of vegetation cover and organic matter and exposed the light-textured soils to the heat of the sun during the dry season and to the direct action of heavy rains in the short wet seasons. Heavy soil erosion set in throughout the entire area, especially where there were human settlements, resulting in the decimation of vegetation. In addition, heavy losses of top soil occurred. These changes led to reduction in productivity of the land and to reduced human development activities, making the area to be declared by the Chilean government, "a zone of extreme poverty". Because subsistence and development activities could no longer take place on the land, there has been continuous emigration of people from the area, a phenomenon that has created a distortion in the population distribution by age and sex, with accompanying effects on family structures.

2. China

18. Much of the land in China to the north of the country where the Gurbantunggut, Taklimakan, Komdag, Badin Jaran and other deserts in the country are found is dry. Most of the lands receive less than 200 millimetres of annual rainfall with evaporation reaching as high as 4,000 millimetres. Prior to 1956, the country had gone through a century of political turmoil, during which desertification advanced unhindered across the northern dry lands as wind-driven sand dunes swept across the northern part of the country, covering agricultural lands on the river banks and causing people to retreat southwards.

19. The impacts of the shifting dunes were exacerbated by intensive deforestation and plundering of agricultural and other activities of the colonizing powers that occupied China at the time. These activities removed vegetation cover, caused heavy soil erosion and exposed more lands to moving sand dunes, thus, rendering more land unproductive. Upon regaining its status the Chinese government took several measures to combat the process of desertification with appreciable success.

3. Africa

20. In the areas south of the Sahara desert covering Burkina Faso, Mali, Niger, Chad, Gambia and other countries, rainfall is very scanty, evapotranspiration far exceeds precipitation during most months of the year and only one rain-fed crop can be grown in a normal year without irrigation. The climate is generally harsh- a short rainy season, often characterized by violent and unpredictable showers followed by a long dry season. Therefore, the area is ecologically fragile.
21. For many years, people living in these areas practiced shifting cultivation- cutting down trees, slashing and burning portions of land for cultivation for a certain length of time and then abandoning them to regenerate while they moved to newer areas. The increasing population led to the extension of agricultural lands closer to the desert margins without allowing enough time for vegetation regeneration. Areas along rivers in the area were also intensively and extensively irrigated without proper checks on water logging and salinization. Over time, these activities exposed much of the soil to the sun, heat, heavy rains and soil erosion during the wet seasons, and to sweeping desert sand dunes during the long dry periods.
22. As more land became useless and productivity reduced, famine and poverty set in and many migrated from their homelands to urban centres. The situation worsened due to the long periods of drought between 1968 and 1973, and between 1982 and 1985, which led to the drying up of major rivers in the area. The entire belt was turned into a desert adjoining the Sahara desert, which resulted in loss of livestock due to lost pastures, severe famine, deaths to many people in the countries, massive migration, and the desperate need for food aid for millions of people in these areas. According the Report of the United Nations Conference on Desertification (Nairobi, 1977), between 100,000-250,000 people died and 3.5 million heads of cattle perished as a result of the