# Lesson 1: Introduction to IWRM


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# Lesson 1 Introduction

- This lesson will define IWRM and will introduce some concepts of IWRM.

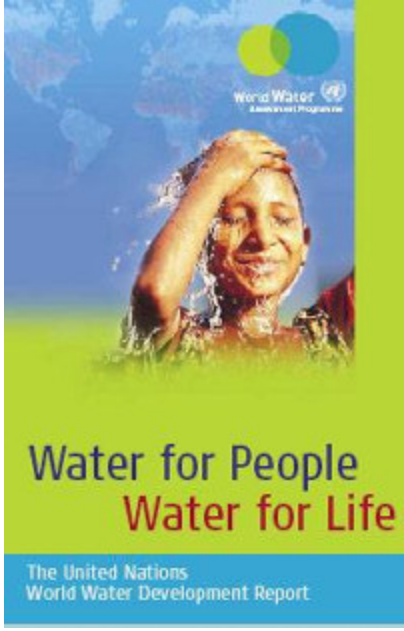
# IWRM: An Overview

***"The message of the developing world - grappling with poverty, growing population, increasing urbanization and industrialization - is clear. Freshwater supply will be a critical issue in the years to come. Information, assessment and monitoring of global water resources will be crucial."***

**- Klaus Toepfer, Executive Director of the United Nations Environment Programme (UNEP)**

- **Every 8 seconds, a child dies from a water-related disease.**
- **50% of people in developing countries suffer from one or more water-related diseases.**
- **80% of diseases in the developing world are caused by contaminated water.**
- **50% of people on earth lack adequate sanitation.**
- **20% of freshwater fish species have been pushed to the edge of extinction from contaminated water**

# From the United Nations World Water Development Report




- About 2 million tonnes of waste are dumped every day into rivers, lakes and streams.
- One litre of wastewater pollutes about eight litres of freshwater.
- There is an estimated 12,000 km³ of polluted water worldwide, which is more than the total amount contained in the world's ten largest river basins at any given moment.
- If pollution keeps pace with population growth, the world will effectively lose 18,000 km³ of freshwater by 2050 – almost nine times the total amount currently used each year for irrigation, which is by far the largest consumer of the resource

- The poor continue to be the worst affected, with 50% of the population in developing countries exposed to polluted water sources.
- Asian rivers are the most polluted in the world, with three times as many bacteria from human waste as the global average.
- Moreover, these rivers have 20 times more lead than those of industrialized countries.
- Water consumption has almost doubled in the last 50 years.
- A child born in the developed world consumes 30 to 50 times the water resources of one born in the developing world.
- Meanwhile, water quality continues to worsen.
- Every day, 6000 people, mostly children under the age of five, die from diarrhoeal diseases.

# What is Integrated Water Resource Management?

- "*Integrated water resources management* is a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." (*Global Water Partnership - Technical Advisory Committee, 2000*)

- IWRM has gone beyond the traditional description of the resource and integrating or balancing demand. The concept now embodies integration across sectors, integration of use, integration of demand, integration with the environment, and integration with the people.

## Other definitions of Integrated Water Resource Development and Management are:

***"IWRM is necessary to combat increasing water scarcity and pollution. Methods include water conservation and reuse, water harvesting, and waste management. An appropriate mix of legislation, pricing policies and enforcement measures is essential to optimise water conservation and protection."*** **(UNDP, 1991)**

*"Water resources means water in the broad sense as available for use and susceptible to human interventions. Water can be surface or groundwater, and is characterised by both quantity and quality.*

*Development and management cover all phases of resources planning, development, use and protection, i.e. assessment, planning, implementation, operation & maintenance, and monitoring & control. They include both combined resource and supply management and demand management. Integrated means development and management of water resources as regards both their use and protection, and considering all sectors and institutions which use and affect water resources (cross-sectoral integration)."*

**Nordic Freshwater Initiative (Danida,1991)**

# Canada's Department of Fisheries and Oceans also studied IWRM. They observed that:

**Integrated watershed management (IWM), itself, is not an exact science. Rather, it is an approach to environmental management that uses the topographically delineated area drained by a stream as both the physical and analytical boundary of analysis.**

**IWM encourages the examination of all biophysical and socio-economic linkages such as those that exist among natural resource sectors or those that exist between upstream activities and downstream impacts.**

**It has a transdisciplinary focus with an emphasis on collaboration among specialists in widely varying disciplines.**

**IWM balances social, economic and environmental values with an emphasis on strategic action and targeting issues and tasks that are essential (better management in the face of decreasing financial and human resources).**

**Furthermore, IWM recognizes the need to cope with uncertainty and complexity of ecosystems and socio-economic systems.**

DFO: http://www-heb.pac.dfo-mpo.gc.ca/english/programs/hcsp/watrshd/wrtrgov.htm

# IWRM has three features that differentiate it from traditional media-based resource management:

- It is more “bottom up” than “top down” and thus emphasizes the building of capacity among water users ( it has also been described as the meeting of top-down and bottom up, as government certainly can have a major role in setting up frameworks to facilitate engagement)
- It encourages cross-sectoral, interdisciplinary management of water resources (i.e. it is integrative across environmental media).
- It encompasses management of other activities (e.g. land use) that affect water resources (i.e. it is solution-focussed).

Heathcote, 2002

**Integrated Water Resource Management (IWRM) is but one aspect of a change in environmental management in general.**

**As one example of this, in a major strategic report prepared for the Government of Ontario, the Executive Resource Group (2001) stated that there is now "striking consensus" that environmental management is undergoing a fundamental change.**

**This change derives from the intersection of several forces including:**

- **Diminishing returns from traditional management models,**
- **Scarcity of human and financial resources,**
- **Increasing societal demand for transparency and accountability,**
- **Rapidly changing technology.**

**The report refers to this change as "a shift towards a strategic approach to managing the environment".**

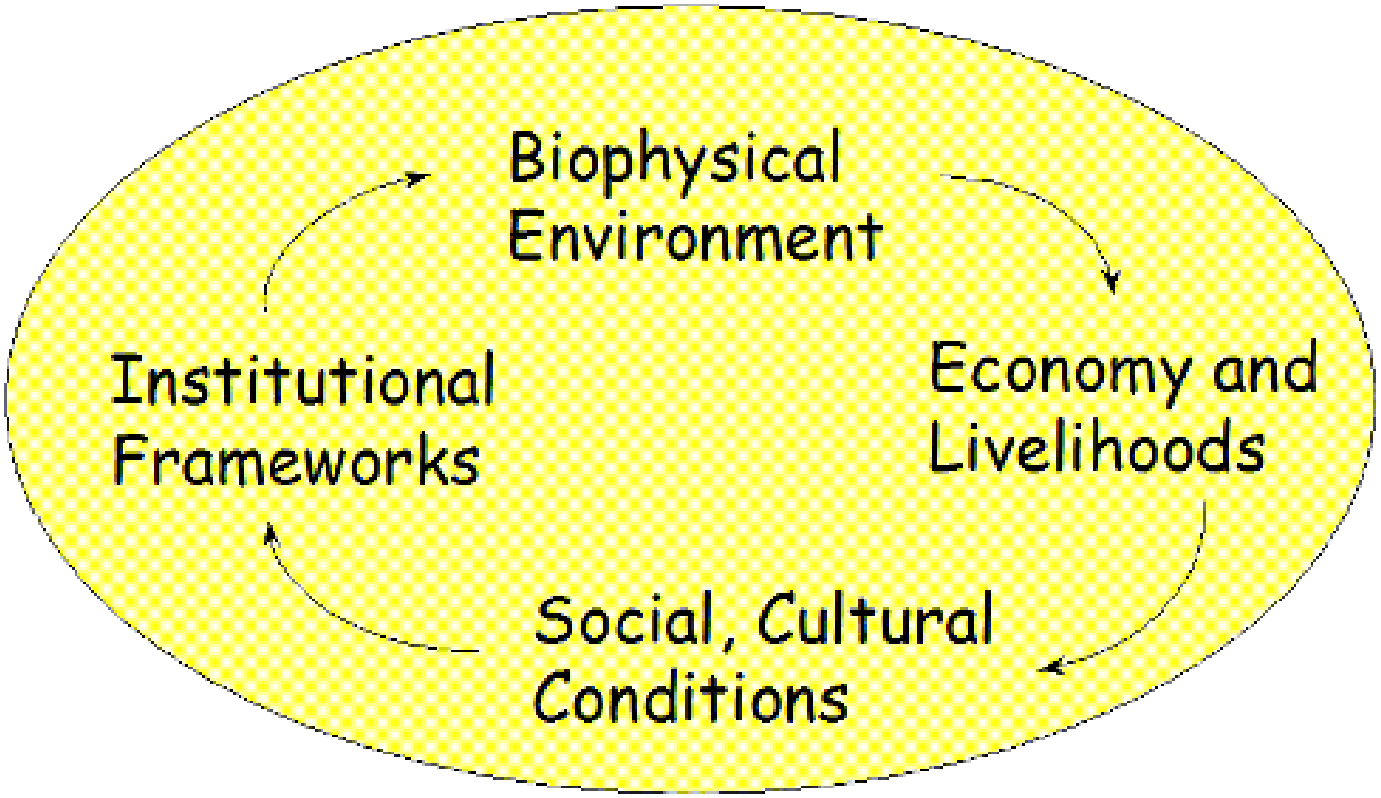
**This overall shift is characterized by five sub-"strategic shifts".**

- **High-level, government-wide vision and goals, with implementation shared across departments**
- **A new emphasis on strategies to promote continuous environmental improvement and accountability across all sources of pollution**
- **A "place-based" approach that recognizes ecological functions rather than geographic or political borders**
- **A more comprehensive and flexible set of regulatory and non-regulatory compliance tools and incentives**
- **An approach that emphasizes sharing of responsibility with industry, NGOs, the public, and the scientific/technical community**

## Key IWRM principles are:

- Water source and catchment conservation and protection are essential.
- Stakeholders within a national framework should agree about water allocation.
- Management needs to happen at the most basic appropriate level.
- Capacity building is the key to sustainability.
- Involvement of all stakeholders is required.
- Efficient water use is essential and often an important “source” in itself
- Water should be treated as having an economic and social value.
- Striking a gender balance is essential.

# An Integrated Approach Aims To Link



**Integrated water resources planning and management aims to take appropriate account of important physical, social, economic and cultural linkages within a water resources system.**

**These linkages may include *physical linkages* between land use and surface and groundwater quantity and quality, *economic linkages* between various, and sometimes competing, water uses, *social linkages* between water development schemes and potential beneficiaries or those adversely affected, and *institutional linkages*, both horizontally and vertically, among various formal and non-formal stakeholder institutions.**

**(From: Bruce Mitchell, University of Waterloo, Ontario, Canada)**

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# Some IWRM Terminology

- ***Drainage Basin:*** **The area of land over which the water drains to a single outlet.**
- ***Watershed:*** **Either the equivalent of a drainage basin, or the delineating points (divide) where water flows to two different outlets.**
- ***River Basin:*** **The drainage basin for a river system.**
- ***Catchment:*** **The equivalent of a drainage basin**

# Some IWRM Terminology

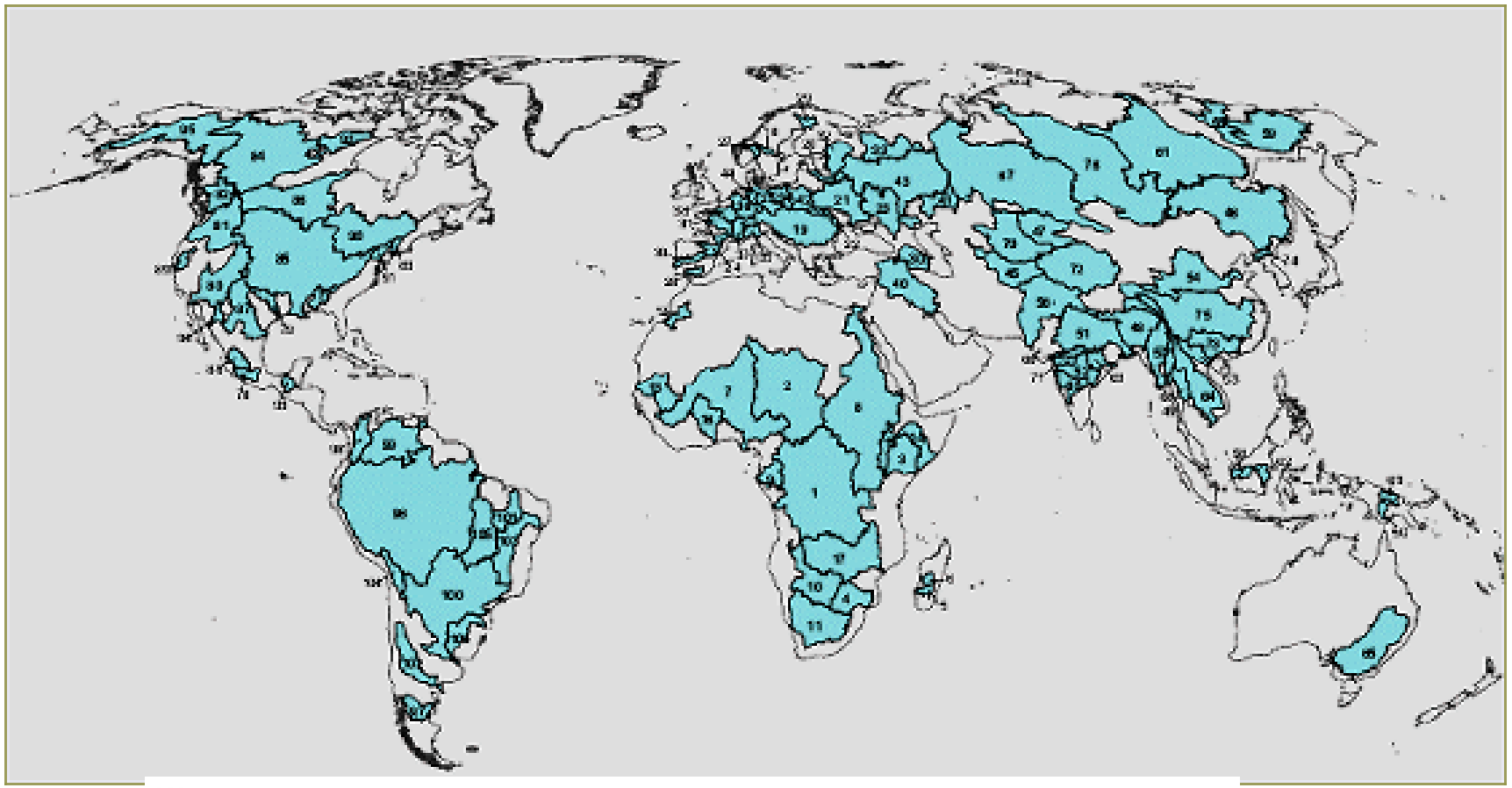
- There is some confusion over the use of the terms *drainage basin*, *catchment* and *watershed*. They can be considered interchangeable in most cases, but different groups of people have preferred one or another over the years. The term "watershed" has become popular in North America, but "drainage basin" and "catchment area" are more popular in Europe and Australia.

- IWRM deals with ALL features of the area under consideration – including surface water and ground water. Note: the groundwater aquifer structure and extent MAY NOT correspond to a drainage basin.

- IWRM may be applied to parts of a drainage basin or watershed (a sub-watershed)

- IWRM may be applied to more than one drainage basin or watershed – or may apply to an area within a political boundary.

# Major Watersheds (drainage basins) of the world:



***Africa***
1 Congo
2 Lake Chad
3 Jubba
4 Limpopo
5 Mangoky
6 Mania
7 Niger
8 Nile
9 Ogooue
10 Okavango Swamp
11 Orange
12 Oued Draa
13 Senegal
14 Shaballe
15 Turkana
16 Volta
17 Zambezi

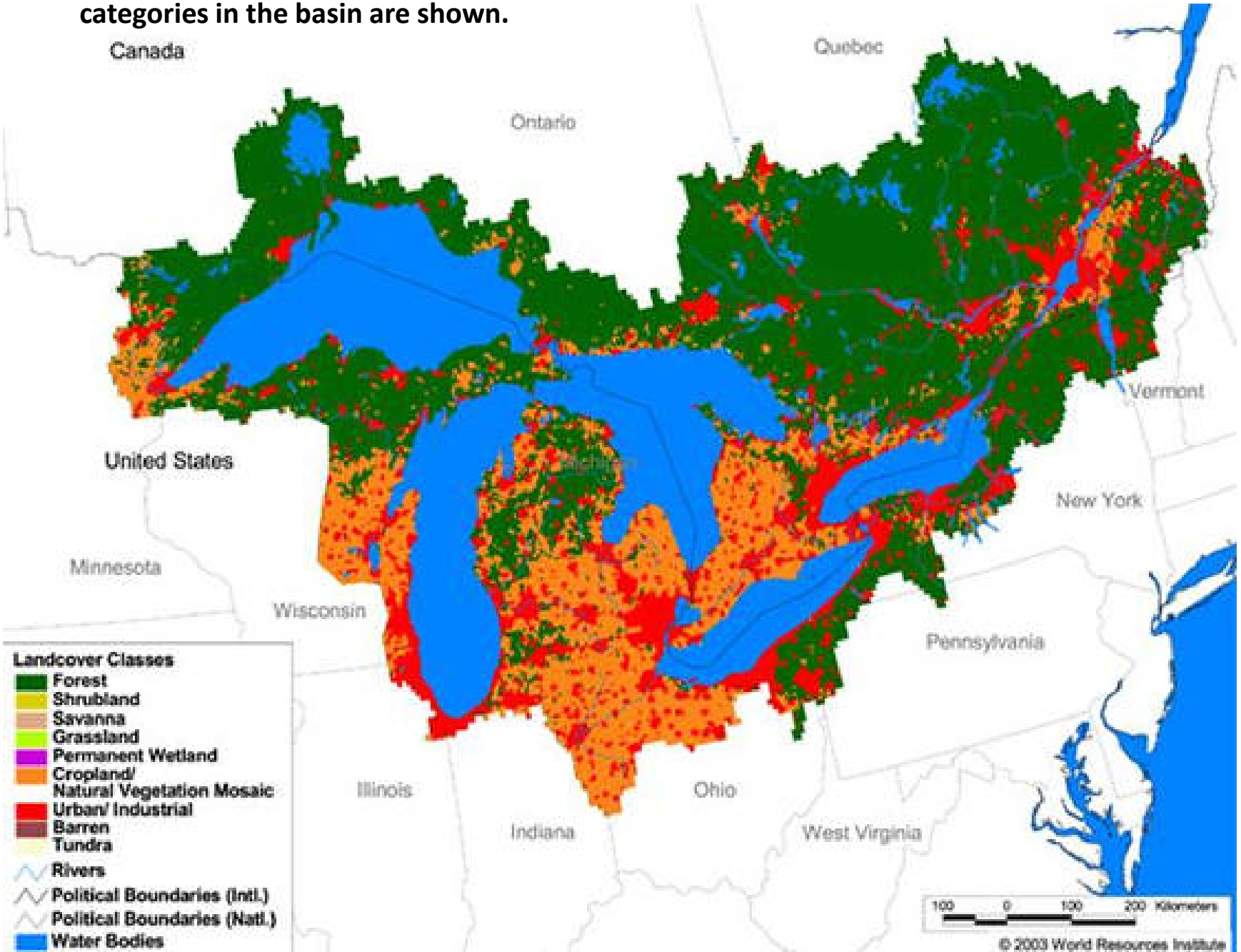
***Europe***
18 Dalalven
19 Danube
20 Daugava
21 Dnieper
22 Dniester
23 Don
24 Ebro
25 Elbe
26 Garonne
27 Glama
28 Guadalquivir
29 Kemijoki
30 Kura-Araks
31 Loire
32 Neva
33 North Dvina
34 Oder
35 Po
36 Rhine & Meuse
37 Rhone
38 Seine
39 Tagus
40 Tigris & Euphrates
41 Ural
42 Vistula
43 Volga
44 Weser

***Asia & Oceania***
45 Amu Darya
46 Amur
47 Lake Balkhash
48 Brahmaputra
49 Chao Phrya
50 Fly
51 Ganges
52 Godavari
53 Hong (Red River)
54 Hwang He
55 Indigirka
56 Indus
57 Irrawaddy
58 Kapuas
59 Kolyma
60 Krishna
61 Lena
62 Mahakam
63 Mahanadi
64 Mekong
65 Murray-Darling
66 Narmada
67 Ob
68 Salween
69 Sepik
70 Syr Darya
71 Tapti
72 Tarim
73 Xi Jiang
74 Yalu Jiang
75 Yangtze
76 Yenisey

***North & Central America***
77 Alabama & Tombigbee
78 Balsas
79 Brazos
80 Colorado
81 Columbia
82 Fraser
83 Hudson
84 Mackenzie
85 Mississippi
86 Nelson
87 Rio Grande
88 Rio Grande de Santiago
89 Sacramento
90 St. Lawrence
91 Susquehanna
92 Thelon
93 Usumacinta
94 Yaqui
95 Yukon

***South America***
96 Amazon
97 Chubut
98 Magdalena
99 Orinoco
100 Paraná
101 Parnaiba
102 Rio Colorado
103 São Francisco
104 Lake Titicaca
105 Tocantins
106 Uruguay

**The "watershed" or "drainage basin" of the North American Great Lakes. Different land use categories in the basin are shown.**



# Specialized Skills for IWRM Planning

**Some of the various specialized skills that can be involved in IWRM are:**

- ❑ **Engineering**
- ❑ **Biology**
- ❑ **Chemistry**
- ❑ **Microbiology**
- ❑ **Soil Science**
- ❑ **Climatology**
- ❑ **Hydrology**
- ❑ **Hydrogeology**
- ❑ **Remote Sensing**
- ❑ **Geographic Information Systems**
- ❑ **Cartography**

# Specialized Skills for IWRM Planning

- Computer Science–Databases, Modeling and Simulation
- Management Sciences
- Agriculture
- Sociology
- Ecology
- Economics
- Aquatic Toxicology
- Environmental Sciences
- Legal & Regulatory
- Governance and Political Science

## Past and Present IWRM Efforts

**More and more agencies have established administrative frameworks that permit and even encourage management of water on a watershed basis.**

**Less frequently are water management activities integrated with other resources management activities affecting or affected by water.**

**These may include, at minimum, the intensity and nature of agricultural activities, forestry, and commercial fisheries.**

"Although integration at the watershed level is increasingly possible, integration at larger scales is, in the words of McDonald and Kay (1988), 'conspicuously absent,' although there are clear advantages to integrated water management at the international scale (especially in international river basins) and even at the global scale."

Despite this, IWRM is improving and becoming more "mainstream". Many agencies now include it in their list of required or preferred practices when dealing with appropriate water issues.

Nevertheless, care must be taken that IWRM does not become simply a routine way to look at and talk about water management without engaging in the rigorous analysis and integration that is required for successful and useful implementations

## Learning From the Assessments of Some IWRM Projects

***Integrated Water Resource Management in Water and Sanitation Projects– Lessons from 11 projects in Africa, Asia and South America*** **(1 January, 1999)**

- **Eight DWSS and three IWRM projects from seven countries were reviewed to identify the extent to which they incorporated IWRM principles.**

- **The review covered a wide range of scales, from the micro-catchment (700 people, 900 ha) to the river basin (1.5 million people, 4,300 km2); landscapes, varying from the humid to the semi-arid, and included a range of socio-economic and developmental backgrounds.**

- **They all shared a commitment to participatory approaches aimed at empowering communities and giving them the maximum possible control over their resources.**

**(Source: Executive summary IRC International Water and Sanitation Centre, 2000)**

**Eight principles of IWRM were identified. These were based on the Dublin principles and other more recent developments.**

## The eight principles are:

1. **Water source and catchment conservation and protection are essential.**
2. **Water allocation should be agreed to between stakeholders within a national framework.**
3. **Management needs to be taken care of at the lowest appropriate level.**
4. **Capacity building is the key to sustainability.**
5. **Involvement of all stakeholders is required.**
6. **Efficient water use is essential and often an important "source" in itself.**
7. **Water should be treated as having an economic and social value.**
8. **Striking a gender balance is essential.**

# Principal Conclusions

- IWRM principles are internationally accepted but not yet truly applied to DWSS (Drinking Water Supply and Sanitation).
- Water source and catchment conservation is gaining recognition but requires further work.
- True stakeholder involvement in water allocation decision making remains limited.
- The framework to allow management at the lowest appropriate level is often not available.

# Principal Conclusions (contd)

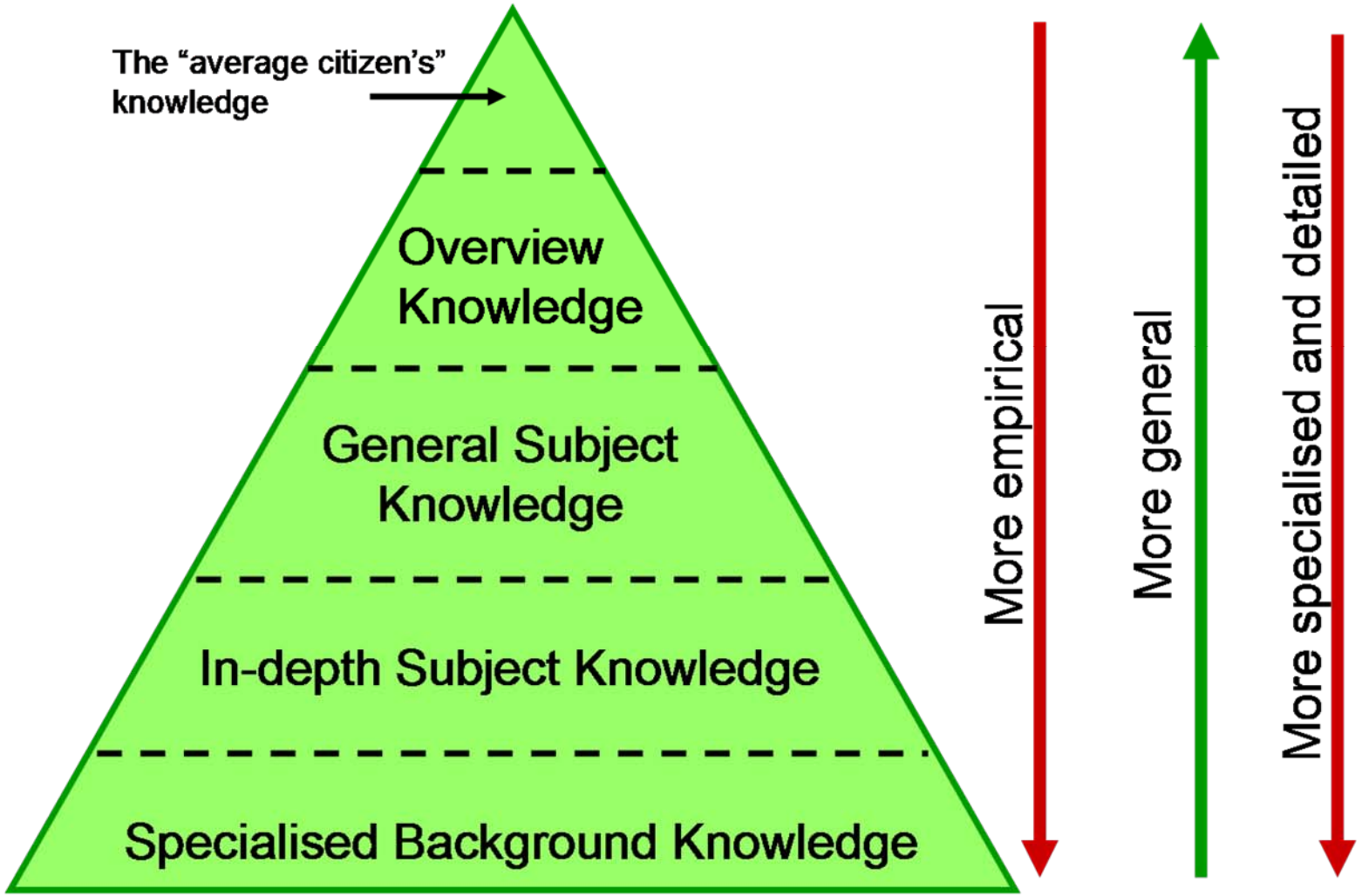
- Capacity building is promoted but not at all levels, and its effectiveness is not monitored.
- Stakeholder involvement is growing, but is still too limited and too narrow in focus.
- Efficient water use is gaining attention but requires much greater emphasis.
- Water is increasingly viewed as having an economic and social value.
- Striking a gender balance is often perceived to mean enhancing women's involvement.

# Knowledge Base for IWRM

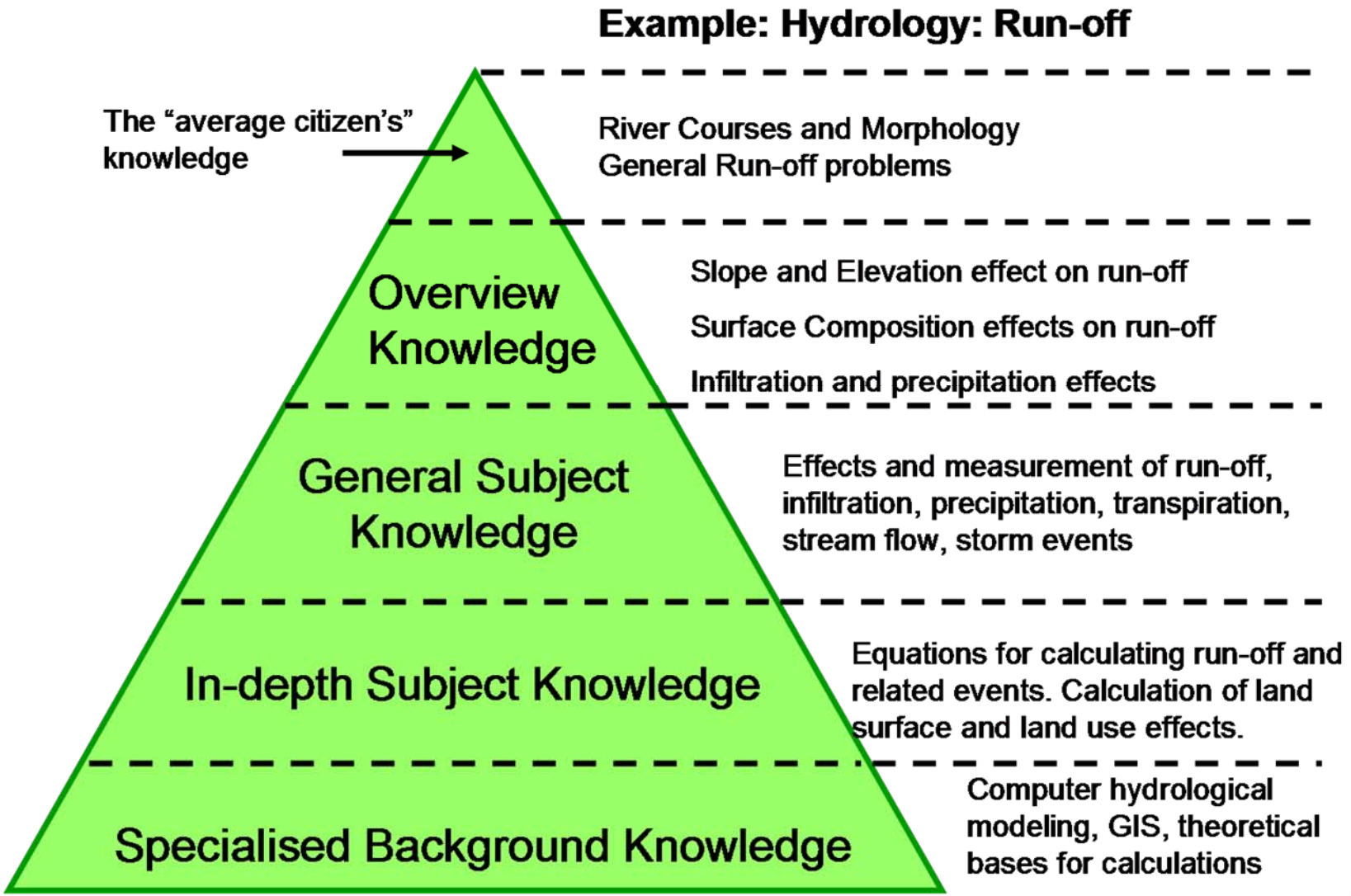
# Knowledge Base for IWRM

**Although many specialists can be involved in IWRM planning processes, and can each bring their expertise to the process, there remains a set of "core knowledge" that all participants in the process should share.**

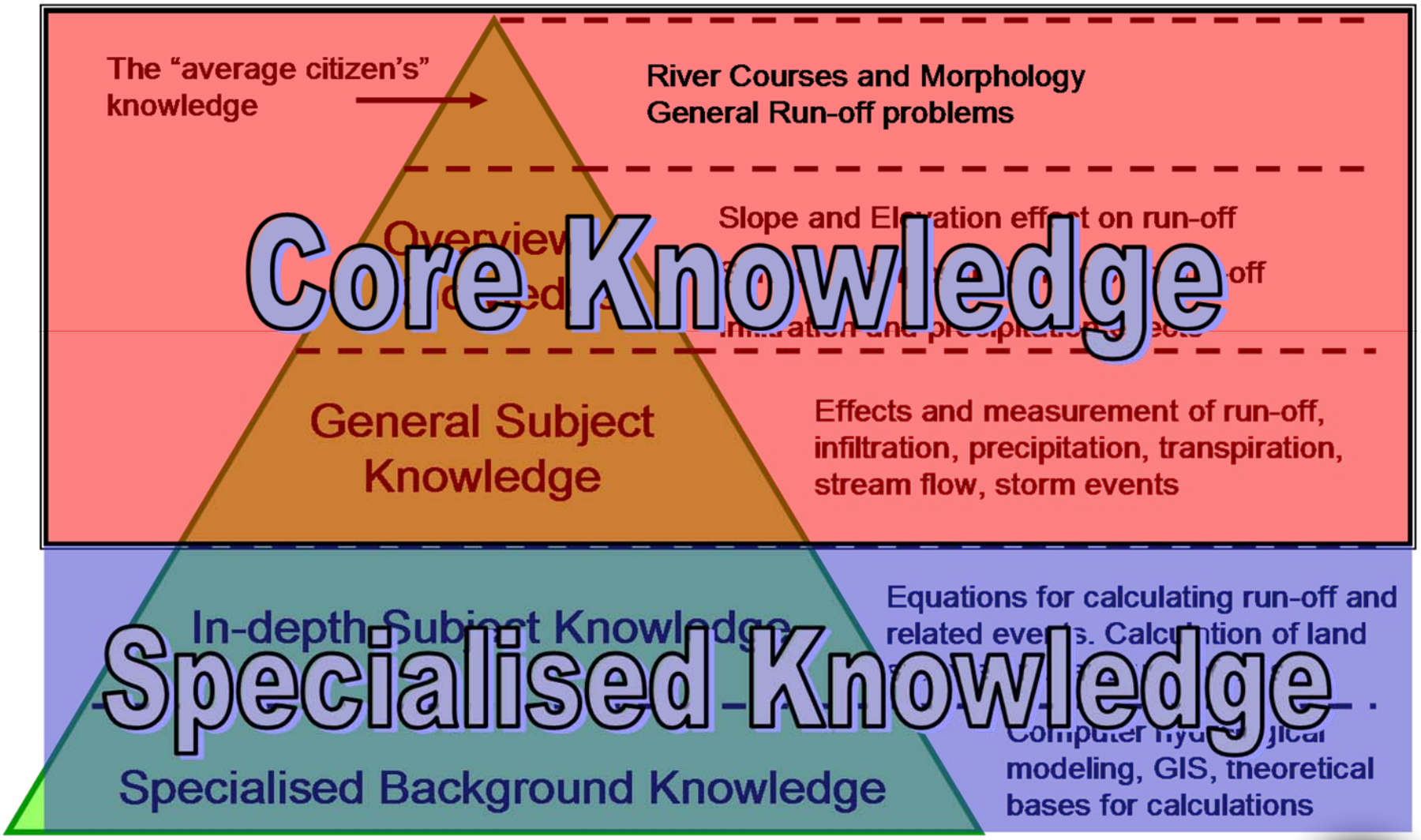
## What is this "core knowledge base"



# Example:


Example: Hydrology: Run-off
The "average citizen's" knowledge
River Courses and Morphology
General Run-off problems
Overview Knowledge
Slope and Elevation effect on run-off
Surface Composition effects on run-off
Infiltration and precipitation effects
General Subject Knowledge
Effects and measurement of run-off, infiltration, precipitation, transpiration, stream flow, storm events
In-depth Subject Knowledge
Equations for calculating run-off and related events. Calculation of land surface and land use effects.
Specialised Background Knowledge
Computer hydrological modeling, GIS, theoretical bases for calculations

## Example: Hydrology: Run-off

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- Deciding what this “core knowledge” should be is an essential part of capacity building for IWRM.
- Each participant then shares a common vocabulary and understanding of this “core knowledge”
- To a certain extent, each participant can communicate effectively with all of the others in the IWRM process.
- If this “core knowledge” is not shared, then these communications may be much more difficult and even impossible.

As an example, if everyone shared the "core knowledge" on hydrology shown in the previous diagrams, communications on that subject would be much more efficient and clearer.

The experts in hydrology would still be required when the knowledge required was more complex and specialized