



Training for Trainers Integrated Flood Management for Sustainable Development

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Measures of Flood Risk Management

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Associated Programme on Flood Management
WMO

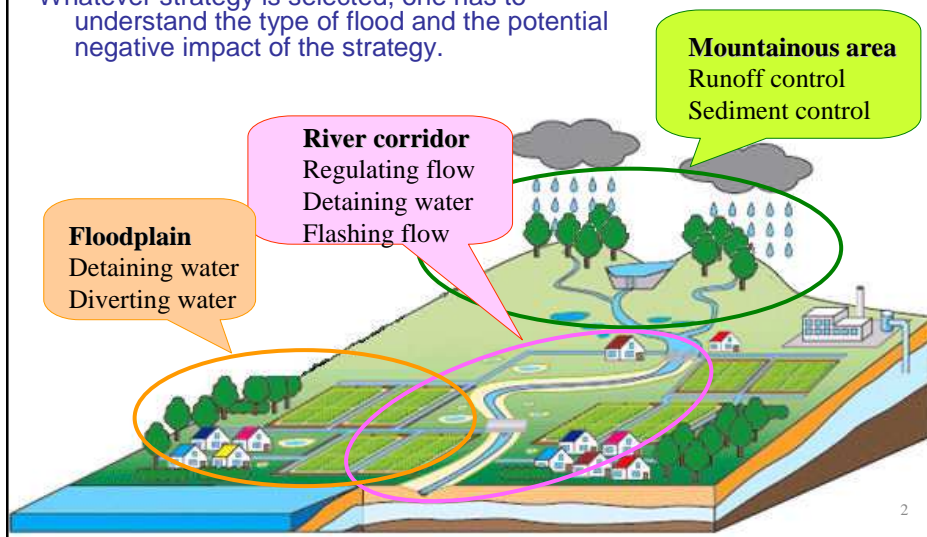
WMO Climate and Water Department

www.apfm.info



Traditional flood management measures

Whatever strategy is selected, one has to understand the type of flood and the potential negative impact of the strategy.





Large River Flooding

Characteristics:

- Catchment response affords long lead times
- Entire hydrographs can be produced with low uncertainty with good quality data
- Local information less valuable
- A hydrologic forecasting is a primarily problem
- Affordable time for coordination of flood response and damage mitigation

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Flash Flooding

Characteristics:

- Catchment response is very fast and allows very short lead times (< 12hrs)
- Prediction of occurrence is of interest
- Local information is very valuable
- A truly hydro-meteorological forecasting problem
- Coordination of forecasting and response is challenging over short time

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Example of Flash Flooding

7/28/2008 Floods in Hyogo Prefecture, Japan



Rapid water level rise by **134cm** in **10 minutes**



New warning light and announce board under bridge

Photo: Hyogo Prefecture

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Flood Management Options

- **Source control to reduce runoff**
(permeable pavements, afforestation)
- **Storing runoff**
(detention basins, wetlands, reservoirs)
- **Increasing the carrying capacity of flood flows**
(dykes, bypass channels, channel deepening and widening)
- **Separating flood water from the population**
(land use control, flood map, flood proofing)
- **Emergency response during flooding**
- **Recovery from disasters**

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Permeable surfaces



Functions

- Reducing runoff

Issues

- Clogging

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Forestation



Additional aspects

- Supporting environmental recovery
- Better landscape

Issues

- Requiring a lot of time to grow enough
- FAO does not agree

Functions

- Reducing runoff
- Capturing sediment
- Soil stabilization (various other functions outside the flood context)

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Sabo dam



Issues

- Longitudinal disconnection
- Deterioration of landscape
- Maintenance and continued function

Functions

- Blocking mud flow
- Sediment control

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Dam



Functions

- Attenuating flood peak
- Generating hydro power
- Regulating flow
- Storing water

Additional aspects

- Multi purpose utility

Potential Issues

- Deterioration of environment
- Longitudinal disconnection
- Capturing sediment
- Possibility of dam failure
- Confined geographic area
- Unpopularity
- Complexity of land acquisition
- Social issues of re-settlement

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Detention Pond



Additional aspects

- Diverting flood damage to rural / agricultural area
- Efficient use of limited plain
- Artificial wetlands (habitat and recreation)

Functions

- Attenuating flood peak during flood events

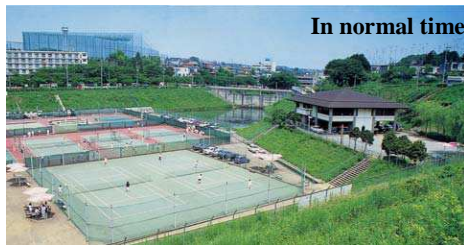
Issues

- Compensation for inundation
- Uncertainty of efficiency

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Rain water storage



Functions

- Temporary storage of rain water on the floodplain
- Rainwater harvesting
- Recreation

Issues

- Possible health issues
- Need for area
- Not indicated for flash floods

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Embankment



Functions

- Blocking inflow to floodplain

Additional aspects

- Can be combined with transport infrastructure or civil Defence infrastructure (shelters)

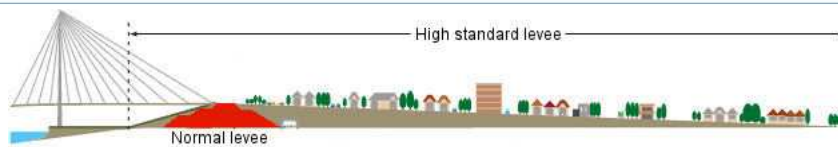
Issues

- Lateral disconnection (water, sediment, aquatic species...)
- Increase of flood damage potential
 - »Design for failure »
- Maintenance intensive

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High Standard Levee



Functions

- Decrease of possibility of breach
- Multipurpose land use

Issues

- Difficulty in securing space for levee (negotiation, cost)

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Diversion channel



Issues

- High cost due to creating new channel (land acquisition)
- Technical difficulty
- Impact on environment
- Full control structure required on inflow to manage environmental flows/low flows

Function

- Diverting river flow from main stream (reducing risk in urban area)

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Channelization



Functions

- Regulating water flow
- Reducing space requirements of natural water course

Issues

- Deterioration of environment
- Increase flow velocity (increase risk to downstream)

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Channel maintenance



Functions

- Increase/maintain conveyance capacity

Issues

- Deterioration of environment in riverbed
- Natural recovery of sediment
- Continued maintenance
- Effectiveness depends on the shape of the flood hydrograph
- Sediment disposal/pollution

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Underground channel



Functions

- Storing water
- Diverting water

Additional aspects

- Less issues of land acquisition
- Possibility of multipurpose use

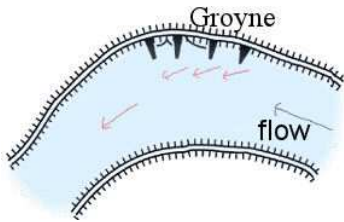
Issues

- High cost
- Technology requirements

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Groyne



Functions

- Reducing bank erosion
- Sediment control

Additional aspects

- Flow concentration (navigation)

Issues

- In case unpopular due to aesthetic aspects
- Not indicated for mountain rivers

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Floodgate, Pump station



Functions

- Preventing backwater from main stream to tributary

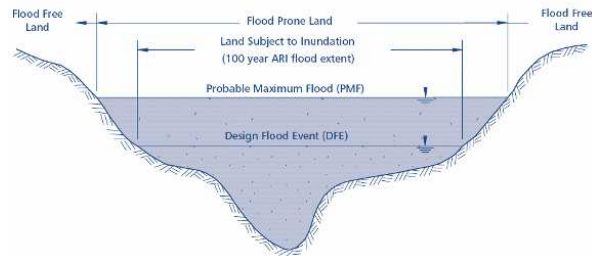
Issues

- Increase risk of inundation on the tributary

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Land use planning



Functions

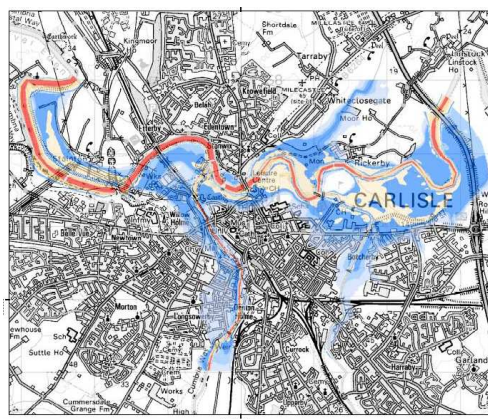
- Preventing increase of exposures

Issues

- Institutional boundary
- economic growth
- informal settlement/law enforcement



Flood mapping



Issues

- Requiring historical information, accurate simulation
- Legal status
- property values
- which floods to include
- documentation

Functions

- Informing areas with a certain likelihood of being inundated



Flood proofing



Functions

- Loss reduction
- Structural integrity
- Continuous functioning of facility

Additional aspects

- Possibilities of wet and dry proofing
- Regulation through building codes/practices

Issues

- Burden on individuals
- Estetic considerations
- Elevated costs

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Awareness raising



Functions

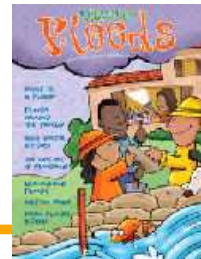
- Educating local communities & individuals in floodplain

Additional aspects

- Promoting self-protection mind

Issues

- Attracting local levels
- Requiring well-educated trainers



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Flood signs



Functions

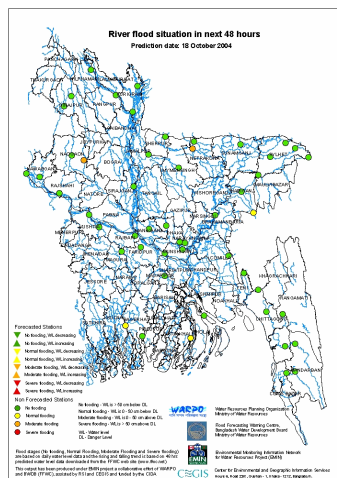
- Informing potential flood risk of the place and evacuation route
- Risk awareness

Issues

- Need education for potential users



Flood forecasting & early warning



Functions

- Forecasting flood stages
- Warning to local communities

Issues

- Accuracy in prediction (especially against flash floods)
- Station maintenance
- Cooperation between NMS&NHS
- Get the right response from Receivers of warnings



Mobile flood defences



Functions

- Blocking inflow to floodplain
- Flood proofing

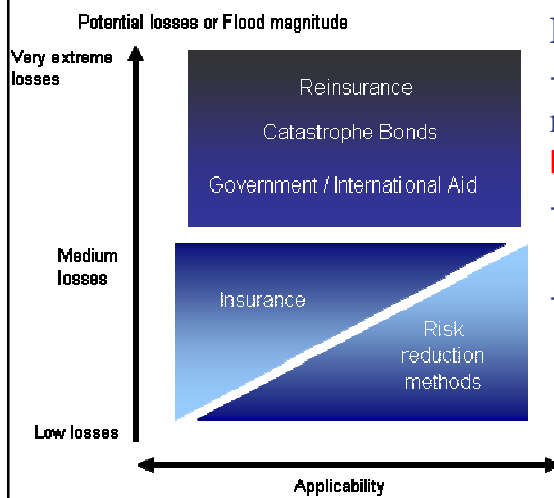
Issues

- Fitting
- Deployment time

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Flood risk sharing mechanisms



Functions

- Transferring or sharing residual risk

Issues

- Ineffective against very extreme flood
- Attracting local levels and individuals

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Thank you
