WATER CONSUMPTION, FISHERIES AND WATER-RELATED RECREATIONAL FACILITIES

Erna .S. Wetzel
Consultant, Somerset West 7120, South Africa

Keywords: impounding dams, reservoirs, canal systems, water tunnels, water distribution, Helsinki Rules, desalination, weather modification, basin states, potable water, water resources, fisheries, recreation, environment, pollution, transport, reservoirs, zoning, erosion, Dublin Statement.

Contents

Summary

A short overview of the use of water for domestic consumption, and its transfer via various water ways, from the earliest historical projects up to modern times is presented. Benefits of water accessibility, the recourse to exotic sources as means of replenishing inadequate water supplies, and the fair division of international water among countries which share catchment areas (based on the Helsinki Rules) are discussed.

This chapter also deals with some of the principal non-consumptive uses of rivers and streams, such as for transportation; for fishing, including both commercial fisheries and sport fishing; and for recreational purposes. It addresses also the influence of some of the negative impacts, such as industrial pollution, turbidity caused by river traffic and eutrophication. Control measures such as zoning, access control and nodal division are recommended. River management to cater for all users, is exemplified by two examples in the concluding section.

1. Introduction

The basic axiom is that *water is life* – without it there will be no crops, no food, no animals and no human life. Unfortunately, like so many other things in the civilized world, humans normally tend to destroy the very commodities that enabled them to develop. One of these life supporters is *water*. In countries where continued drought conditions do not force the inhabitants to work carefully with this limited resource, unnecessarily heavy demands are made on water supplies, whether for industrial, agricultural or human consumption.

As a manifestation of civilization, the ability to reschedule the availability of water, by building impounding dams and managing river systems, represents one of the most useful human achievements in the harvesting of technological progress. However, due to the pressures of global economic advancement and rapid population growth – the demands on humankind's water resources have also increased dramatically during the last century and will certainly continue to do so in this challenging and technologically more advanced new era beyond 2000.

These growing demands will most certainly force water authorities to take an in-depth look at the better management of the provision and the quality of consumable water. The partnership between the said authorities and an informed public has never been as important on water matters as it is now. Channeling water for urban consumption by way of dams, reservoirs, canal systems, tunnels, pipelines, etc. will probably be the only way that this life-giving resource can be adequately harnessed and protected to the benefit of all concerned.

Since the earliest times, rivers have ensured the survival of humankind. In fact, rivers have been used for commerce and recreation more than any other ecosystem. They have been abstracted from, fished in, boated on, discharged into. Their headwaters have been diverted, their middle reaches dammed and their flood-plains developed. One of the main features which made rivers so attractive, is the presence of unidirectional moving water – a continuing renewable source, and also a rapid removal

system for unwanted substances and a valuable store of potential energy (see *Rivers and Human Development*).

2. Consumptive Uses of Water

The term *consumptive uses* implies some loss of quantity and/or quality of the water, after being used, making it unsuitable for direct re-use, and requiring proper treatment before its disposal or re-use for other purposes. These consumptive uses include those for agriculture (irrigation and stock-watering), industry and for domestic water. The first use does not require water of potable condition, whereas for the other two uses usually potable water standards have to be maintained. After use, there is a change in the quantity and quality of the water returning to the receiving river, stream or lake system.

2.1. Agriculture

For agricultural uses untreated water from rivers is generally adequate, if intended for irrigation. For farm stock-drinking and wild-life watering purposes, water from bored water wells, also known as *boreholes* or *bores* is acceptable, if not containing excessive dissolved salts, otherwise surface water that is untreated, but not too turbid, contaminated or infested with chemical or biological pollutants, may be suitable.

2.2. Industry

Nowadays, industry still relies heavily on rivers for its day-to-day operation. As an example, the Columbia River in the north-western USA, the fourth largest river in the country, is another example of a river well-harnessed for industrial purposes. Since the mid 1800's, it became one of the world's largest hydro-electricity generating rivers, with nineteen major dams and sixty smaller ones. Although the water is not lost in the production of hydro-electric power, it impacts on the environment, particularly the spawning movements of fish are interrupted by the dams. Hydro-electric power generation is a non-consumptive use of water, as only the energy.of the water is utilized, without diminishing its quantity. This is true in principle, although actually some water may be lost due to evaporation, sedimentation and leakage en route.

For the generation of thermal power from oil, coal or natural gas, water is needed for heat exchange and evaporative cooling purposes, which makes for large quantities of water being consumed. Other industrial uses, such as for steel mills, paper mills, factories and manufacturing, food processing, require great amounts of water and therefore also generate considerable volumes of effluent or waste water.

2.3. Potable Water

Water for human consumption requires great care in its treatment and conditioning, especially water obtained from rivers and streams. Underground water, simply known as groundwater, generally requires much less treatment, unless it is contaminated or if containing excessive amounts of dissolved salts, when it will be too brackish for drinking or washing purposes, without proper treatment, such as by means of ion

exchange, desalination, or softening processes, or by blending it with treated surface water. Generally, potable water is used for most domestic and urban water supply purposes, to avoid the cost of having a dual water supply system, and for hygienic reasons. However, there are many instances where consumption of public piped water supplied would be unsafe, and only the drinking of bottled, treated or spring water is advised (see *Potable Water*).

3. Conservative Uses

The term *conservative use* is used to designate those uses that leave the water after use in basically the same state as before, referring to both its quantity and quality, and therefore available for further use. Water transport, recreation, and fish culture are such conservative uses, and are dealt with in the following sections.

3.1. Transport

From a water transport point of view, vessels of all kinds, of many different forms and makes – from the most primitive wooden rafts, and canoes to modern-day barges – have navigated on rivers, streams and lakes throughout the ages. As trade and industry developed, so the uses of natural waterways were adapted to support the enterprises of a new world, and contribute to its economic viability. For example, in the USA in the upper Ohio, Monongahela and Allegheny Rivers, over sixty million tons of raw materials and finished products are transported annually through the twenty-three locks and dams on these rivers. Artificial waterways were constructed to join or supplement the natural ones on several continents. The use made by water transport of water resources is essentially a non-consumptive one, in as much as the water is still available afterwards for other uses (see *River Navigation and Associated Structures*).

3.2. Recreation

Industry is not the only user of rivers - where humankind has access to rivers, lakes and other water bodies, recreational use is made of the amenities offered. Water-adventurers in kayaks, motorboats, and canoes enjoy the challenges of gorge traversing, white-water rafting and water-skiing. In countries or regions endowed with abundant natural water systems, in the form of lakes, rivers and streams, a considerable part of the well-being and income of their inhabitants is derived from recreational activities. In America alone, for example recreational fishing creates 1.2 million jobs nationwide.

Recreational uses have begun to compete with conventional industrial and commercial uses to such an extent that many river basins came under scrutiny by environmentally concerned interests and agencies. This process has led to the establishment of the Environmental Protection Agency in the USA, to whose standards developers nowadays have to conform regarding any new project or amendment to an existing project. The recreational needs are at present considered equally important to the industrial and commercial needs, regarding the use of river water.

3.3 Sport Fishing and Commercial Fisheries

Sport fishing (angling, fly-fishing and game-fishing), as well as commercial inland fisheries and pisciculture, utilize available water, without consuming the water. However, the resource still has to be managed properly to allow both the fish population and the industry to remain stable. In Manitoba in Canada, for instance, Lake Winnipeg and Lake Manitoba are managed through the use of quotas, mesh size of gill nets, by the seasonal regulation of fishing and limiting the number of licensed fishermen.

Salmon is an important commercial fisheries enterprise in the Pacific States in the USA, on the Columbia and Sacramento Rivers. Similarly crawfish is a staple food in the Gulf States of the USA, especially around New Orleans. Lobster and crab are of economic importance on the eastern seaboard (Chesapeake and Delaware Bays) and the New England States in the USA. Fresh water entering these estuaries from polluted rivers, however, would endanger these interests, hence strict standards of effluents are maintained to preserve these assets.

4. Impacts of Consumptive Uses of Water

Consumptive uses of water have direct impacts on other claims on the water, such as by the environment, and by other user areas such as recreation.

4.1. Environmental Considerations

Whereas other water-related activities might encroach upon sensitive environmental and ecological issues, there are often intangible benefits (tourism, recreation), which also come into consideration. Due allowance must be made to ensure the sustainability of these intangible benefits. For example, a trout stream may be endangered due to impoundment and introduction of sediments or effluents, and therefore its catchment area needs to be well maintained.

In the case of the River Thames in London, this well-known river that once has been heavily polluted due to industrial activities, has recently been cleaned up through exercising pro-active and positive measures. It has now been restored to almost its pristine state. Estuaries and river mouths are difficult areas to maintain in their original state, due to over-development and interference with the natural water-exchange and dilution processes. The well-known cases of the pollution of Boston and Sydney harbors are examples of the tenuous balance that often exists between biologically sound and unsound maintenance practices.

-
-
-

Bibliography

Abrahams Harold J. (1978). *The Hezekiah Tunnel*, in "Management and Operations," Journal of the American Water Works Association (J.AWWA), pp 406 to 410. August. 78:8:406. (Paper No.86173 Jerusalem). Denver CO: American Water Works Association. [Deals with the design and construction background of a famous historical water supply structure.]

Ambroggi Robert P. (1966). *Water under the Sahara*, Scientific American, Volume *214*, No. 5., pp 21-29. New York: Scientific American. [An in-depth discussion of the discovery and implications of deep groundwater aquifers under the Sahara Desert in North Africa.]

Ambroggi Robert P. (1980). *Water*, Scientific American, Volume *243*, No. 3., pp 91 to 104. New York: Scientific American. [Deals mainly with the availability of water for the various consumer sectors.]

Bishop D. (1981?)."Water Quality Criteria for Selected Recreational Uses." [Contains useful guidelines for developers and conservationists.]

Boon P.J. (1990). "River Conservation and Management." Chichester, West Sussex: Wiley [Deals with findings of stream conservation congresses, river management and stream ecology, and presents a balanced view of how to manage conflicts between uses and their impacts.]

Brundtland G.H. (1989) *ESSAY: How to secure our common future*. Scientific American. Vol 261 No 3. Sept. p. 134. New York: Scientific American. ["Our generation is the first to have seen planet Earth from a distance. From that perspective it is all too apparent that our species is dependent on a single tiny, fragile globe floating in space, a close and vulnerable system."]

Dangerfield B.J. (1979; 1981). *The Structure and Management of the British Water Industry*; also: "Recreation: Water and Land." 255 pp. London: Institute of Water Engineers and Scientists. [Deals with aquatic sports facilities and outdoor recreation, and expresses the future potential water resource utilization for recreation in harmony with nature. Compiled and published by the Institute of Water Engineers and Scientists]

De Manielle M. (1990). Guidelines for Upgrading and Developing Urban Rivers and Recreation. (Translation from Afrikaans: *"Riglyne en stappe vir die ontwikkeling en opgradering van stedelike riviere en ontspanning"*.) Unpublished, unnumbered report on a project for the Master's degree in City and Regional Planning, University of Stellenbosch, South Africa. [Explains the scope of recreational possibilities inherent in urban rivers, and how to develop and manage them.]

Helsinki Agreement (1966)., Report of the Fifty Second Conference, Helsinki, Finland, pp 447-553, London: International Law Association. [Contains the full text of the "Helsinki Agreement" on the division or apportionment of international water between sharing or adjacent basin states.]

Jenkins S.H. (1981). "Environment Impact of Man's Use of Water." Proceedings of a Specialist Conference held in Brighton, England in 1980. New York: Pergamon. [The paper deals mainly with aspects of water supply engineering.]

Jordaan J., Plate E. J., Prins J. E. and Veltrop J. (1993). *Water in our Common Future*, Committee on Water Research (COWAR), Paris: UNESCO. [A report on the water prospects, an expansion of the theme "Our common Future" of the Brundtland Report, which again was a response to the Club of Rome publication, "The Limits to Growth".]

Jordaan Jan M. (1993). *Augmenting Water Resources*. Unpublished, unnumbered post-graduate lecture in Hydraulic Engineering, Department of Civil Engineering, University of Pretoria, Pretoria. [Examines the potential uses of "exotic sources" of water to supplement scarce supplies.]

Kluth D.J. (1990), "The Great Man-made River Project," Proc. Sixth International Conference on Pressure Surges, Chapter 9, pp. 121 to 128, Cranfield, Bedford, UK: British Hydromechanics Research Association (BHRA). [A technical overview of the features of the large scale groundwater-transfer pipeline project in the eastern part of Libya.]

La Riviere J.W. Maurits (1989) "Threats to the World's Water." Scientific American. Vol 261 No 3. Sept. pp. 48-55. New York: Scientific American. ["Population growth, ignorance and poverty, along with poor agricultural practices, have endangered water resources. Unless appropriate steps are taken soon, severe shortages will occur."]

MacNeill J. (1989). *Strategies for Sustainable Economic Development.* Scientific American. Vol 261 No 3. Sept. pp. 104-113. New York: Scientific American. [Describes how world economics is fast depleting stocks of ecological capital and how maintaining countries' economic growth can only be reconciled with environmental integrity.]

Sancold (1994). *Large Dams and Water Systems in South Africa*. South African National Committee on Large Dams (SANCOLD), 256 pp. Pretoria, South Africa: J.P. van der Walt & Son. [Reviews a century of progress of dam engineering and water supply in South Africa.]

Shanklin J. (1962). "Water for Recreation: Values and Opportunities." International Association of Water Pollution and Control: "Water Quality and Management for Recreation and Tourism." Report to the Outdoor Recreation Resources Review Commission, by the Geological Survey, US Department of the Interior. Washington DC: Superintendent of Documents. [Deals mainly with the water quality aspects of water resource management for aesthetic benefits.]

Van Rooyen Johan S. (1984). The Division of International Water according to the Helsinki Agreement, Unpublished Internal Report: Water Planning 5CW7, Department of Water Utilisation Engineering, University of Pretoria, Pretoria, South Africa. [Discusses the implications of the various articles of the "Helsinki Agreement" *q.v.*, with comments on the application of each article.]

Wulff H.E. (1968).*The Qanats of Iran*., Vol *216* No. 4. Scientific American, April. pp 95-105. New York: Scientific American. [Describes the historical development of the *qanat*-system developed in ancient Persia, as is still evident in modern Iran.]

Young G.J., Dooge J.C.I. and Rodda. J.C. (1994) "Global Water Resources Issues." Cambridge: Cambridge University Press. [Reference is made in the present chapter to a Keynote Paper presented at the ICWE Conference, Dublin, (1992) by E. J. Plate, entitled "Scientific and Technological Challenges" and which preceded and led up to the "Dublin Statement." The actual *Dublin Statement* was published by the WMO, the World Meteorological Organization, but is not readily available in libraries. Background papers, such as the one authored by Plate, were circulated to delegates at the Conference, but are not readily available. The most accessible reference on this subject of global water resources is found in this book by Young, Dooge and Rodda. It includes the full *Dublin Statement* in its final form (as an appendix).]

Biographical Sketch

Erna Wetzel was born and raised in Pretoria, South Africa where she obtained her B.A. Degree in 1983 at the University of Pretoria. She worked for the Department of Water Affairs for five years as Public Relations Officer, being responsible, *inter alia*, for the Department's monthly magazine, "Water", as well as assisting the Theme Editor with the text of volume "Large Dams and Water Systems in South Africa", a publication of the South African National Committee on Large Dams, (1994). After moving to Cape Town, South Africa, she continued working for the same Department.
Ms Wetzel is currently assigned to the Public Relations Division of the South African National Life Insurance Company (SANLAM) in their Head Office in Bellville, South Africa. She also assisted the Topic Editor as a consultant and editorial assistant with assembling and reviewing textual material for the Topic of Hydraulic Structures and Water Data Acquisition Systems.