

## CATCHMENT SYSTEMS

**Paul Roberts**

*Water Resources Consultant, Pretoria, South Africa*

**Keywords:** Catchment, drainage basin, international rivers, river systems, inter-basin water transfers, international water law, institutions.

### Contents

1. Introduction
  2. Catchments
    - 2.1 International rivers
    - 2.2 International water law
    - 2.3 Characteristics of catchments
  3. River systems
  4. Inter-basin water transfer
  5. Institutional and legal issues
  6. Conclusion
- Bibliography

### Summary

Catchment systems discussed in this article refer to water resource development projects within a given drainage area (catchment) which should preferably be developed, managed and operated on a systems basis for optimal utilization of the resource. The modern approach is the application of integrated water resources management in such systems. Many catchments are shared with other countries and international water law is an important aspect in this regard. The article provides information on the extent of international river basins which number 267, include 140 countries, and make up some 48% of the world's total land area. International water law is described as applicable to such catchment systems.

Many examples exist worldwide of catchment systems which include augmentation by means of inter-basin water transfers. Broad guidelines are provided for the consideration and implementation of such transfers.

Institutional aspects can be complex and several models are provided in the article which are applicable to catchment systems.

The management of catchment systems requires sophisticated computer simulation models in order to achieve optimal results for both water quantity and quality.

### 1. Introduction

The development of water resources in a river system is normally an incremental process and starts with a single reservoir on the mainstream or tributaries. As the demand for water increases, so does the number of water projects until a complex

system of mutually-dependent projects is realized. Such systems can no longer be operated on the basis of independence and sophisticated analytic tools are required for this purpose. Water shortages often require the import of water from other river systems (inter-basin transfers) which imply a plethora of environmental, legal, political and institutional issues.

Many river systems are of an international nature and affect two or more countries which require consideration and application of the principles of international water law when developing and managing such systems. Institutional issues are important in the management of complex river systems and such institutions take on many different forms.

Social, environmental and economic factors are of importance in integrated water resources management as detailed in the publication by the Global Water Partnership (2000).

The topics mentioned above are addressed in this article.

## **2. Catchments**

A catchment may be defined as “*an area determined by the geographic limits of a system of interconnected waters, the surface waters of which normally share a common terminus.*” The common terminus may be either the sea where the lower end is an estuary with its river – sea interface or an inland terminus such as the Aral Sea in Central Asia or the Okavango Swamp in Botswana, Southern Africa.

Other terminology which is used is catchment area, drainage basin, watercourse (normally takes both surface and groundwater into account). Reference should be made to the Berlin Rules of the International Law Association (2004) for a discussion of terminology.

A catchment system as used in this article is “*the system of water resource projects within a catchment and which may include water transfers from other catchments*”.

### **2.1 International rivers**

The International Commission on Large Dams (ICOLD 2006) recently completed a publication on the topic of Shared Rivers: Principles and Practices. The report contains a detailed tabulation of international rivers (also called shared rivers, shared watercourses, transboundary rivers, etc) and their characteristics.

The number and drainage areas of the international shared river basins of the world are given in Table 1. Figure 1 gives an overall global depiction of the distribution of international river basins.

The size of the shared river basins ranges from a few hundred square kilometers to almost 6 million km<sup>2</sup>. The size of the drainage basin (catchment area) is not necessarily the most important indicator and the importance of the water resource will be the

controlling parameter. The international river basins are shared between two and up to 17 countries for a river such as the Danube. Generally the larger the number of basin states, the greater the complexity of the joint management of such a shared resource.

Continent	Number of shared rivers	Number of countries	Drainage area km <sup>2</sup>	Percentage of total area %
Africa	62	46	18 364 704	60.6%
Asia and Middle East	55	31	17 009 095	38.2%
Europe	72	40	6 031 098	60.6%
North America	18	3	8 428 783	34.8%
South and Central America	60	22	10 876 145	61.1%
TOTAL	267	142 <sup>1</sup>	60 709 825	47.9%

<sup>1</sup> Two countries are duplicated in two Regions

Table 1: International Shared Rivers of the World

It can therefore be concluded that international shared rivers are a significant proportion (47.9%) of the world's total land area and impact on many countries of the world.



Figure 1: Global distribution of international river basins

-  
-  
-

TO ACCESS ALL THE 9 PAGES OF THIS CHAPTER,  
Visit: <http://www.eolss.net/Eolss-sampleAllChapter.aspx>

**Bibliography**

Basson MS, Allen RB, Pegram GGs and Van Rooyen JA, (1994), *Probabilistic management of water resource and hydropower systems, on behalf of the Department of Water Affairs and Forestry, South*

*Africa*, Water Resources Publications, ISBN 918334-89-6.

Department of Water Affairs and Forestry (2004), *National Water Resource Strategy*, September 2004. [The first strategy produced in terms of the National Water Act. International water obligations are discussed in the document as well other policy issues related to the management and utilization of the resource.]

Global Water Partnership Technical Advisory Committee (TAC) (2000): *Integrated Water Resources Management*. TAC Background paper No 4, March 2000.

International Commission on Large Dams (2006), *Shared Rivers, Principles and Practices*, in press, 2006. [A comprehensive review of the topic which includes many illustrative examples and eight comprehensive case studies. Tables of shared river information attached.]

International Law Association (2004). *Berlin Rules on Water Resources*, International Law Association 71<sup>st</sup> Conference, Berlin, August 2004. [The ILA has updated the Helsinki Rules in the light of developments in international water law, particularly the UN Convention. A separate document is also available which gives the sources on which the Rules are based. Rules and Sources available on [www.ila-hq.org](http://www.ila-hq.org) by accessing Committees-Water Resources]

United Nations (1997): *Convention on the law of the non-navigational uses of international watercourses*. United Nations A/51/869, 11 April 1997.

United Nations Environmental Programme (UNEP) (2002). *Atlas of International Freshwater Agreements*, ISBN: 92 807 2232 8, 2002. [The Atlas is a consolidation and dissemination of information about shared water treaties. Some 120 river basins are included in the Atlas which has one or more treaty. The Atlas contains a detailed listing of more than 300 international freshwater agreements. The World's International Basins are described together with a number of most informative thematic maps related to shared rivers.]

World Commission on Dams. *Dams and Development: A New Framework for Decision-Making*, Earthscan Publications Ltd, November 2000. [The WCD was an independent, international, multi-stakeholder process which addressed the controversial issues associated with large dams. Reference should be made to the ICOLD website ([www.icold-cigb.org](http://www.icold-cigb.org)) for ICOLD's reaction to this Report.]