Integrated Lake Basin Management

This Presentation

- What are Lakes
- Lakes differ from rivers
- Lake Management
- Why bother about Lake management
- Lessons learned
- Planning for sustainable lake management

What are Lakes?

- There is no universal definition for a lake. The International Glossary of Hydrology (UNESCO and WMO 1992) briefly states, that a lake is an "inland body of water of considerable size".
- In the broadest sense, lakes, wetlands and reservoirs can be considered “standing water” systems

What are Lakes?

- In scientific terms, standing waters are termed “lentic” systems, whereas flowing waters (rivers) are known as “lotic” systems.
- In general, because lakes usually have both inflowing and out flowing rivers, a lake basin can be characterized as a complex combination of both lentic and lotic waters, with this distinction between the two being of great importance for lake management .

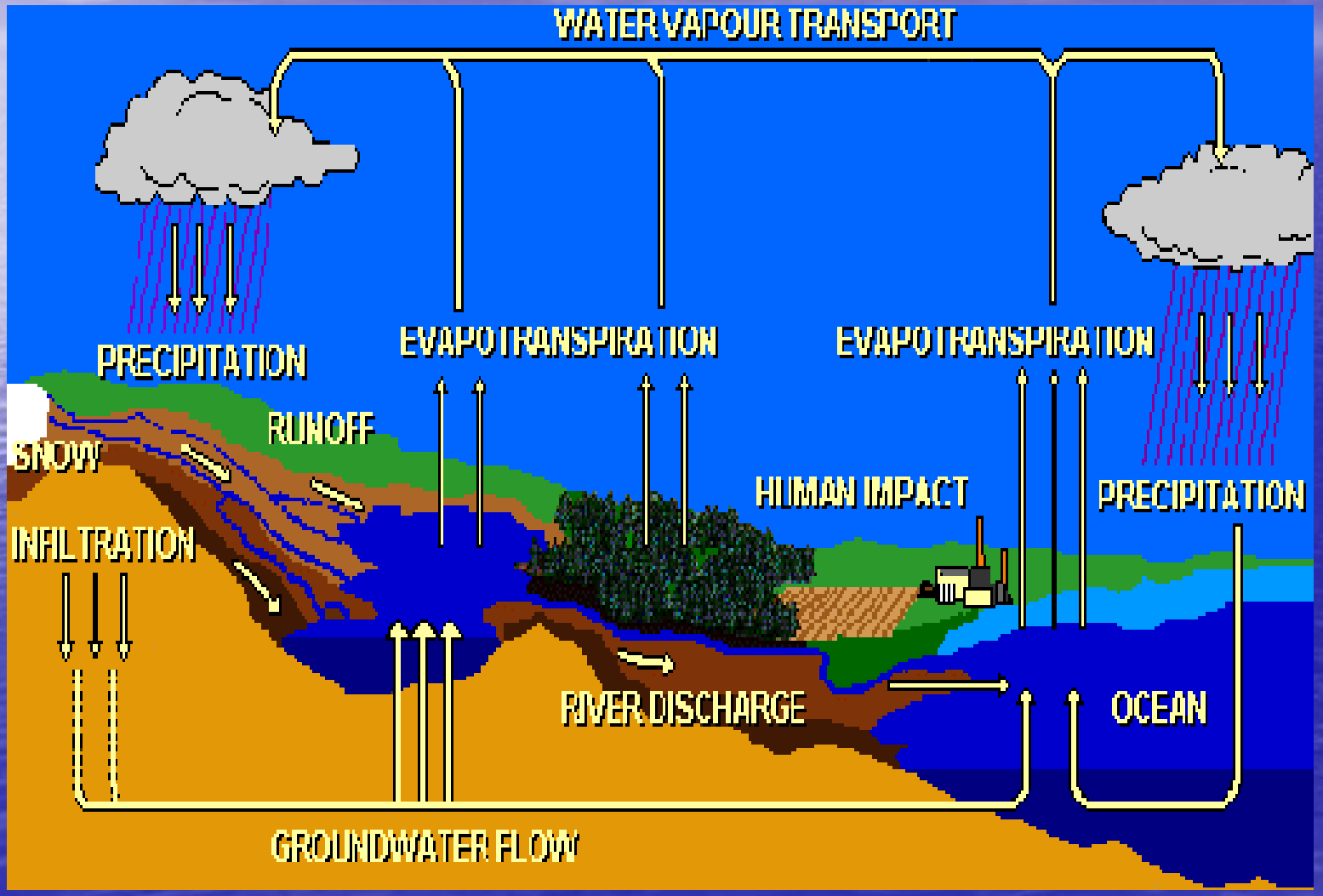
What are Lakes?

- The EU Water Framework Directive, WFD (2000/60/EC) has defined a lake as a body of standing inland surface water. The Annex II of the WFD has in a way determined also the minimum size of a lake, which should be taken into account to be 0.5 km2 (50 ha).

Lakes as part of River Basin

- Different water bodies in the watershed are closely connected to the entire environment.
- A lake is only one element, involved in the hydrological cycle of the river basin
- Lake management and monitoring is only a part of river basin management and monitoring.

Lake- one element of Hydrological Cyckle



Lakes differ from Rivers

Lakes differ from rivers as ecosystems in many respects;

- hydrological circumstances,
- thermal properties,
- production/decomposition relations,
- sedimentation rate and sediments, and in stability of certain phenomena.
- Lakes are almost closed systems. Substances once introduced to the lake are permanently incorporated in the circulation.
- Only a part of them are removed (depending on water exchange rate).
- Rivers are open systems, in which constant downstream transport of substances takes place

Lakes differ from Rivers

- In lakes the vertical distribution of temperature depending on the season is a very important phenomenon.
- During summer time a clear thermal stratification can be detected in all deeper lakes.
- In the upper water layer the temperature is highest, and can be at the same level than the temperature in rivers at the same time.

Lakes differ from Rivers

- The temperature in the deeper layer of the lake is, on the contrary, usually very cold (5---10 oC) during the whole summer stratification period.

- This cold layer is a very important part of the lake from the monitoring point of view. Many slight pollution indications can particularly be detected for the first time just in the hypolimnion, usually in the very thin water layer nearest to the bottom sediments.

Lakes differ from Rivers

- Sedimentation is a very important process in lakes, and has a dominant role in nutrient cycles, and thus also in the eutrophication process. Sedimentation areas must be identified before the implementation of the monitoring programmes

Lakes differ from Rivers

- While some problems originate in a lake itself (such as overfishing), the vast majority of problems originate from activities on the land surrounding a lake.
- Therefore manangement of a lake means management its drainge basin. The two can not be separated.
- Unfortunety, it is rare when the boundaries of the basin and political system coincide. In some cases, the origin of a given problem may lie beyond the lakes's basin such as with long range transport of toxic materials .

Lake management

In fact, the occurrence and management of lake problems is influenced by three characteristics of **lentic** water systems –

- integrating nature
- long water retention time and
- complex response dynamics.

Long retention time

- Although lake ecosystems are resilient when faced with stresses that have existed over evolutionary time scales, they can be extremely vulnerable to “new” stresses, such as the introduction of exotic species.
- The long water retention time also means that once a lake is degraded, it can take a very long time – if ever–for it to recover or be restored. It also leads to lags in ecosystem response that are poorly matched to the human management time-scale.

Long retention time

- The relatively long retention time of most lakes compared to rivers, means that the ”lake time scale” is not equal to the political time scale. There is usually a significant delay between an action (positive and negative) and the change in a lake.

Management Implications long retention time

Because the problems can build up and become noticed slowly, and take equally as long to be managed, institutions involved in lake basin management need to be prepared to engage in sustained actions, with long term funding commitments.

- management with a precautionary approach

Complex response dynamics

- Means that connections are often indirect and not easy to determine. Changes are often irreversible and dependent on path. This behavioural characterstics apply not only to natural lakes but also to man – made lakes all essential components to river basin systems

Management Implications complex response dynamics

Complex response dynamics, particularly in relation to long water retention times, imply that the problems need to be anticipated as far in advance as possible through monitoring, development of indicators and analytical studies, while carrying out scientific explorations to unravel the complex processes and their implications.

- Scientific studies may also help develop novel solutions to these problems.

Integrating Nature

Lakes receive pollutant inputs from diverse sources in various forms from their drainage basins and beyond. The inputs to a lake can exist in the form of

- **Atmospheric precipitation**; flows from rivers and other inflowing channels; heat- and wind-induced energies that cause waves;
- **Thermal energies** that affect mixing properties; and
- **Land-based and airborne pollutants** and contaminants, nutrients, and organic substances, both living and nonliving matter.

The integrating nature refers to the mixing of these inputs within a lake so that both resources and problems are disseminated throughout the volume of a lake.

Management Implications Integrating nature

The integrating nature of a lake means that many lake resources, as well as lake problems, are shared throughout the lake.

As a result, it is not

- sensible to subject different parts of a lake to different management regimes.

This is particularly

- Relevant to transboundary lake basins.

A related consequence of their integrating nature is that

- It is difficult to exclude users from accessing a lake's resources.

These properties require lakes and their basins to be subjected to adaptive management, utilizing wide-ranging policy instruments.

Why lakes?

- Lakes and their surrounding watersheds are unique and valuable ecosystems for both people and nature. Lakes are critical "storage tanks" for freshwater. More than 90% of all available liquid surface freshwater is contained in lakes and reservoirs. Despite their importance, many of the world's lakes are in crisis

The Degrading Trend of the World's Lakes

The global experience of lake basin management encompasses a wide variety of lessons.

- Some are at early stage of resource development and the resulting degradation of their environments is minimal.
- Others have been overexploited and their ecological services functions are suffering from serious degradation.

And

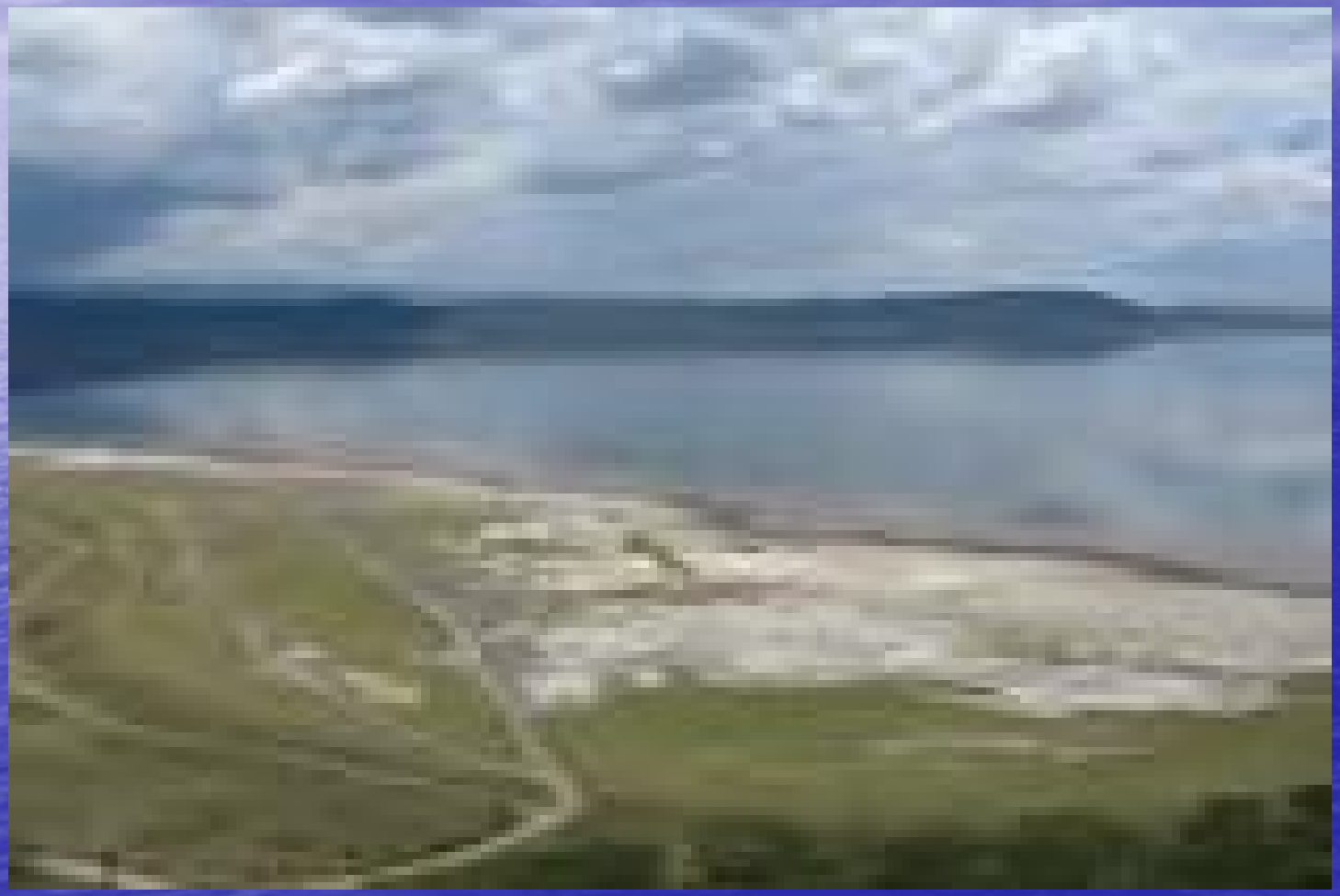
- still others have been introduced with measures for achieving

sustainable resource development, use and conservation.

Overfishing due to fine mesh size

Invasive parasitic fish, sea lamprey

Exposed salt on Lake Nakuru shoreline



Impacts of water hyacinth on lake transportation

Fish pens in Laguna de Bay

Shoreline and littoral habitat destruction

Inflowing sediment plume to Lake Superior

Dried bed of Aral Sea

Storm water effluent

Industrial wastewater

Smoke from biomass burning covering Lake Victoria

Toxic contamination

Damage from acid rain

Increasing lake levels in Himalayas due to glacial melt

Integrated Lake Basin Management (ILBM)

Regardless, the way in which the stress is exerted from the basin to the lentic body of lake water is the same, and a common and integrated approach is needed to address these wide ranging issues in lake basin management.

ILBM

- ILBM is a way of thinking that assists lake basin managers and stakeholders in achieving sustainable management of lakes and their basins.
- It takes into account that lakes have a great variety of resource values whose sustainable development and use require special management considerations for their lentic (static) water properties.

ILBM

Good basin management of a lake can be realized only through ILBM, or continuous improvement of lake basin governance that integrates institution, policy, participation, science, technology and funding.

- Improvement of the state of world' s lakes can be realized by promoting ILBM globally, with long-term and strong political commitment

Lessons Learned

- **Importance of Basin Approach:** Management does not stop at the lakeshore, but must extend into the basin, and often beyond.
- The largest number of lake issues reported in several studies originated from their upstream or downstream basins.
- **Border Barriers (Transboundary Lakes) Must be Overcome:** In principle, transboundary

lakes are more difficult to manage. In practice, however, there is good progress in establishing

agreed plans of action and institutions.

Lessons Learned cont..

- **Technological Interventions Can be Effective:** Technologies can have dramatically positive effects on lakes, provided the root causes of their problems and their sustainability are properly addressed.
- **Success Depends Heavily on Stakeholder Involvement:** Degradation of the ecosystem services provided by lakes results from unsustainable human interventions for resource development. Sustainability can be best achieved when the respective stakeholders fully understand and appreciate their respective roles regarding the problems.

Lessons Learned cont..

- **Long-term Commitment is Essential:** The long water retention time and complex dynamics of lakes means that successful project outcomes are seldom immediate. Thus, there is a need for indicators that illustrate both planning (Process Indicators), implementation (Stress Reduction Indicators) and actual lake basin improvements (Environmental Status Indicators).

Lessons Learned cont..

- **Monitoring Should Not be Overlooked:** Long-term monitoring data sets can form the basis for mutual understanding of lake basin management issues, thereby leading to cooperative actions to address them.
- **Lake Basin Management is a Continuing Process not a One-time Project:** Management interventions at a lake basin usually first happen in isolation, often for non-lake related reasons. Through time, however, the need for the integration of projects can grow.

From experience

Experiences learned indicates that good lake basin management requires six necessary component for effective management response:

Institutions- to manage the lake and its basin for the benefit of all lake basin resource uses;

- **Policies -**to govern people's use of lake resources and their impacts on lakes;
- **Involvement of people** central to lake basin management;
- **Technological possibilities** and limitations exist in almost all cases;
- **Knowledge** both of a traditional and scientific nature is valuable;
- **Sustainable finances** to fund all of the above activities are essential.

Planning for Sustainable Lake Management- General Overview

- Lake basin planning is the process of developing an agreed set of goals for use of lake basin and the means for achieving those goals typically within a particular time frame and resource constraint
- Plans can be developed at different levels of specificity from local to basin-wide plans, and from sectoral to comprehensive plans.

Lake Basin Planning(LBP)

Development of a plan requires

- involvement of stakeholders and instituions concerend with lake basin managment,
- the use of reliable and timely information,
- the assessment and selection of both policies and technological responses to issues,
- and the identification of financing options for implementing the plan.

LBP

- The lake basin plan is the mechanism for putting the components together in an effective and fair way for resource development, environmental protection, and social benefit.
- The viability of a management plan for lake basin is strongly dependent on the alignment of the plan with regional and national plans for socioeconomic development and environmental conservation

LBP

- Political decision makers can be powerful influences in drawing up and implementing management plans.
- They can promote
  - institutional cooperation
  - ensure alialignment with socioeconomic development and environmeal conservation plans,
  - and access te necessary finance for implementation


THANKS