

PART IV

SPECIAL THEME: WATER

WORLD WATER RESOURCES AND PROBLEMS¹

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Terrestrial Renewable Supply

Fresh water constitutes 2.5 percent of the total water volume on Earth, and two thirds of fresh water is locked into remote ice caps and glaciers. Just 0.77 percent of all fresh water is accessible to man: in groundwater, soil pores, lakes, swamps, rivers, the atmosphere and living things, including men themselves. Part of the volume of even these sources is salty water, the use of which for many human purposes is limited.

Only fresh water flowing through the solar-powered hydrological cycle is renewable. This annual flux is about 500 000 km³; the accuracy of this figure is probably not better than ± 5 percent, which is also roughly its annual variability. The methods to estimate this crucial flux are still so poor that any attempts to determine its possible trends due to the enhanced greenhouse effect are more or less insignificant. The estimates of the annual river flow in the world vary between 35 000 km³ and 45 000 km³. An often cited figure is 40 700 km³, based on an extensive inventory by UNESCO in the 1960s and 1970s.

A maximum sustainable - although highly theoretical - limit for the use of natural fresh water is the total precipitation on all land areas. This is called the terrestrial renewable freshwater supply (TRFS), and its value has been estimated at 110 300 km³. For comparison, this is four times the water volume of the Baltic Sea. As a long-term average, the global TRFS is the sum of river flow and evapotranspiration, but in short-term calculations the changes in terrestrial water storages induce small fluctuations into this balance. If the UNESCO estimate is used for global runoff, the estimate for land area evapotranspiration is 69 600 km³. Thus river flow amounts to 37 percent and evapotranspiration to 63 percent of TRFS.

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The Amazon River accounts for 14 percent of global runoff. As the population of the Amazon Basin is only 0.5 percent of world population, man's possibilities to utilize this huge freshwater source in this basin are very limited. The same is true for several other large rivers: the Zaire, Mackenzie, Ob, Jenisei, and Lena rivers and a number of rivers in tropical and subtropical Asia. For example, on the islands of Kalimantan and New Guinea there are six rivers bigger than the Nile (which has a mean flow of $2600 \text{ m}^3 \text{ s}^{-1}$), but very few people have ever heard even the names of these giants (Kapuas, $5600 \text{ m}^3 \text{ s}^{-1}$; Sepik, $4800 \text{ m}^3 \text{ s}^{-1}$; Mahakam, $4560 \text{ m}^3 \text{ s}^{-1}$; Mamberamo, $4110 \text{ m}^3 \text{ s}^{-1}$; Fly, $3870 \text{ m}^3 \text{ s}^{-1}$; Rajang, $3120 \text{ m}^3 \text{ s}^{-1}$).

Together, the inaccessible remote river flow is globally estimated to be about $9\,000 \text{ km}^3$, i.e. about one fifth of all river water. This leaves $31\,700 \text{ km}^3$ that is geographically accessible. Unfortunately, this amount is very unevenly distributed in time; flood flows constitute the bulk of it. Quantitatively, "the bulk" can only be estimated based on different assumptions and definitions; there is no rigorous scientific way to perform this task. Generally, different estimates usually fall in the vicinity of $20\,000 \text{ km}^3$. Thus, from the human point of view, about half of all river flow is lost; at the same time this "water loss" often induces material losses together with human suffering and victims. The most efficient way to reduce the amount of water lost during floods is the construction of reservoirs. The present storage capacity of man-made reservoirs is around 5500 km^3 , of which some 3500 km^3 is actively used to regulate runoff.

Approximately $11\,000 \text{ km}^3$ of the global river runoff can be considered as stable surface or groundwater flow. Adding to this the component controlled by dams gives an estimate of the total stable flow. As some reservoirs have a large year-round storage capacity, about half of the actively regulated flow can be considered a part of annual flow. Thus, the total stable flow amounts to about $12\,700 \text{ km}^3$.

The portion of total stable flow used by humans will also be estimated. A logical distinction is made between two categories of water use: withdrawals or abstraction, and human instream flow needs. Withdrawals or abstractions i.e. water removed from rivers, lakes or aquifers, is also referred to as the water demand. Part of this water is returned to the river it was taken from and can be used again (although water quality is often deteriorated); part of it will never be available to other users. The latter use is referred to as water consumption. In the case of human instream flow needs, water stays in the river, but is used for waste water dilution, navigation, hydropower production etc. This type of water utilization may also affect water quality and, consequently, although it can be used again, other users as well.

Agriculture is by far the largest water use sector in the world. Agricultural water withdrawals are estimated to be around 2900 km^3 per year. The proportion of consumption to withdrawals varies with climatic factors; it typically ranges between 50 percent and 80 percent. With an average estimate of 65 percent, global agricultural water consumption amounts to 1880 km^3 . Industrial water use is levelling off or even declining in many developed countries, but continues to grow in the developing world. Including the

thermoelectric power industry, industrial use is around 1020 km^3 annually. Most of this is discharged back into rivers; only about 100 km^3 is consumed. Municipal water use per capita varies greatly between countries. A rather rough global estimate is 300 km^3 per year, of which some 50 km^3 is consumed.

When considering overall water consumption by humankind, at least one additional component should be included. Evaporation losses from reservoirs are significant particularly in arid climates. Total consumption due to this phenomenon is usually estimated to be 5 percent of the reservoir volume annually, i.e. 270 km^3 . Thus, overall human water consumption can be estimated to be some 2300 km^3 per year, while total withdrawals amount to 4500 km^3 . Even the latter figure is only some 12 percent of total river runoff. On the basis of this percentage, there should be no major water problems in the world.

The instream water use requirement should also be estimated, but this cannot be made with reasonable accuracy. In calculation attempts, this requirement is usually assumed to be mainly created by the need to dilute pollution. An often used dilution factor for assessing waste absorption capacity is 28 litres per second per 1000 people. Applying this rate to the present world population yields a requirement of 5100 km^3 .

In actual fact, the waste waters of roughly one third of global population go through at least secondary treatment before being discharged back into the watercourse, while in developed countries floods may cause major waste flushing events. Thus, it is not wise to give anything but a scale estimate of a few thousand cubic kilometres for the instream dilution use of water. The flow requirement of navigational uses might be of the same order of magnitude. Mankind also utilizes considerable amounts of rain-water directly in agricultural and other biomass production. This “green water use” has been estimated at $18\,200 \text{ km}^3$ per year, i.e. much more than the amount of “blue water use”.

The Water Resources of Different Regions

At a high level of authority, water resources have been defined by the World Meteorological Organisation (WMO) as the total amount of water available, or capable of being made available, for use in sufficient quantity and quality at a location and over a period of time appropriate for an identifiable demand. At the continental level, blue water resources range between $4000 \text{ m}^3 \text{ a}^{-1} \text{ cap}^{-1}$ (Europe, Asia) and $50\,000 \text{ m}^3 \text{ a}^{-1} \text{ cap}^{-1}$ (Australia and Oceania). However, owing to the huge water resources of New Guinea, the figure for Australia itself is considerably smaller, only half of the blue water resources of the “genuinely wettest” continent, South America.

When the water resources of a country are presented, they may refer to the total amount of water flowing in the rivers of that country. This is a reasonably good definition in the case of island states, but unfortunately national borders do not coincide with river basin

divides. This implies that many countries have foreign water flowing in their rivers. Therefore, a better way is to give the water resources of a country without the inflows from upstream countries. The range between different countries is very large:

	Country	m³/a per capita
1	Iceland	606 000
2	Surinam	452 000
3	Guyana	282 000
4	Papua New Guinea	174 000
5	Gabon	140 000
...		
34	Finland	21 300
...		
149	Saudi Arabia	119
150	Jordan	114
151	United Arab Emirates	64
152	Egypt	43
153	Kuwait	11

Water Quality Issues

From a human health point of view, the key issues driving water quality degradation today include waterborne pathogens and noxious and toxic pollutants. According to the World Health Organisation (WHO), waterborne infectious diseases caused three million deaths in 1995, 80 percent of these were children under five.

Water pollution problems owing to human activities exist and affect all living things at different levels, both in developed and developing countries. Industrial, mining and waste disposal sites are the most frequent point pollution sources of aquatic ecosystems. The cumulative impact of multi-point pollution is common in many urbanized river basins. Diffuse pollution by nitrates, phosphates and pesticides together with eutrophication occurs as a result of poor agricultural water management. When this pollution affects groundwater, problems become more complicated than in the case of surface waters.

Salt water intrusions caused by aquifer overexploitation in coastal areas and by irrigation of agricultural lands also affect large areas. The acidification of soil and fresh water by atmospheric emissions of sulphur and nitrogen dioxide are problems with continental dimensions.

Land Degradation

An extensive survey by the United Nations Environment Programme (UNEP) has estimated that almost 20 million square kilometres of land in the world are degraded. This is 17 percent of all vegetated land in the world. The largest areas of degraded land occur in Asia and Africa but the loss of drylands is, surprisingly, highest in Europe. This can perhaps be related to the intensity and length of land use in the Mediterranean region. Lightly degraded land has lost below 10 percent of its productivity. For moderately degraded land the loss is 10-25 percent, for strongly degraded land 25-50 percent and for extremely degraded land over 50 percent. Of the total of 20 million square kilometres, the percentages for these four categories have been estimated at 38, 46, 15 and 0.5 percent, respectively. Water is most responsible for land degradation, causing 56 percent of it. This is twice as much as that caused by wind. Chemical degradation is responsible for 12 percent and physical processes for 4 percent.

In its survey, UNEP placed special focus on Africa. Water erosion is a particularly severe problem in South Africa and Namibia; in the Sahel it hits worst the Ethiopian Highlands, which can lose up to one billion tonnes of top soil per annum. However, even though it can be completed with good accuracy on an experimental plot, the estimation of erosion rates over a large area is very difficult. A high fraction of erosion may take place during intense storm events, which are localized and might not hit scientists' experimental plots. In addition, much of the sediment load in rivers may come from bank erosion rather than from agricultural lands affected by the catchment.

Salinization contributes to the land degradation of less than 4 percent of the total degraded area. However, it should be taken into account that the loss is very different if one hectare of fertile, irrigated land is degraded instead of one hectare of low-quality land. Salinization is, in fact, a particular nuisance in irrigated areas.

Water Scarcity

There are many ways to classify regions or countries according to water scarcity. In a widely used classification, four categories of water stress, based on the availability of fresh water, are distinguished: low water stress, moderate water stress, medium-high water stress, and high water stress. Low water stress occurs in countries that use less than 10 percent of their available fresh water. These countries generally do not experience major stresses on the available resources. Moderate water stress occurs when the use of available water in the range of 10-20 percent. This generally indicates that availability is becoming a limited factor, and significant effort and investment are needed to increase supply and reduce demand. Medium-high water stress occurs when water withdrawals are in the range of 20-40 percent. The management of both supply and demand will be required to ensure that the use remains sustainable. There will be a need to resolve competing human uses, and aquatic ecosystems will require special attention

to ensure they have adequate water flows. Developing countries, in particular, will need major investments to improve the efficiency of water use. High water stress means use of more than 40 percent of available water. This indicates serious scarcity, and usually an increasing dependence on desalination, fossil groundwater etc. There is an urgent need for intensive management of the supply and demand of water.

In addition to these water stress categories, the UN has divided people into four income classes: low, lower-middle, upper-middle and high. Well over half of the world's 6.2 billion people fall into the low income category, and more than one third of these people are in countries that already face medium-high to high water stress. The main water use in these countries is for irrigation, to a large extent with the same methods that have been in use for thousands of years. These countries also suffer from a lack of water pollution control. As to what the future holds, they have neither the water nor the money to shift development away from inefficient irrigation. Elsewhere, climate change is not expected to coddle these countries.

International River Basins

A divide between two river basins would often be a suitable line along which to draw a border between neighbouring countries. In fact, there are many such borders in the world, most of them very peaceful. However, the cases in which national borders follow a river or are crossed by them are even more frequent. Along these borders, conflicts over water use have been numerous. Altogether, there are almost 250 international river basins, covering more than half of the Earth's land area and affecting a population of 2.8 billion people. Most international river basins are shared by two countries; 30 are shared by three, eight by four and 14 by five or more.

There are 60 countries in the world in which the proportion of foreign water exceeds 20 percent:

Africa: Egypt (96), Mauritania (96), Niger (89), Namibia (86), Botswana (80), Sudan (77), the Congo (Congo-Brazzaville) (73), Eritrea (68), Chad (65), the Gambia (62), Ghana (62), Benin (60), Mali (60), Somalia (56), Mozambique (53), Swaziland (42), Guinea-Bissau (41), Kenya (33), Senegal (33), Zambia (31), Zimbabwe (30), Nigeria (21).

Asia: Turkmenistan (96), Cambodia (82), Uzbekistan (76), Azerbaijan (61), Iraq (60), Vietnam (60), Syria (52), Tajikistan (47), Bangladesh (42), Thailand (38), Pakistan (36), Kazakhstan (33), Jordan (24), Israel (21).

Europe: Hungary (95), Bulgaria (91), the Netherlands (89), Moldova (83), Romania (82), Luxembourg (80), Slovakia (80), Yugoslavia (65), Albania (53), Latvia (49), Portugal (45), Germany (44), Lithuania (43), Croatia (42), Austria (38), Belgium (33), Slovenia (32), Belarus (29), Estonia (27), Greece (23).

South America: Paraguay (70), Uruguay (52), Venezuela (35), Argentina (30), Brazil (25).

In addition to the percentage of foreign water used, other important factors are the overall amount of foreign water and the location of foreign water sources in the country. If a large international river flows far from the population centres or main agricultural areas of a country, this additional water source might not be of great value.

International waters can also be located under ground. If a groundwater aquifer is shared by two or more countries, questions about water ownership become even more difficult than with surface waters. In the case of renewable groundwater, hydrologically there is no difference with surface water; the rights to use water should be divided proportionally to the aquifer recharge. In case of fossil water, however, this logic does not work.

How, then, should international rivers be managed? Six research perspectives needed for the “perfect” management of international rivers have been presented: natural sciences, engineering, social optimization, law, decision-making, and ethics. From the natural sciences perspective, essential information on physical, chemical and biological processes in the river basin is needed. The engineering perspective has led to questions concerning how different structural measures affect water resources. These measures have been the core of 20th century river basin management. With social optimization, a balance between benefits and costs is sought; optimal versus feasible solutions are to be presented. The law perspective should give comparisons between the rules and practices of river basin management, as well as address the relationship between management rules and justice. Within decision-making, the actual behaviour of all actors – water users, economic sectors, authorities, etc. – and their motives should be studied. Last, but not easiest lies the question: “What is ethical?” The answer may be completely different in neighbouring countries. Fertile ground for successful river basin management has been created if research from all these perspectives is carried out. In practice, this has happened very seldom, if ever. Even if it would happen one day, all perspectives are at their best semi-objective.

Measures to Reduce Water Scarcity

Many opportunities exist to increase water resources. Some of these can be introduced with relatively low costs, some require expensive technology. However, there are also methods which can be characterized as high-tech but low-cost. Often, the effective use of water resources is more important than trying to increase them. If waste water is abundant in the world, wasted water might be even more abundant. Water use efficiencies below 50 percent are common in agriculture, industry and municipal water use. The following section will not give water-saving tips; instead some methods to increase water resources are discussed. Their order is not based on their potential importance, but mainly on their position in the hydrological cycle.

Rainfall augmentation

Throughout history, man has tried to modify the weather. Rainmaking has been a favourite topic. The modern technology of weather modification is based on the discovery in the late 1940s that supercooled cloud droplets could be converted into ice crystals with the help of an artificial nucleus such as silver iodide. Today, the knowledge on cloud microphysics offers relatively good possibilities to estimate when a cloud seeding can be successful. The atmosphere needs to be in such a condition that a relatively small human-induced disturbance can trigger the formation of rain. The best targets are often clouds hanging over a mountain slope, where seeding can reach a long cloud band in one flight. The successful seeding of cumulus clouds, however, is rather difficult.

Altogether some sixty countries have performed trials in scientific rainmaking. The most extensive experiments have been carried out in the USA, Israel, Australia, Italy and the former Soviet Union. The results have not always been convincing. Among the most successful are the seedings in northern Israel in 1961-75; they increased winter precipitation by 15-20 percent. A similar increase was obtained in Jordan in 1995, over an area of 8000 km² in the northern part of the country. In Colorado, a 10 percent enhancement has been reached. Increases in excess of 50 percent have been reported in some experiments, but it is possible that they are exaggerated.

Cloud seeding may also cause problems of a legal nature. A neighbouring country might interpret this manipulation to have adverse effects within its territory with thinking along the lines of: "If they hadn't made rain there, it would have rained in our country." Consequently, the international community is developing guidelines for resolving conflicts arising from weather modification activities.

Rainwater harvesting

Rainwater harvesting refers to the collection and concentration of rainfall and its use for different purposes, mainly in agriculture and by households. In the past, water harvesting played an important role world-wide in agricultural societies in arid and semiarid areas. After a decline during the 20th century, it has regained importance in recent decades.

Each rainwater harvesting system requires a catchment area with a sufficiently high runoff coefficient. According to the size of this catchment, three major types of rainwater harvesting can be distinguished: microcatchment harvesting, macrocatchment harvesting, and large catchment harvesting. A microcatchment can be a roof or an inclined collection basin with low infiltration capacity. A single tree or bush can be planted directly into this basin. Macrocatchment harvesting is also called water harvesting from long slopes or harvesting from external catchment systems. In this case, the catchment is located outside the cropping area, to where water is then transferred.

Large catchment harvesting systems can be many square kilometres in size and give rise to runoff water flowing through wadis or other channels. This method is also called floodwater harvesting and is comprised of two forms. In the case of “floodwater harvesting within the river bed” the water is dammed and, as a result, it partly or completely inundates the valley bottom or flood plain. The water is then absorbed into the earth leaving the area available for use as pastures or even cropland. In the case of “floodwater diversion” water is forced to leave its natural course and is conveyed to nearby cropping areas. Large catchment harvesting requires more complex structures of dams and distribution networks and higher technical knowledge than the other two harvesting methods.

Internationally, the best known rainwater harvesting systems are those found in the Negev Desert. They date back as far as the 10th century B.C. and reached their peak some two millennia later. Cisterns carved into the hillsides to ensure drinking water throughout the year for people, sheep and goats were an essential part of the system. In northern Yemen, a system also dating back to at least 1000 B.C. diverted enough water to irrigate up to 20 000 hectares, producing food for as many as 300 000 people. Since at least the Roman times, water harvesting techniques were applied intensively in northern Africa. Archaeological research has revealed that the wealth of the “granary of the Roman Empire” was largely based on runoff irrigation. In Egypt, the north-west coast and northern Sinai have a long tradition of water harvesting. Wadi terracing structures have been used there for several millennia.

Successful water harvesting projects are often based on field experience and trial and error rather than on scientifically well established techniques. Thus, they cannot be reproduced easily. Agricultural extension services often have limited experience with these methods. In very dry years, rainwater harvesting cannot necessarily compensate for water shortages. Another disadvantage is the possible conflict between upstream and downstream users, and possible harm to fauna and flora adapted to running waters and wetlands. Rainwater harvesting can also be a rather labour-intensive method.

Collection of fog and dew

The collection of fog droplets in coastal and high mountain areas as well as the harvesting of dew in desert areas was practised already in ancient times. This form of water collection took place in Mexico, Chile, Colombia, Sudan, Yemen, Oman and Namibia, for example. Moisture collection can be improved by using artificial surfaces such as nets or polyethylene sheets. Today, in the village of Chungungo in northern Chile, 75 synthetic nets with a total area of 3500 m² are used to collect moisture from fog. In average weather conditions, about three litres of water per square metre can be collected per day. Prior to the introduction of this system, water was delivered to the 350 villagers by tankers from a distance of 70 km.

Old and new groundwater innovations

A *qanat* is a horizontal tunnel that taps underground water in an alluvial fan without pumps or other equipment, and brings water to the surface. A *qanat* system is composed of three parts: one or more vertical head wells, dug into the water-bearing layers of an alluvial fan, to collect water; a gently downward-sloping tunnel leading the water from the head wells to a lower point at the surface; and a series of vertical shafts between the ground surface and the tunnel, for ventilation and removal of excavated debris.

The longest *qanat* in Iran is 40 km long and has a mouth diameter of almost two metres. Altogether, there are an estimated 40 000 *qanats* in Iran with a total length of 270 000 km. Until the 1950s, the *qanat* system provided for over half of Iran's water needs and many towns still utilize them. The digging of *qanats* obviously required much labour and a special class of slaves existed in Ancient Persia to maintain the system. Areas that can be supplied with water from *qanats* lie near low-elevation alluvial fans and often provide less fertile soil conditions than those which are higher up. Sometimes *qanats* dry up during prolonged droughts and collapsed tunnels occur.

An example of unconventional technology being used to collect groundwater can be found with the construction of underground dams. Compared to an open-water reservoir, groundwater is well protected against evaporation losses, which can be as high as four metres per year in a hot, arid climate. It is not uncommon that geological conditions allow the damming of a permeable layer, which is confined by an impermeable stratum. Nature itself uses this system extensively in coarse river sediments.

Desalination

Several techniques are available to convert saline or brackish water into fresh water. Examples are distillation processes which can include multistage flash (MSF), multiple-effect distillation (MED) and vapour compression; electro dialysis processes such as electro dialysis and electro dialysis reversal; reverse osmosis (RO) processes; and freezing.

Over 12 000 desalination plants with a combined total capacity of 25 million m³ per day had been installed world-wide by the end of 1997 (excluding shipboard units). Some of the plants are located in slightly astonishing places with, for example, the northernmost one in the world serving oil production in the Alaskan North Slope. A large plant is lowering the salt content of the Colorado River at the Mexican border.

With 26 percent of global desalination capacity, Saudi Arabia leads the world in this area. Almost two thirds of global capacity is in the Middle East, 10 percent is in North America and 8 percent is in Europe. Distillation - both MSF and MED - account for 65 percent of capacity, RO for about 30 percent and electro dialysis for some 5 percent. About half of all desalination plants have RO systems, but the use of distillation in large units answers for its high share of the capacity. In recent years, the global desalination

market has been driven by industrial development, tourism and population increase, especially in the Middle East, North Africa and Southern Europe. In 1996 the value of the market was US\$ 1.6 billion and was expected to exceed US\$ 2 billion by 2001. Prices, however, are falling as competition increases in the equipment market, particularly in membrane technology.

Desalination using renewable energy has been intensively studied in recent years. The idea is not new; a plant based on solar desalination was built in Las Salinas, Chile, in 1872. It was in use for 40 years and produced about 20 m³ of fresh water per day. The world's largest desalination plant is now in Libya (2000 m³ per day); it is partly powered by wind turbines. The European Union also has an interest in solar desalination. A small EU-funded pilot joint solar/wind plant is in operation on Tenerife and two more have been planned, one in Greece and one in Jordan. These plants collect the sun's rays to heat water, but also use windmills to reduce the atmospheric pressure and thus decrease the boiling point of the seawater taken into the system. The cost of desalinated water in the Tenerife plant has been estimated at US\$ 1.9/m³.

The cost of desalinated water varies significantly depending on plant type and size, the quality and source of water, the location of the plant in relation to the coast, the price of energy, chemicals and labour, and the cost of waste disposal. In general, the costs are still so high that the use of desalinated water for irrigation purposes is too expensive. A study performed in 1994 compared the costs of water transfer and desalination in order to increase the water resources of the Gaza Strip. The conveyance of water from the Nile to Gaza was estimated at US\$ 0.20-0.82 per m³, from the Euphrates to Gaza at US\$ 0.36-0.82 per m³ and desalination at US\$ 0.61-0.87 per m³. The reduction of desalination costs is possible in the future. The best current technologies use about 30 times the theoretical minimum energy requirement. New innovations might reduce energy requirements to ten times the minimum. However, for the foreseeable future, desalination is likely to continue to be used primarily to meet household water needs in water-scarce, energy-rich countries.

Water transfer

A number of large water transfer projects have been carried out on all continents, excluding Antarctica, particularly in the latter half of the 20th century. Most of them have been intra-country projects in, for example, Southwestern United States, Australia, Libya and Saudi Arabia. The largest water transfer project in the world, the Kara-Kum Canal, also used to involve only one country, the Soviet Union, but today is shared by four partners: Tajikistan, Kyrgystan, Uzbekistan and Turkmenistan. Most of the runoff is generated in the first two countries, while the use of water is concentrated in the latter pair. This cannot be without causing tension in the region.

In southern Africa, there are several water transfer projects either in the construction or the planning stages. South Africa already receives water from Lesotho and the scheme is being extended. As for Botswana, the country only has two perennial river systems,

the Chobe and the Okavango in the north. These constitute around 95 percent of the country's total surface water. In addition, they flow through sparsely populated areas at the same time feeding biologically important and sensitive areas, most notably the Okavango Delta. A recent plan by the Botswana Government was to take water from the Okavango and pump it to the South by pipeline. This plan was stopped by environmentalists and high-level pressure from the international community. Considering these pressures, the Botswana Government launched the National Water Master Plan for the period 2000-2020. Central to it is the huge US\$ 400 million North-South Carrier Project. This scheme consists of a 360 km long, 1.4 m diameter pipeline, which will take water to the capital Gaborone from the Letsibogo Dam, to be built at the confluence of four rivers in the northern part of the country.

One of several water transfer utopias is located in the southern half of Africa. The water-stressed states in the south could in theory set their sights on the huge River Zaire, as the "ultimate solution" to their need for new water resources. The scarcity of water is a dominant feature in almost all southern Africa countries. For a Finn, a symbol for this situation could take the name of the currency in Botswana, the "pula", which means rain in the Setswana language.³

Apart from water, power can also be transferred. The African Development Bank agreed in 1993 to pay for a feasibility study for erecting a 4000 km power line from Zaire⁴ to Egypt. The idea was to turn the Zaire River into a major hydropower source. This river could produce up to 20 000 MW of electricity from one site, the Inga Falls. The world's largest existing hydropower plant, the Itaipu in the Parana River, produces some 12 000 MW.

Iceberg utilization

The Antarctic releases 1000 km³ of fresh water each year in the form of tabular icebergs. This is one quarter of human water withdrawals. The idea of transferring this resource to lower latitudes is not new. Small icebergs were towed from southern Chile to Valparaiso and Laguna San Rafael already in the 1880s. A suitable iceberg for today's towing efforts would be two kilometres long, half a kilometre wide and some 200 metres thick. Satellite images could be used to locate the candidates. Insulation against melting could be provided, whereby losses during a half a year's trip from the Antarctic waters to the Arabian coast would only be 20-30 percent. Vessels big enough for towing already exist.

³ Pula in Finnish means "shortage".

⁴ Now the Democratic Republic of the Congo (Congo-Kinshasa).

What does one do when an iceberg arrives? This is a good and rather difficult question. First of all, conventional ports are far too shallow for a load which extends to the depth of at least one hundred metres. Perhaps a floating port with ice-grinding facilities and a pipeline to transfer the “ice flour” to the shore could be a suitable alternative. The cold content of an iceberg can be as valuable in energy production as its water content is in its use. This double-benefit greatly improves the economy of the undertaking. However, although Saudi Arabia for example has performed a feasibility study on iceberg utilization, no country has started a modern ice business.

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INTERNATIONAL LAW AND WATER¹

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Introduction

Many natural resources have a double function: on one hand, they serve as natural resources subject to human consumption and exploitation and, on the other hand, they have a particular ecosystem function. Water is a good example of such a natural resource. While it has several uses such as navigation and irrigation, it also has an essential ecosystem role. This dual character is reflected in international rules which regulate and manage water issues. Indeed, over the last hundred years or so, international law has strived to solve, regulate and manage various problems relating to the utilization and protection of water.

International law textbooks usually make a distinction between marine and freshwater resources. While the former refers to oceans and seas, the latter includes, in particular, rivers and lakes. Given the different nature and international character of marine and freshwater resources it is understandable that legal frameworks covering them are quite different. This work will concentrate on the protection and utilization of freshwater resources which have an international character.

Boundary waters refer to waters such as rivers, lakes, reservoirs and canals, parts of which are situated in different states.³ They are called boundary waters because they either form a boundary between states or they run across one. For example, in many cases state boundaries have been drawn to coincide with rivers or a watershed for easy

¹ This paper is based on a lecture given by the author on 26 August 2004. The paper is also based on the work: Tuomas Kuokkanen, *International Law and the Environment: Variations on a Theme*, The Erik Castrén Institute of International Law and Human Rights, Volume 4 (Kluwer International: The Hague/London/New York, 2002).

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³ See Article 2(b), Convention on the Law of the Non-navigational Uses of International Watercourse, New York, 21 May 1997, not yet in force, 36 *International Legal Materials* (1997) 700, www.un.org/law/ilc/texts/nonnav.htm.

recognition. With regard to contiguous rivers that cross boundaries, interest in regulating them results from the physical qualities of such rivers.⁴ Boundary waters are also called international watercourses because they are already by definition international. For this reason, regulations on the use of these shared natural resources⁵ have to be established bilaterally or multilaterally. Conversely, states do not have an interest in regulating the internal waters of other countries which do not affect international waters.⁶

In order to understand better the various legal aspects relating to water issues, rules of international law relating to water can be divided into three broad categories or approaches: general international law, the regulatory approach and the management approach. The first category refers to general functions of law, such as dispute settlement, or classical principles, such as good faith or *sic utere*. The regulatory approach seeks to solve problems in advance through international regulation. As opposed to general rules, the approach consists of specific substantive rules on the utilization and protection of waters. The management approach refers to a more technical and policy oriented approach where politics and diplomacy have more of a supervisory role. It aims, through technically oriented management, to co-ordinate, reconcile and optimize long-term water concerns and short-term utilization interests.

While the approaches are divided on substantive grounds, they also reflect historical development. The general international law approach refers in particular to the era before substantive water regulations. The regulatory approach grew in the 20th century from the need to regulate utilization and protection of water issues. The management approach began to develop in the 1980s and 1990s. However, even though the management approach tends to dominate currently, the other two doctrines are nevertheless still relevant, and not retired to the history books.⁷

⁴ As Berber notes, 'water which is today in the territory of one state and therefore a part of its state territory will flow tomorrow into the territory of another state and become part of that state's territory.' See F.J. Berber, *Rivers in International Law* (1959), at 4.

⁵ In discussing early treaties on fresh water Schwebel notes that 'their assumption that boundary waters are a shared natural resource is beyond controversy.' See Stephen M. Schwebel, Special Rapporteur, 'The second report on the law of the non-navigational uses of international watercourses', *Yearbook of the International Law Commission* (1980), Vol. II Part One, at 195.

⁶ For example, the crux of the case concerning the diversion of water from the River Meuse, which related to the use of the canal known as Zuid-Willemsvaart, was the finding that the two parties had limited their sovereignty only at the treaty area. Outside this area, the parties were free to take any action provided that it would not violate the treaty. See *Case Concerning the Diversion of Water from the River Meuse (Netherlands v. Belgium) (Judgement)*, PCIJ Series A/B, No. 70 (1937) at 26.

⁷ For discussion, see Kuokkanen (2002), *supra* note 1, at xxi-xxxiii and 347-358.

Recourse to general international law

Early water conflicts were relatively infrequent. Moreover, if such disputes occurred they were predominantly bilateral in nature. It was therefore sufficient to deal with them retrospectively through traditional international dispute settlement techniques by applying general international law to the facts.

Traditionally, water issues reflect the tension between an upstream and a downstream country. From a legal point of view, the starting point in considering the applicable law is the abandonment of the doctrine of absolute sovereignty which would allow an upstream country to use waters in its territory without limitations and a downstream country to prohibit the causing of any harm. As both the upstream and downstream country can rely on it in an absolute manner, the doctrine is self-contradictory. In the water context, the doctrine of absolute territorial sovereignty propounded by Judson Harmon in his legal opinion has become known as the Harmon doctrine.⁸ The doctrine is based on a philosophical approach supported by early scholars, rather than an application of international law in an adjudicative context. In view of this lack of professional value, the Harmon doctrine revealed a need to develop more functional and analytical ways to deal with water disputes.

The *Lac Lanoux* case⁹ is a seminal case relating to water in which the arbitral tribunal managed to settle the dispute by applying judicial techniques. The case illustrates how a resort to third-party adjudication may prevent stalemates and promote a more constructive solution.¹⁰ By distinguishing between the formal and substantive aspects of sovereignty, a method capable of resolving concrete issues, unlike the Harmon doctrine, was applied by the tribunal. To supplement this method, the tribunal used procedural techniques involving the allocation of burden of proof. From the environmental point of view, the ruling recognized that a state has a right to use its natural resources but must take into account the interests of other states.

The dispute in the *Lac Lanoux* case related to the exploitation of natural resources rather than to the protection of the environment. In effect, hydroelectric interests versus agricultural interests formed the background to the dispute. While the French government planned to divert water to generate electric power, the Spanish government was concerned about the possible adverse impact of such a diversion on Spanish

⁸ Official Opinions of the Attorneys-General of the United States, Advising the President and Heads of Departments in Relation to Their Official Duties, Vol. XXI, Treaty of Guadalupe Hidalgo - International Law, Opinion by Judson Harmon, at 274-283.

⁹ *Affaire du Lac Lanoux*, XII *United Nations Reports of International Arbitral Awards*, at 285-317; *Lake Lanoux Arbitration* (English translation) 24 *International Law Reports* (1957), at 105-142.

¹⁰ John G. Laylin and Rinaldo L. Bianchi, 'The Rôle of Adjudication in International River Disputes. The Lake Lanoux Case', 53 *American Journal of International Law* (1959) 30-49, at 37.

agriculture. From the legal point of view, France relied on its right to use its natural resources, while Spain argued that the French project required prior agreement between the two governments.

By way of a dictum, the tribunal stated that there existed a rule prohibiting an upper riparian state from altering the waters of a river in circumstances calculated to do serious injury to the lower riparian state. As Spain was not able to submit evidence showing any injury there was no need for the tribunal to consider what would amount to so-called serious injury. Thus, that threshold was left undecided.

Regulating Boundary Waters

In view of the inherent international aspect of boundary waters, it was natural that states began to regulate the use of such waters through bilateral and multilateral agreements. The general purpose of boundary water treaties was to prevent disputes by reconciling the various interests of riparian states. This objective is explicitly stated in the Preamble of the 1909 Boundary Waters Treaty between Canada and the United States, according to which the aim of the treaty is:

to prevent disputes regarding the use of boundary waters and to settle all questions which are now pending . . . and to make provision for the adjustment and settlement of all such questions as may hereafter arise.¹¹

In the same vein, the ruling by the Permanent Court of International Justice in the *Case Concerning the Diversion of Water from the River Meuse* throws light on the distinction between dispute settlement and the regulatory approach.¹² The Court found that a treaty dating from 1863 between the Netherlands and Belgium was ‘an agreement freely concluded between two States seeking to reconcile their practical interests with a view to improving an existing situation rather than to settle a legal dispute concerning mutually contested rights.’¹³ Thus, the essence of the 1863 treaty was to regulate practical interests in order to prevent disputes.

H.A. Smith emphasizes the need for a regulatory approach in his famous work on the economic uses of international rivers.¹⁴ He points out that in many cases a river system can present complex questions because the use of its waters is demanded simultane-

¹¹ Treaty between Great Britain and the United States Relating to Boundary Waters, and Questions Arising between the United States and Canada, Washington, D.C., 11 January 1909, reproduced in *United Nations Legislative Series, Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, UNLS ST/LEG/SER.B/12 (1964), at 260.

¹² *Supra* note 6.

¹³ *Ibid.*, at 20.

¹⁴ Herbert Arthur Smith, *The Economic Uses of International Rivers* (1931), at 1-13.

ously for navigation, irrigation, electric power and the supply of large cities, and he specifies that the function of law is 'to provide rules for settling the possible conflict of interests'¹⁵ by aiming to strike an equitable balance between them. Berber too argues in favour of treaty-making which, according to him, represents the highest form of political wisdom. Noting the rudimentary, vague, and developing character of international water law, he contends that 'the conclusion of specific and specialised water treaties remains far and away the best solution.'¹⁶

In order to regulate the various interests concerned, states concluded many watercourse treaties from the beginning of the 19th century up to World War II. In exceptional cases states established joint jurisdiction or agreed on common use with regard to a particular watercourse. More often, substantial regulations concerning the navigational and non-navigational uses of boundary waters were drawn up.

States have been particularly eager to conclude agreements to safeguard the freedom of navigation. Furthermore, states have established international bodies to deal especially with navigational interests. The first international waterway administration was established in 1804 to deal with navigation on the Rhine River. A general declaration on the freedom of navigation was made by the Treaty of Paris in 1814. Subsequently, in 1821 a river commission was established to oversee navigation of the Elbe. Internationalization was pushed further by the 1856 Treaty of Paris which established the European Danube Commission consisting not only of representatives of riparian states but also of non-riparian states.¹⁷ Following the model of the Danube administration, the International Commission for the Navigation of the Congo was established in 1885. After World War I, the freedom of navigation of the important European rivers was confirmed by the Treaty of Versailles. For example, Article 291 declares the Danube an international river. Finally, under the auspices of the League of Nations, the Statute on the Régime of Navigable Waterways of International Concern was adopted at Barcelona in 1921.¹⁸ The Statute defines as navigable waterways of international concern all parts of a waterway which separate or traverse different states and which are naturally navigable to and from the sea.

Turning to non-navigational uses of boundary waters, already prior to the Second World War, states concluded a number of bilateral and multilateral treaties. While some of the treaties regulated utilization in general terms, others regulated such traditional uses as irrigation, fishing and the floating of timber. After the Industrial Revo-

¹⁵ *Ibid.*, at 13.

¹⁶ Berber, *Rivers*, *supra* note 4, at 270.

¹⁷ Articles XVI-XVII, General Treaty for the Re-Establishment of Peace between Austria, France, Great Britain, Prussia, Sardinia and Turkey, and Russia, Paris, 30 March 1856, 114 *Consolidated Treaty Series* 409.

¹⁸ Statute on the Régime of Navigable Waterways of International Concern, Barcelona, 20 April 1921, 7 *League of Nations Treaty Series* 50.

lution, it was recognized that regulations should be extended to cover modern uses of boundary waters. To this end, bilateral agreements were concluded in order to impose detailed regulations on, for example, the use of hydro-electric power, the size of a dam to be constructed in a boundary water or the volume of water to be diverted for mining or industrial purposes. Moreover, in 1923, a multilateral treaty called the Convention Relating to the Development of Hydraulic Power Affecting More than One State was concluded.¹⁹

During the late 19th century and early 20th century, environmental issues and problems were not perceived to be very important and only a few boundary water treaties imposed regulations aimed at preventing pollution.²⁰ As the recognition of freshwater pollution problems increased there was a need to widen the scope of water agreements. Furthermore, it was understood that there was a need to comprehensively regulate a hydrologic unit. Thereby, the process of internationalization was broadened from only regulating boundary waters to also controlling watercourses of international concern.

In the 1960s and 1970s, several bilateral and multilateral treaties were concluded to protect regional watercourses. For example, regulations were issued to protect Lake Constance,²¹ the Mosel,²² the Rhine²³ and the Great Lakes.²⁴ These regulations set specific water quality objectives or emission limits or alternatively established joint bodies under which specific regulations could be determined. Thus, the emphasis was placed upon waters crossed boundaries rather than waters which formed boundaries. To emphasize this aspect, international instruments began to refer to transboundary or international waters rather than to boundary or frontier waters.

¹⁹ Convention Relating to the Development of Hydraulic Power Affecting More than One State, Geneva, 9 December 1923, 36 *League of Nations Treaty Series* 76.

²⁰ Only few treaties imposed limitations upon the use of waters in order to avoid pollution. See, for example, second paragraph, Article IV, 1909 Boundary Waters Treaty, *supra* note 11 : 'It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other.'

²¹ Convention on the Protection of the Waters of Lake Constance Against Pollution, Paris, 16 November 1962, 620 *United Nations Treaty Series* 191.

²² Protocol Concerning the Constitution of an International Commission for the Protection of the Mosel against Pollution, Paris, 20 December 1961, 940 *United Nations Treaty Series* 211.

²³ Agreement Concerning the International Commission for the Protection of the Rhine against Pollution, Berne, 29 April 1963, 994 *United Nations Treaty Series* 3; Convention for the Protection of the Rhine against Chemical Pollution, Bonn, 3 December 1976, 16 *International Legal Materials* (1977) 265.

²⁴ Agreement between the United States of America and Canada on Great Lakes Water Quality, Ottawa, 22 November 1978, reprinted in Philippe Sands, *Principles of International Environmental Law*, Vol. IIA (Cambridge University Press, 1995), at 559.

Management of international watercourses

While the doctrine of sustainable development gained worldwide acceptance after the Brundland Commission's 1987 Report *Our Common Future*²⁵ and the 1992 Rio Conference, its seeds germinated and grew from early attempts to manage natural resources. In the water context, the doctrine of reasonable and equitable utilization represents such an early attempt.

The principle of reasonable and equitable utilization began to develop in the beginning of the 20th century. The indeterminacy of absolute sovereignty in the settlement of international disputes led to bilateral and multilateral agreements on the use of boundary waters based on the principle of equitable utilization.²⁶ The development of the principle highlighted a need to manage international watercourses by optimizing long-term interests and short-term needs and by taking into account all relevant factors and reaching a conclusion on the basis of the whole.²⁷

In his work *The Economic Uses of International Rivers*, H. A. Smith notes that in view of various interests it may be complex in a concrete case to determine which of these prevail.²⁸ He points out that conflicts of interest between states should be appraised taking into account the wider community to which states belong. In the same vein, when considering the principles governing international fluvial law, the Permanent Court of International Justice in the *River Oder* case stated as follows:

[The] community of interest in a navigable river becomes the basis of a common legal right, the essential features of which are the perfect equality of all riparian States in the use of the whole course of the river and the exclusion of any preferential privilege of any one riparian State in relation to the others.²⁹

From the doctrinal point of view, the concept of equitable utilization did not necessarily mean equal division or 'mathematical equality',³⁰ but rather equality of rights.³¹

²⁵ World Commission on Environment and Development, *Our Common Future* (Oxford University Press, 1987), UN Doc. A/42/47 (1987)(Brundtland Report).

²⁶ See, for example, Treaty between the United States of America and Mexico Relating to the Utilization of the Waters of the Rio Grande (Rio Bravo) from Fort Quitman, Texas, to the Gulf of Mexico, Washington, D.C., 14 November 1944, *United Nations Legislative Series* ST/LEG/SER.B/12 at 236.

²⁷ See Preamble, Article 6 and Article 24(2), Non-navigational Convention, *supra* note 3.

²⁸ Smith, *International Rivers*, *supra* note 14.

²⁹ *Case Relating to the Territorial Jurisdiction of the International Commission of the River Oder*, PCIJ Series A, No. 23 (1929) at 27.

³⁰ Martti Koskenniemi, 'International Pollution in the System of International Law', XVII *Oikeustiede-Jurisprudencia* (1984) 91-181, at 154.

³¹ See Stephen M. Schwebel, Special Rapporteur, 'Third report of the law of the non-navigational uses of international watercourses', *Yearbook of the International Law Commission* 1982, Vol. II (Part One), Document A/CN.4/348, para. 47 (footnote omitted): 'In short, disputes over the right to use waters flowing across sovereign lines must be adjusted on the basis of "equality of rights". But such equality does not necessarily mean equal division.'

According to Jerome Lipper, the principle of equitable utilization means that a riparian state cannot deprive another riparian state's right to an equitable share of the natural resources of an international watercourse.³²

In 1966, the International Law Association adopted the Helsinki Rules on the Uses of the Waters of International Rivers as a statement of existing rules of international law.³³ According to Article IV of the rules:

Each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.³⁴

What amounts to a reasonable and equitable share is, pursuant to the Helsinki Rules, 'to be determined in the light of all the relevant factors in each particular case.'³⁵ The rules specify relevant factors by providing a non-exhaustive list. For instance, the economic and social needs of each basin state as well as the avoidance of unnecessary waste in the utilization of waters of the basin shall be considered.³⁶ Also, use of the waters by a basin state that causes pollution resulting in injury in a co-basin state must be considered from the overall perspective of what constitutes equitable utilization.³⁷ Thus, the idea of equitable sharing is not to provide an identical share but rather 'to provide the maximum benefit to each State from the uses of the waters with the minimum detriment to each.'³⁸

The principle of equitable and reasonable utilization was subsequently codified in the 1997 Convention on the Law of the Non-navigational Uses of International Watercourses. According to the key provision in Article 5:

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 consistent with adequate protection of the watercourse.

Along with the emergence of the doctrine of sustainable development, the concept of sustainable use of international watercourses was generally accepted. Chapter 18 of Agenda 21 deals with integrated approaches for the development, management and

³² Jerome Lipper, 'Equitable Utilization', in A.H. Garretson, R.D. Hayton, C. J. Olmstead (eds), *The Law of International Drainage Basins* (Oceana Publications: New York, 1967) 15-88, at 43.

³³ Helsinki Rules on the Uses of International Rivers, *International Law Association Reports* (1966) 477-532.

³⁴ *Ibid.*, at 486.

³⁵ Article V(1), *ibid.*, at 488.

³⁶ Article V (2), *ibid.*

³⁷ Article X, *ibid.*, at 496-497.

³⁸ See the commentary of Article IV, *ibid.*, at 487.

use of water resources. In 2001, the United Nations Environment Programme (UNEP) Governing Council adopted the UNEP Water Policy and Strategy.³⁹ Furthermore, since the 1990s most of the new freshwater agreements recognize, as Birnie and Boyle put it, 'in some form the importance of sustainable development, sustainable use, or sustainable management as an aim or objective.'⁴⁰ Several regional conventions serve as examples of this.⁴¹

Another important development relates to environmental regime-building. In pursuit of long-term environmental goals, from the 1970s onwards many regimes began to design step-by-step interim objectives, usually through separate annexes or protocols. The same development occurred also in the water field. Several watercourse agreements include detailed annexes subject to constant amendments. In addition, some watercourse agreements serve as framework conventions in two different ways. First, some agreements have adopted separate protocols on particular subjects.⁴² Second, some conventions give an incentive or even oblige riparian states to conclude bilateral or regional agreements.⁴³

The purpose of regime-building in the water sector has been to establish dynamic processes and frameworks under which normative regulations and scientific expertise would develop in synchronism. Through the partnership between policy and science, water regimes seek to manage on a long-term basis potential adverse effects and to reconcile economic interests and environmental concerns.

³⁹ See the article by Niels Ipsen and Marko Berglund in the present Review.

⁴⁰ Patricia Birnie and Alan Boyle, *International Law & the Environment* (2nd ed., Oxford University Press, 2002), at 316-317.

⁴¹ See, for example, Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Helsinki, 17 March 1992, in force 6 October 1996, 31 *International Legal Materials* (1992) 1312, www.unece.org/env/water/text/text.htm (UNECE Convention); Convention on Co-operation for the Protection and Sustainable Use of the Danube River, Sofia, 29 June 1994, in force 22 October 1998, *Official Journal* L342, 12 December 1997, at 18; Agreement on Co-operation for the Sustainable Development of the Mekong River Basin, Chiang Rai, 5 April 1995, 34 *International Legal Materials* (1995) 865, www.mrcmekong.org/pdf/95%20Agreement.pdf; Protocol on Shared Watercourse Systems in the Southern African Development Community, Johannesburg, 28 August 1995, ocid.nacse.org/qml/research/tfdd/toTFDDdocs/205ENG.htm; Convention on the Protection of the Rhine, 12 April 1999, *Official Journal* L289, 16 November 2000.

⁴² A good example of this is the UNECE Convention, *supra* note 41. So far, Parties to the Convention have adopted the following protocols: Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, London, 17 June 1999, 38 *International Legal Materials* (1999) 1708, www.unece.org/env/water/text/text_protocol.htm; Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes and to the 1992 Convention on the Transboundary Effects of Industrial Accidents, Kiev, 21 May 2003, www.unece.org/env/civil-liability/welcome.html.

⁴³ See Article 9, UNECE Convention, *supra* note 41; and Articles 3 and Article 4 of the Non-navigational Convention, *supra* note 3.

With the emergence of the doctrine of sustainable development, water protection and utilization of waters are sought to be managed under the same framework. However, even though the doctrine of sustainable management is able to reconcile the protection and utilization of watercourses, the tension between them remains.

Conclusions

Even though some of the above doctrines are discussed separately as an attempt to understand them more thoroughly, this does not mean that the doctrines are also functionally separate. On the contrary, doctrines and concepts discussed under the dispute settlement, regulatory and management approaches are in a number of instances inter-linked. Take, for example, the recent *Case Concerning the Gabčíkovo-Nagymaros Project* before the International Court of Justice.⁴⁴ The case reflects prima facie general international law because Hungary and Slovakia resorted to traditional dispute settlement in order to solve their bilateral dispute. Looking at the case more closely one can, however, also distinguish regulatory themes. For instance, the case concerned a 1977 boundary waters treaty between the two parties⁴⁵ which was concluded for the development of 'water resources, energy, transport, agriculture and other sectors of the national economy.'⁴⁶ Moreover, the parties committed themselves 'to ensure that the quality of water in the Danube was not impaired as a result of the Project.'⁴⁷ Furthermore, one can label many arguments by the parties as reflecting the management approach. For example, parties referred to ecological risks,⁴⁸ scientific evidence⁴⁹ and the precautionary principle.⁵⁰

In the same vein, the judgement of the Court reflects different themes. For instance, the Court applied the doctrine of state responsibility and other classical legal methods and techniques. The judgement can also said to be based on the regulatory approach in view of the fact that the Court urged parties to negotiate to ensure the achieve-

⁴⁴ *Gabčíkovo-Nagymaros Project (Hungary/Slovakia)*, ICJ Reports (1997) 7, www.icj-cij.org/icjwww/idocket/ihs/ihsjudgment/ihs_ijudgment_970925_frame.htm. For discussion see, for example, Charles B. Bourne, 'The Case Concerning the Gabčíkovo-Nagymaros Project: An Important Milestone in International Water Law', 8 *Yearbook of International Environmental Law* (1997) 6; Alan E. Boyle, 'The Gabčíkovo-Nagymaros Case: New Law in Old Bottles', 8 *Yearbook of International Environmental Law* (1997) 13; Peter H. F. Bekker, 'Gabčíkovo-Nagymaros Project', 92 *American Journal of International Law* (1998) 273.

⁴⁵ Treaty Concerning the Construction and Operation of the Gabčíkovo-Nagymaros System of Locks, 16 September 1977.

⁴⁶ *Gabčíkovo-Nagymaros Project*, supra note 44, at para. 15.

⁴⁷ *Ibid.*

⁴⁸ *Ibid.*, at para. 40.

⁴⁹ *Ibid.*, at para. 54.

⁵⁰ *Ibid.*, at para. 97.

ment of the objectives of the 1977 treaty, in accordance with such modalities as they may agree upon. In addition, the judgment reflects the management approach. For example, the Court noted that the need to reconcile economic development with the protection of the environment ‘is aptly expressed in the concept of sustainable development.’⁵¹ Furthermore, the Court referred to the principle of equitable and reasonable utilization of international watercourses and noted that ‘[r]e-establishment of the joint régime will also reflect in an optimal way the concept of common utilization of shared water resources.’⁵²

In light of the above, the categorization of the relevant water issues into three approaches – general international law, the regulatory approach and the management approach – represents three contextually different ways into which water related materials can be arranged. Even though the management approach seems to be dominating at present, general international law and the regulatory approach are equally relevant.

⁵¹ *Ibid.*, at para. 140.

⁵² *Ibid.*, at para 147.

INTEGRATED WATER RESOURCES MANAGEMENT INTERNATIONAL FRESHWATER AGREEMENTS AND NATIONAL WATER POLICY AND LAW REFORMS¹

Niels Ipsen² and Marko Berglund³

Introduction

The first part of this article addresses the rights and responsibilities of states as developed in international freshwater agreements. The recent Atlas of International Freshwater Agreements⁴ documents the numerous agreements and conventions relating to international watercourses and provides a starting point for a comprehensive inventory of such agreements. The influence and opportunities related to agreements adopted at the regional or sub-regional level are also viewed. The second part presents how the principles of integrated water resources management can be included in modern water policies and legal frameworks at the national level. Finally, the Water Policy and Strategy of the United Nations Environment Programme (UNEP) is presented.

¹ This paper was developed from a lecture given by Niels Ipsen on 27 August 2004.

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⁴ United Nations Environment Programme, *Atlas of International Freshwater Agreements* (UNEP, 2002), www.unep.org/Documents.Multilingual/Default.asp?DocumentID=67&ArticleID=3813&cl=en.

International Freshwater Agreements

International agreements

The importance of shared international watercourses and basins cannot be overemphasized. The 263 rivers which cross or demarcate political boundaries account for 50% of the Earth's land surface and 60% of the total freshwater flow. Forty percent of the Earth's population lives in a basin shared by two or more countries. Sharing river basins can lead to problems, including conflicts between upstream and downstream users on abstraction, pollution, environmental damage, etc. The fact that catchments do not coincide with national borders makes it necessary for countries to solve problems through international law and local agreements. This is not a new phenomenon. Thus, there is a multiplicity of legal texts covering international watercourses, with an estimated 2000 active agreements. Since 1945, around 300 treaties on water management have been established. However, most of these agreements address specific issues such as co-managing a dam for hydropower, particular basin-wide development projects etc. and only the most recent ones take into account the challenges of competing uses of scarce water resources, pollution or environmental damage.

An analysis of the existing agreements is under way with a view to creating a compendium of key provisions included in existing multilateral agreements. Compiling such a document will help guide drafters in formulating future conventions. To this end, in 2002, UNEP introduced the Atlas of International Freshwater Agreements which documented the world's international river basins and their related agreements.⁵ The Atlas is linked to an electronic database of available texts, and begins a discussion on the complexities of transboundary water management.

At the global level, international water law has continuously been developed since the Second World War. The Helsinki Rules on the Uses of the Water of International Rivers were adopted by the International Law Association in 1966.⁶ It put forward the principle of equitable utilization and held that upstream states should refrain from causing substantial injury to downstream states. In 1992, the United Nations Conference on Environment and Development broached the issue and highlighted the importance of water. Chapter 18 of Agenda 21 is dedicated to the use of water and advocates integrated water resources management.⁷ In 1997, the UN Convention on the Law of Non-navigational uses of International Watercourses was adopted.⁸

⁵ *Ibid.*

⁶ The Helsinki Rules on the Uses of the Waters of International Rivers, Helsinki 1966, (International Law Association: London, 1967), www.internationalwaterlaw.org/IntlDocs/Helsinki_Rules.htm.

⁷ United Nations Conference on Environment and Development (UNCED), *Agenda 21: Environment and Development Agenda*, UN Doc. A/CONF.151/26, www.un.org/esa/sustdev/documents/agenda21/index.htm

⁸ Convention on the Law of the Non-navigational Uses of International Watercourse, New York, 21 May 1997, not yet in force, 36 *ILM* (1997) 700, www.un.org/law/ilc/texts/nonnav.htm

When developing a new agreement relating to international watercourses, a first step would be to take under consideration the 1997 Convention as well as the three pillars of sustainable development: social development, economic development and environmental protection. The drafters of any such new agreement should look through this double filter, comparing the agreement's provisions to the UN Convention and the pillars of sustainable development, and assess what is needed. Using the UN Convention as a starting point, drafters should look at what provisions might be expected in an ideal agreement. A list of principles, linked to specific articles, that should be supported by the terms of an agreement includes:

First, basin-wide agreements should be strived at. The definition of an international water system is crucial and should be as precise as possible. It should include all surface waters, including rivers, lakes and tributaries. The question of subsurface waters and ground water needs to be resolved and the issue of surrounding ecosystems and whether they should be included needs to be addressed.

Second, provisions which allocate the costs and benefits of the utilization of international watercourses should be addressed. The need for the distribution of costs and benefits becomes apparent when addressing the use of natural resources or hydroelectric projects, for example. The user/polluter pays principles should be applied as far as possible and liability rules for environmental or other harm should be established. Adjustments for capacity should be made and the idea of differentiated responsibilities should be adhered to.

Third, the principle of equitable utilization and participation should be applied. Optimal and sustainable use should be aimed at. Participation with a right to utilize the waters of international watercourses should be guaranteed and a duty to co-operate in the protection and development of those watercourses should be established. These should be based on equality of access, the social and economic needs of the states concerned, the existing and potential uses of the resources, the availability of alternatives and the need for consultation.

Fourth, the obligation not to cause harm should be consolidated. The harm in question must be significant and deal with the transboundary effects of use in one riparian state on other riparian states. In cases of unexpected harm, methods of notification should be set up within agreements to improve the flow of information and provide for an early warning system.

Fifth, a mechanism for the fast and efficient exchange of information should be set up. There should be regular exchanges of available data and an obligation to notify of planned measures. Adequate notice should be guaranteed to give time for a response. The opportunity for consultation or negotiation should be made available. A procedure for the appeal on reasonable belief of significant adverse effects should be established.

Sixth, a transboundary political forum, a river basin commission for example, should be envisaged. To this end, a management or monitoring authority could be established

if deemed required. In this case, the authority of such bodies over the parties must be decided, as must their competences. A central question here is how much of a state's sovereignty is released to the river basin authority.

Seventh, conflict resolution mechanisms need to be established. At the least, these should include the classic conflict resolution methods of consultation and negotiation. If agreed to by the parties, arbitration or the search for a legal remedy in international courts could be resorted to. The question of state responsibility for harm by private entities to other states and of responsibility for transboundary harm to private interests should be resolved. Penalties for violation may be set up and compensation decided on.

Having developed the Atlas on Freshwater Agreements,⁹ UNEP is looking to continue its work in this area by developing generic draft framework provisions based on the principles set forth in the UN Convention and using successfully applied examples from existing agreements. Similarly, example river basin authorities and formats to follow when drafting future agreements will be provided.

Agreements at the regional or the sub-regional level

Regional or sub-regional agreements or protocols may become important drivers in implementing international water law at the basin level. The Southern African Development Community (SADC) Protocol on Shared Watercourses is an example of such a sub-regional framework agreement.¹⁰ The Protocol was signed in 1995 and ratified in September 1998. A Revised Protocol, signed in 2000, entered into force on 22 September 2003.¹¹ The Protocol covers the 14 member countries of the SADC and sets out principles for the joint management of river basins shared by two or more countries.

The provisions of the Protocol call for the harmonized use of water resources. The parties are called on to maintain a balance between development and environment, and thereby aim towards the goal of sustainable development. The parties are called on to observe the objectives of regional integration and respect international water law. The watercourses in question should be utilized in an equitable and sustainable manner. Measures need to be planned in conformity with a set procedure. Parties should work to prevent the causes of harm and fight to mitigate its effects. Access to the legal system for individuals whose rights have been affected should be granted. Reasonable regard to

⁹ UNEP, *International Freshwater Agreements*, *supra*. note 4

¹⁰ Protocol on Shared Watercourse Systems of the Southern African Development Community, Johannesburg, 28 August 1995, in force 29 September 1998, ocid.nacse.org/qml/research/tfdd/toTFDDdocs/205ENG.htm.

¹¹ Revised Protocol on Shared Watercourses of the Southern African Development Community, Windhoek, 7 August 2000, in force 22 September 2003, 40 *International Legal Materials* (2001) 321, ocid.nacse.org/qml/research/tfdd/toTFDDdocs/208ENG.htm.

the rights and legitimate expectations of other states should be given. Ecosystems and the aquatic environment should be protected and preserved. Moreover, parties should strive to resolve all disputes amicably.

The Protocol further calls for the following actions to be undertaken by the parties. They should pursue and establish co-operation on projects and exchange information and data. Parties should notify of planned measures, although urgent implementation without notice may be allowed. The Protocol calls for parties to prevent, reduce and control pollution and environmental degradation. The introduction of alien species should be prevented. Parties should respond to the needs of the parties with regards to the regulation of flows. Installations, facilities and works should be maintained and protected. A permit or authorisation system for non-domestic uses should be introduced, particularly relating to waste discharge into waters. Parties are called upon to notify of emergency situations and refer disputes that cannot be resolved amicably to the SADC Tribunal.

The Protocol empowers watercourse states to enter into basin agreements that apply the provisions of the Revised Protocol. Moreover, it prohibits watercourse states from entering into agreements about particular waters unless they have obtained consent from an affected state. Finally, the Protocol requests riparian states to establish institutions such as watercourse commissions, water authorities or other boards, as may be determined.

A review of the implementation of the SADC Protocol took place in 2003. It showed that agreements are gradually being established for the region's shared basins. Furthermore, all new agreements have been formulated in accordance with the Protocol's provisions and the revision of existing agreements has moved these in the direction of the Protocol's goals and provisions. Several countries are in the process of adapting institutional structures to cope with international issues. The SADC has played an important role in overseeing the implementation of the Protocol among the parties and has provided support and guidance to these. In some respects, the provisions of the Protocol have become the language of discussing transboundary issues.

Water Policy and Law Reforms

It is widely agreed that integrated water resources management (IWRM) forms the overall framework for water management, including for agreements related to international watercourses as well as for management at the national and local levels. It is a comprehensive management concept which aims to take under consideration the numerous and diverse elements which affect sustainable water management. It covers wider policy issues, the legal and institutional framework as well as more detailed management instruments which are used to implement the scheme. Integrated water resources management is a process that begins with an analysis and reform of the enabling environment. This basically is the international, national, provincial or local

policies and legislation that constitute the rules of the game and enables all the institutions and stakeholders to play their respective roles. A proper enabling environment is essential to ensure both the rights and assets of all stakeholders, from individuals and public organizations to private sector companies, as well as to protect public assets and intrinsic environmental values.

Water policy

Integrated water resources management begins with the development of a policy, which can be translated as a government's vision of where to go and how to get there. As policy concerns the day to day lives of people, its aims and goals should be shared by a country's citizens. Policies work by acting as a framework within which, in this case, water resources are managed. This strategic game plan usually covers the use, allocation and conservation of resources as well as environmental protection. Policies also set wider objectives, priorities and principles for the management of the quantity and quality of water resources, both surface and ground water, as well as coastal and fresh water.

Having decided on a policy, a government then translates this into laws and regulations putting into place the desired regime. Legislation consolidates policy and aims to avoid negative externalities and conflicts over use in different sectors and between upstream and downstream users. There is a multi-tiered hierarchy within policy-implementing legislation, ranging from the global to the local. Global agreements head the hierarchy in front of regional and sub-regional agreements. Basin agreements follow, with national water law and regulations and by-laws coming next. Local regulations come at the bottom of the hierarchy.

Although policy statements relating to water resources exist in many countries, these are often scattered in different documents. These may include acts, regulations and action/master plans. Legal provisions exist, but are often developed independently of each other, depending on their precise content. Water acts may be supplemented by coastal acts and land use acts, for example. The policies and laws of different sectors such as agriculture and health may also separately address the issue of water.

The shortcomings of this lack of an integrated approach are further compounded by the fact that if a water policy and/or law are in place, they often only concern the water supply and do not address management of the resource. Moreover, where there is a coastal zone management policy, it often only concerns the physical planning of the coastal zone and the exploitation of marine resources. The lack of coherence between interrelated issues and policies and the resulting weak enforcement is evident. What is needed, then, is a coherent set of policies and legal acts addressing issues related to water resources, both fresh and salt water, in a comprehensive manner. These policies must furthermore have the support of the populations which they affect.

New legal frameworks shall ideally constitute an overall policy framework taking into account international conventions, national constitutions, government statutes and

sector policies. The process should incorporate consultations and seek consensus with all line ministries and organizations relevant for the management of water. Vice versa, when formulating new development policies for other sectors, water resource policy statements should be taken into account where relevant. Policy statements must be clear and realistic. Care should be given to the fact that good intentions reflected in vague statements such as 'No pollution of surface waters shall occur' will never be applicable.

The statements contained in policy documents need to have a relatively long life as they must pass a laborious political adaptation process. Detailed guidelines which may need recurrent adaptation to the country's actual development level should be avoided and placed into the more dynamic parts of the legislative system. Examples of overall policy statements include determination of who owns the water, i.e. the state or the people, or whether some water is private and some public. Other key issues to be decided include whether water is a human right or a free commodity, for example. Overall allocation priorities must be decided and should cover domestic needs, economic activities, issues related to the environment and international obligations. The question of equity must be addressed.

The guiding principles of policy documents operationalize political intentions by setting a more detailed conceptual framework supporting overall policy objectives. Some of the more conceptual statements which apply to integrated water resources management are found in the four Dublin Principles.¹² According to these, fresh water should be seen as a finite and vulnerable resource, water development and management should be based on a participatory approach, women play a central part in the provision, management and safeguarding of water, and water has an economic value in all its competing uses and should be recognized as an economic good.

Some of the more detailed guiding principles behind IWRM hold that land and water should be managed together based on catchment and river basin boundaries. Moreover, land and water should be managed at the lowest appropriate level. The private sector has an important role in water resources management and its potential should be harnessed in this respect. Some of the more general environmental law principles already adopted by the international community are also present in the IWRM concept. These include the precautionary principle and the user pays and polluter pays principles. Furthermore, it is important to apply realistic standards and regulations and to balance economic and regulatory instruments. Open access to information on water should be given and international co-operation on water pollution control should be promoted.

¹² International Conference on Water and the Environment, 26-31 January 1992, The Dublin Statement on Water and Sustainable Development, Guiding Principles, www.wmo.ch/web/homs/documents/english/icwedece.html.

One of the key elements of IWRM is the integration of the various elements and actors into a comprehensive all-encompassing system. This means the integration of fresh-water and coastal zone management as well as of land and water use. Surface water and ground water should be managed in an integrated manner as should water and wastewater. The parallel issues of water quality and quantity should be integrated into management as should upstream and downstream water-related interests. National policy development requires cross-sectoral integration. Finally, all relevant stakeholders should be integrated in planning and decision-making processes.

Having established a policy framework, national legislation should be put into place to implement this strategy. National legislation clarifies the entitlements and responsibilities of the state, users and providers, as well as the role of the state vis-à-vis other stakeholders. It formalizes the process of water allocations and provides legal status for the various water user groups and ensures the sustainability of water resources. National laws usually come either in the form of framework legislation or full prescriptive legislation. As with other framework legislation, framework water legislation sets the ground rules and leaves the details to regulations which can be changed administratively. Full prescriptive legislation, on the other hand, sets detailed rules and requires parliamentary approval for changes. Although the choice depends on legal tradition, the dynamic process thinking behind IWRM is easier to provide for within a framework legislation approach.

New elements are being introduced in modern IWRM-based water law. These include the definition of priorities and overall principles for water allocation as well as for the protection of water and water-related ecosystems. Basins are being defined as the units of management. Institutional management frameworks are being defined and national water councils or basin committees are being instituted to deal with cross-sectoral management. Water action plans – or IWRM plans – are being legally instituted as a mechanism for continuous adaptation of institutional and technical capacity to respond to actual requirements.

Realistic and enforceable regulations are being defined based on IWRM planning processes. The water action plan identifies and prioritizes issues for management. It analyzes different options for regulating priority issues, including non-legal instruments, and it takes into account capacity constraints in the proposed regulatory mechanisms. However, it should be noted again that the transition towards IWRM is a medium- to long-term process and that the context is very different in different countries. For example, reform processes in developed countries begin in existing complex administrative environments while many developing countries are only at an initial stage in developing their administration.

Moreover, a number of implementation difficulties arise when trying to apply the IWRM principles. These include inter alia the invocation of prior water rights, the lack of technical capacity in developing countries for creating basin and catchment agencies for example, the logistics involved in extensive stakeholder participation, and in

particular the will for true co-ordination between the various sectors involved. Moreover, there are methodological issues related to the definition of ecosystems water needs, the economic valuing of water uses, and the administrative constraints for integrated land and water management, for example.

IWRM is a new concept and experience with its actual implementation at the national level is still limited. As is the case for international agreements, concrete experience in implementation is needed to find practical solutions on the ground. It is therefore important that such experience is effectively exchanged and disseminated through intergovernmental collaboration bodies, education systems and networks, international support organizations, etc.

UNEP Water Policy and Strategy

UNEP is one of the international organizations which have put water and its management high on the agenda. As an illustration of this, in 2001 UNEP Governing Council adopted the UNEP Water Policy and Strategy (WPS).¹³ It sets the following goals and focal areas in line with the internationally expressed needs for support within environmentally sustainable water management:

UNEP WPS Goals are: achieving greater global understanding of freshwater, coastal and marine environments by conducting environmental assessments in priority areas; raising awareness of the importance and consequences of unsustainable water use; supporting the efforts of Governments in the preparation and implementation of integrated management of freshwater systems and their related coastal and marine environments; providing support for the preparation of integrated management plans and programmes for aquatic environmental hot spots and; promoting the application by stakeholders of precautionary, preventive and anticipatory approaches.

UNEP WPS Focal Areas are: freshwater scarcity and water conflicts between human activities and aquatic ecosystems; land-based sources of pollution and alteration of habitats, and their impacts on aquatic ecosystems; aquatic biological diversity; resource use and management planning in harmony with economic and social development and; knowledge and technology transfer in integrated management.

The policy and strategy document, which also provides detailed outputs and descriptions of UNEP's water related projects and programmes, is subject to updates and revisions to take into account new conceptual and political developments, as well as the need for support in countries and regions. The next update will be adopted at UNEP Governing Council in March 2005.

¹³ See www.unep.org/dpdl/water/index.asp.

WATER CO-OPERATION BETWEEN FINLAND AND RUSSIA ON THE LOCAL AND REGIONAL LEVEL¹

Anna-Liisa Tanskanen²

Background

Neighbouring area co-operation has formed an integral part of Finland's foreign policy and economic co-operation since 1990. After Finland joined the European Union (EU) in 1995, cross-border co-operation increased and strengthened at the regional and local levels. One reason for this was the adoption of the subsidiarity principle in the implementation of regional development programmes which increased the power of regions. A common body dealing with issues in the Finnish-Russian border regions was established in the late 1990s. The area covered by this body includes eastern Finland and the Republic of Karelia, an autonomous republic in the Russian Federation. This area is called Euregio Karelia.³ The Euregio Karelia framework comprises border region co-operation in the fields of business, the environment, tourism and culture, and promotes development of living conditions in bordering regions with a common cultural and natural heritage.

Euregio Karelia is formed of the provinces of North Karelia, Kainuu, and Northern Ostrobothnia on the Finnish side, and the Republic of Karelia on the Russian side. Euregio Karelia is currently the only Euregio which extends outside the borders of the European Union. The length of the common border between the Russian Federation and Finland is approximately 1300 kilometres; the length of this border within in Euregio Karelia is 700 kilometres. The total surface area of Euregio Karelia is about 236 700 km², of which the Republic of Karelia covers two-thirds. The total population of the Euregio Karelia is approximately 1 400 000, of which 770 000 live in the Republic of Karelia.

¹ This paper is based on a lecture given by the author on 27 August 2004.

² EU Co-ordinator, North Karelia Regional Environment Centre.

³ The Euregio scheme was set up by the EU to increase cross-border co-operation between EU countries.

In practice, the actual political power of Euregio Karelia is minimal and national legislation remains valid. Thus, governmental agreements and the strategy of the Ministry of the Environment of Finland with regard to co-operation in neighbouring areas also form the framework for regional level environmental co-operation. In 2004, the Finnish Government adopted a new strategy on co-operation with neighbouring areas. Currently Finland's priority sectors in neighbouring area co-operation with the Russian Federation include decreasing nuclear and environmental risks, stabilizing democracy and promoting a constitutional state, promoting the renewal of administration and legislation and promoting economic reform. Effective cross-border co-operation links government level co-operation and strategies to local and regional level co-operation, improving social and economic development and environmental protection in border areas.

Common nature, different problems

North Karelia in eastern Finland and the Republic of Karelia are peripheral regions, where natural resources have traditionally played an important role in the regional economies. The natural environment is quite alike: the physical environment of the Republic of Karelia is in many ways similar to that of eastern Finland and Fennoscandia. Eastern Finland and the Republic of Karelia have abundant surface and ground waters. Lakes and rivers cover 23 percent of the Republic of Karelia and 18 percent of Finnish North Karelia.

The history of nature and land use is different, however, as can be seen in the environment and state of the environment. First, in North Karelia in Finland only groundwater is used for water supply purposes while in the Republic of Karelia 96 percent of drinking water is taken from surface waters. Second, the main pollution load in eastern Finland is from diffuse load while in the Republic of Karelia point sources are dominant, especially in population centres. Consequently, the environmental health situation differs and waterborne epidemics are more frequent in the Republic of Karelia than in eastern Finland. However, as pollution does not stop at the border, the environmental situation in a border area is a concern for neighbouring countries. Moreover, water basins do not recognize or follow borders. For example, 19.9 percent of the Lake Ladoga catchment area is situated in Finland.

Research and monitoring co-operation

Lake research co-operation dates back to the late 1970s and early 1980s when vendace fish species were studied in Lake Pyhäjärvi, a cross-border lake between Finland and the Republic of Karelia. Co-operation continued after the collapse of the Soviet Union with research on Lake Ladoga, the biggest lake in Europe with a surface area of 17 891 km², a volume of 837 km³, a mean depth of 47 metres and maximum depth of 230 metres.

The water exchange rate of Lake Ladoga is 11 years, which makes the limnic process rather conservative.

The ecological condition of Lake Ladoga concerns several million people, including the six million inhabitants of St. Petersburg. The main problems of Lake Ladoga are eutrophication and contamination. As Lake Ladoga and its basin are large, covering several administrative regions and areas, and it has a unique nature and also attracts a multitude of interests, there are and will be conflicts related to the area, the lake and its natural resources. Therefore the precautionary principle, a participatory approach and basin management principles are important in the management of the lake. Nowadays, research co-operation includes not only lakes and rivers but also forest fragmentation and land use studies. Research is usually connected to the environmental and water related impacts of forestry and forest management practices.

Development of monitoring and monitoring methods is important for all institutions taking part in this co-operation. A common understanding on methods used and an inter-calibration of those methods makes the exchange and comparison of research and monitoring results possible. As the new EU Water Framework Directive⁴ promotes information exchange and co-operation in the management of catchment areas covering non-EU countries, common monitoring methods will be needed in the future. Therefore, joint research on cross-border lakes such as Lake Pyhäjärvi, for example, is important at the moment.

Information exchange and environmental awareness

Environmental information exchange started with the publication of the joint Ecological Bulletin, aimed at the general public. The first bulletin, issued in 1992, compiled for the first time basic information about the state of waters and air quality in eastern Finland and the Republic of Karelia. The bulletin gives a comprehensive view about the problems and activities concerning water protection and air quality improvements. The second bulletin in 1997 dealt with nature protection, nature reserves, natural parks and biosphere reserve activities.

Environmental awareness-raising and environmental information exchange between regions is one of the key areas of co-operation. Practical projects concerning environmental information exchange across the border have been carried out. One such initiative is Kaarna, a mobile environmental education and information dissemination unit supplied with special environmental awareness material for different audiences. The Kaarna initiative has concentrated on environmental work in the Republic of Karelia

⁴ Council Directive 2000/60/EC of 23 October 2000 establishing a framework for the Community action in the field of water policy, OJ 2000 No. L327, 22 December 2000.

around the following themes: hazardous wastes, waste composting, restoration and protection of wells and savings in water use. The aim has been to motivate people to think and discuss water issues. Kaarna has visited schools as these, and the education system in general, provide the widest existing channels for disseminating information and knowledge about such issues. Through children, information is passed onto their parents, friends and relatives. Furthermore, a positive attitude to water protection and conservation developed at an early age is often carried into adulthood. It is important to establish a mobile environmental unit like Kaarna for the Republic of Karelia for water and environmental awareness-raising purposes. The organization responsible for this future work should be clarified and agreed.

Development of municipal water services and waste water treatment

Other aims of cross-border co-operation between Finnish Regional Environment Centres and the Republic of Karelia have been the promotion of the use of ground water as a supply of drinking water and the development of waste water facilities in the Republic of Karelia. The North Karelia Regional Environment Centre and the North Savo Regional Environment Centre have actively supported ground water investigations in the Republic of Karelia and in developing technology for the provision of drinking water for Karelian citizens from ground water sources. The improvement of water services is important for human health and welfare and also for the development of agriculture and the food industry.

The first investment project started in 1993 with the construction of the Lahdenpohja waste water treatment plant. Now, the work includes ensuring the co-ordinated operation of the waste water treatment plant together with the City of Joensuu Waterworks. The experiences gained in Lahdenpohja have influenced other local authorities in the Republic of Karelia to plan new investment projects which, with the exception of Sortavala, have not been realized due to lack of financing. The City of Joensuu, the City of Joensuu Waterworks, the the City of Sortavala authorities and the Sortavala water utility, together with the North Karelia Regional Environment Centre and the Ministry of the Environment of Finland have been active in planning investment projects and financial proposals and agreements. The activities have been fruitful as a new water supply facility in Helylä and a new waste water treatment plant in Sortavala have been built with the help of EU Tacis funding. At the moment, water and waste water networks are being inventoried and plans for improvement activities are under way.

The joint projects and investigations have shown that the obstacles to water service development are of an economic and institutional nature and do not result from technological deficiencies. Due to insufficient funding of maintenance works, inefficient operations and excessively high water and energy consumption, the need of renewing and repairing existing systems is immense. To target the improvement activities effi-

ciently, more data is needed on the current situation relating to the environmental infrastructure, for example.

A pilot project to improve the operation and management of municipal water services was started in the Pryazhinsky District together with the City of Kitee. The goal of the project was to develop an institutional base and the management and finances of municipal water services in sparsely populated regions with large rural areas. This would facilitate future investment and renovation work to be effectively implemented after the project. The project included an assessment of the situation, capacity-building in water analysis, a technical development plan, a finance and management development plan, and raising public awareness of municipal services and of techniques to reduce water consumption. The work with customers and awareness-raising was included in the project as institutional development starts with customer-friendly service, based on demand, that consumers are willing and able to pay for. Often services are taken for granted and their value is understood only once they stop functioning. Moreover, customers should be aware of their habits and the consequences of non-payments, delayed payments and excess water and energy use. They should know how to conserve water and how to maintain in-house pipes and equipment. During the project, water services were reorganized in Pryazhinsky District. The financial situation of the water utility improved, facilitating future investment in improvements suggested in the water service development plan created during the project.

Partners and actors in water co-operation at the local and regional level

Research organisations such as Joensuu University and the Russian Academy of Science's Karelian Research Centre and its institutes, especially the Northern Water Problems Institute and the Institute of Biology, have been active in water research co-operation. This is natural, due to the win-win situation of such co-operation. The co-operation makes new financial resources possible to both parties and specialists can learn from each other. For example, integrated research and monitoring development has been important to both countries.

The regional environmental authorities – the Finnish Regional Environmental Centres situated in border areas, the Agency for Natural Resources and Environmental Protection of the MNR of Russia, and the Republic of Karelia Regional Energetics Committee – are key partners in co-operation. The North Karelia Regional Environment Centre and the North Savo Regional Environment Centre have been active in water supply development and investment planning. Especially long term co-operation on ground water use and investigation of ground water resources has been vital.

Twin municipality activities between eastern Finland and the Republic of Karelia have long traditions. Most municipalities in eastern Finland have a twin municipality agree-

ment with districts of the Republic of Karelia. Municipalities situated in the proximity of the border have been particularly active. In the early years, twin municipality activities were based on cultural activities, but now also social development activities and environmental co-operation take place between municipalities. Water supply and waste water utilities co-operation, for example, between the City of Joensuu Waterworks and water utilities in Sortavala and Lahdenpohja in the Republic of Karelia, has been important for renewing infrastructure and improving maintenance of water supply and waste water treatment plants. The Water Co-operative of Kitee has given input and experience in the restructuring of water services in Pryazhinsky District.

Surprisingly perhaps, non-governmental organisations (NGOs) have been passive in water co-operation issues between eastern Finland and the Republic of Karelia. One reason for this might be the relatively small amount of cross-border lakes and rivers affecting the state of waters on the other side of the border. Another reason may be that having concentrated on forest sector activities, especially on the ecological and economic impacts of wood-harvesting and trade, NGOs might not have the resources to work with cross-border co-operation in the water sector. Only recently have NGOs emerged in regional water co-operation, through labour and trade union associations, voluntary associations of water sector experts and professionals, and local Finnish-Russian associations.

Lessons learned

Usually the lack of financing is an obstacle cross-border co-operation at the local and regional level, especially in peripheral regions with low economic or social capacity for co-operation. Since Finland joined the EU, EU financing through Interreg and Tacis programmes have been used to finance environmental co-operation. The actors and main partners in water sector co-operation have together learned to apply and use these financial instruments for joint benefit and for the benefit of the environment. The participative and co-operative models for the planning of projects and financial applications have improved the implementation and final results of the projects.

With cross-border co-operation, language difficulties are the most referred to and encountered problems, but these are also the easiest to overcome. Partners need only to allocate resources to translation and interpretation or employ staff with the necessary language skills. Normally, language is not a problem in cross-border co-operation as far as only Finnish or Russian is needed. However, the more languages are needed, the more difficult it is to find a specialized workforce or interpreters, and the bigger the share of financing allocated to administration and translation services. Even though language is a minor problem, it should be noted that a common language and joint definitions of key terminology and actions are needed. As language only represents a part of cultural differences, a deeper understanding of terms and meanings can be gained by understanding cultural, organisational and institutional differences and inherited ways of negotiating, discussing, acting and working. This mutual understanding can be gained only through long-term co-operation. A sustainable and strong partnership is

based on personal contacts and long-term commitments to co-operation. Even though most of the cross-border co-operation on the local and regional level is at the moment project-based, long term co-operation strategies and structures for co-operation are essential to reinforce the environmental improvements achieved thus far.

At the moment there is no joint forum where regional environmental co-operation targets or activities could be discussed, prioritized and agreed. Building up this kind of a forum would increase networking opportunities and the transfer of experiences between organisations. It would also improve the efficiency and effectiveness of environmental co-operation as it would help to prioritize action and work at the local and regional level, decrease overlapping of activities and encourage a multi-stakeholder approach to joint environmental problems.

Investments and technology transfer are needed to improve deteriorated facilities and networks. In the beginning of cross-border co-operation, water supply and waste water treatment projects were technology and engineering oriented. Technology transfer and investment projects have only recently aimed at the development of viable water utilities, fostering not only technological upgrading of water supply and waste water treatment plants and networks, but also institutional development and capacity-building. Focus on institutional development and capacity-building instead of engineering and technological solutions would help in reaching sustainable results in a long run. Only when there is increased accountability for results and the required human and economic capacity to operate, maintain and develop new technologies, will technological co-operation reach sustainable results. Cross-border co-operation fosters environmental innovations and their diffusion. Innovations are not only connected to new technologies but also to organizational and management improvements. A hard economic environment in particular influences the need to find low-cost solutions. Networking between different actors and sectors also fosters innovation in research and development activities.

Fundamentally, it could be said that the most important result of these cross-border projects is co-operative learning: learning to work with experts from a different cultural, organisational or professional background. At its best, cross-border projects foster co-operation across the border, between institutions and between sector experts, resulting in a more holistic approach to environmental problems and projects. Still, there is much to be done to enhance cross-sector co-operation and to include economic, health, social and educational issues into water sector co-operation. Cross-border co-operation relies on the high level of enthusiasm of key persons to work together, build up partnerships and attain incremental improvements in the long run. During cross-border projects it is inevitable that problems and obstacles concerning financing, local customs and bureaucracy will be encountered, but if partners are highly committed to co-operation, they can be solved together.

Regional and local level environmental co-operation complement government level co-operation. A bottom-up approach to joint environmental problems can be effective and

cost-efficient and result in sustainable improvements. It increases citizen-awareness and inspires local authorities to act and take responsibility over their own environment. In the end, the state of the environment is a matter for people living in the area and not only for governments, authorities or research organisations.

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