



Training for Trainers Integrated Flood Management for Sustainable Development

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Environmental Aspects of IFM

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WMO

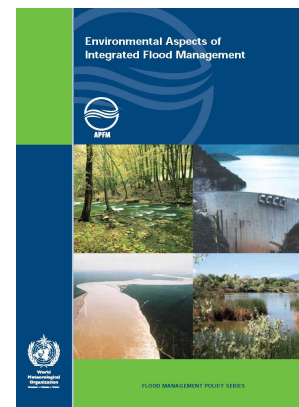
WMO Climate and Water Department

www.apfm.info



Objectives

- Provides a rational and balanced way of addressing development needs and ecosystem protection issues in flood management
- Understand the basic concepts of the morphology and ecology of rivers and their flood plains





Development needs and Ecosystem preservation

Importance of balancing

Development needs

flood risk reduction
Land development
Inhabitancy

&

Ecosystem Preservation

Biodiversity
Ecosystem service
e.g. Wetland reduces flood peak.

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Dilemma of Human-Being

Drivers of environmental degradation:

- Poverty and consumerism
- Agricultural development
- Industrialization
- Urbanization
- Transportation
- Tourisms
- Population growth

How to promote environment protection with:

- **Poverty alleviation**
- **Improving livelihoods and human security**



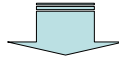
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Downsides of traditional flood control

Altered natural environment of the rivers:

- Fixed river shape
- Separated river channels from their flood plains
- Impeded natural morphological and ecological processes



Resulting in spatially homogeneous ecosystems:

- Loss of habitat
- Loss of biological diversity
- Loss of ecosystem productivity
- Loss of services provided by such ecosystems

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What should Flood Managers Understand?

1. Basic concept of morphology and ecology of rivers and their flood plains



2. Flood processes and ecosystem services: inter-relationship

3. Impact of flood management interventions on ecosystems

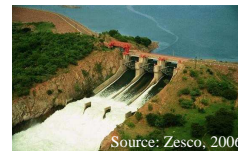
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Why should Flood Managers Understand?

Such understanding helps flood managers:

- Understand the environmental impacts of FM measures
- Evaluate various options in flood management
- Explore environmentally sensitive design for new projects
- Mitigate the adverse impacts of previous/existing works



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1. Basic concepts of morphology and ecology

- Fluvial (river) processes and flood plains
- Morphological regime
- Biological diversity
- Morphological and ecological connectivity

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Fluvial processes and flood plains

Floods:

- Simply a part of the natural variation of hydrological processes, allowing water to flow over the banks and inundating the adjacent lands
- Play a key role in determining the level of biological productivity and diversity of rivers and their flood plains



Photo by Liang Changsheng

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Fluvial processes and flood plains

Flood plains

- Highly heterogeneous ecosystems
- A complex assemblage of: small channels, depressions, backwaters, hillocks, ridges, etc.

Depression wetlands within flood plains

- Connected to rivers by small channels
- Bringing flood water and associated fine sediment and nutrients
- Allowing migration of fish that spawn on the flood plain
- Providing habitats for birds



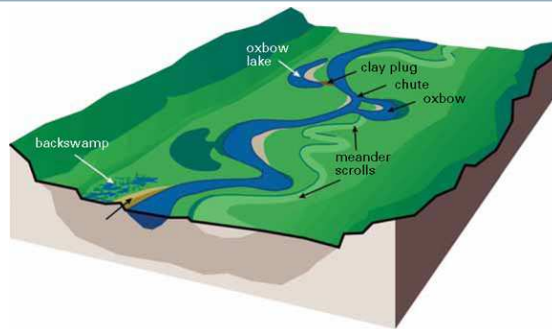
Photo by: Yin Hexian

Meandering of the Yellow River, China

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Morphological Regime



An example of an alluvial river corridor with meandering pattern

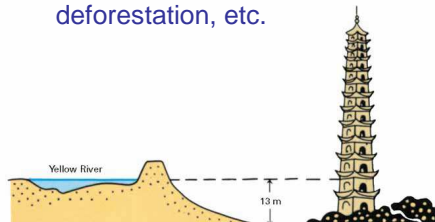
Source: Federal Interagency Stream Restoration Working Group, 1998 (revised 2001).



Morphological Regime

Aggradation

Under natural conditions or due to human induced land use change, deforestation, etc.



Sketch map of the "hanging river" near Kaifeng, China

Source: Li, G., 2003. Ponderation and Practice of the Yellow River Control, Yellow River Conservancy Press.

Degradation

Due to dam construction, soil protection, reforestation, etc.

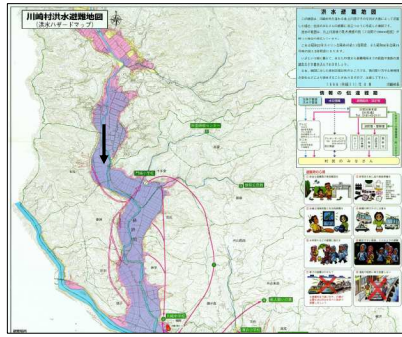


Kerr dam on the Flathead river, U.S.A.



Application for river management

Flood hazard map of Satetsu River, Japan (1999 release)



↑ Aerial photo

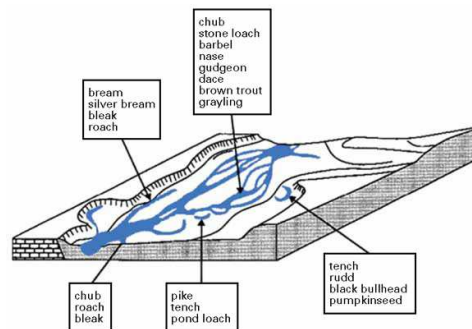
Flood disaster in 2002



Biological diversity

Most of the species have varying requirements during their life cycles, but also at different times of the day or the year.

Implication that organisms need to be able to move between different habitat patches



Source: Richards, K., Brasington, J., and Hughes, F., 2002. Geomorphic dynamics of floodplains: ecological implications and a potential modelling strategy, *Freshwater Biology* 47: 559-579.

Use of spawning habitat by different fish species in the Upper Rhone



2. Flood processes and ecosystem services

- Roles of various ecosystems in the hydrological processes and response
- How ecosystems interact with flow regimes including flood events
- Opportunities and limitations of ecosystems as flood alleviation service provider

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Shifting Habitat Mosaic Steady State Concept

Various ecosystems:

- Forests
- Tree root
- Ponds and lakes
- Wetlands

River morphology as well as the habitat availability are most likely in a state of regime or dynamic equilibrium.

Configuration of individual patches is continuously changing, but the overall availability of different habitat types remains more or less the same over a reach.



Habitat diversity and connectivity are not fixed in space and time, but they are continuously created and destroyed by the river dynamics.

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3. Impact of flood management interventions on ecosystems

- Flow regime
- Sediment transport and balance
- Water quality
- Biological diversity

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Impact of flood management interventions on ecosystems

Structural flood control and protection works:

- Dam and reservoirs
- Detention and retention basins
- Bypass and diversion channels
- Embankments
- Channelization

- Environmentally sensitive operation
- Lateral disconnection kept to a minimum, removal and setting back
- Avoiding channelization and using environment friendly materials



can help:

- Maintain ecological health of riverine ecosystems
- Keep the environmental impacts to a minimum

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Framework for Environment-friendly flood management

Elements:

- Scientific understanding and analysis
- Environmental assessment
- Environmentally sensitive economic analysis
- Stakeholder participation
- Adaptive management approach
- Monitoring
- Enabling mechanism



Approach:

Adopting a threefold approach of

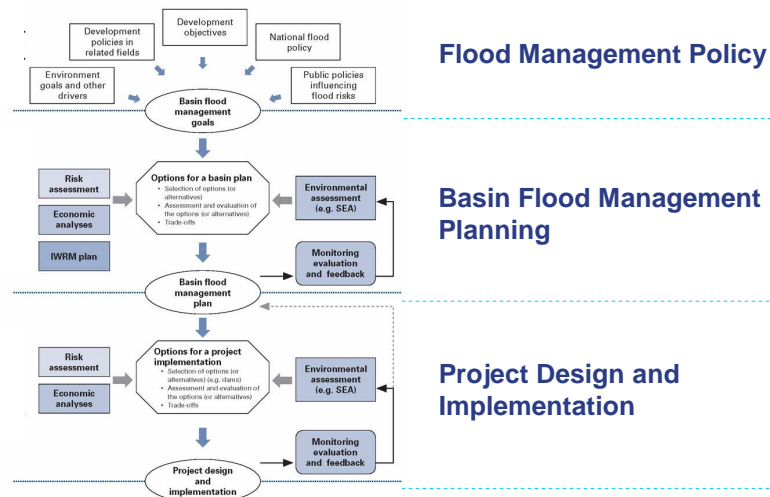
- 1) avoiding
- 2) reducing, and
- 3) mitigating adverse impact on the environment

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Framework for Environment friendly flood management

Stakeholder Participation



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Environmental Assessment

Strategic Environmental Assessment (SEA):

- Applied at policy and planning level

Environmental Impact Assessment (EIA):

- Applied at the project design and implementation level

Similarities

- Procedures: screening; scoping; identification, prediction and evaluation of impacts; monitoring, etc.
- Interaction and consultation with stakeholders

Differences

- Levels of detail to be assessed
- Option (s) or alternative (s) to be considered

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Adaptive Management

Scientific uncertainties of:

- Existing conditions of ecosystems
- Impact of human interventions on environment and ecosystems



Precautionary principle:

“Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

Adaptive management:

Continuous monitoring and modification

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Thank you
