

# Integrated River Basin Management

By Tetsuro TSUJIMOTO

## Elementary Concepts and Definitions:

River basin

Precipitation-Evapo-transpiration ←weather, climate.....*Meteorology*

Divide→River basin, Catchment, Watershed,

Run-off process surface runoff, subsurface runoff (intermediate), groundwater.....*Hydrology*

River flow.....*Hydraulics*

Water, sediment, materials (biophilic elements)

Flux network ← flow - stock

Landscape *connected one another by flux networks*

Geographical characteristics – Land use with human activities  
*related to ecosystem*

Ecosystem ←*interrelating system* .....*Ecology*

Ecosystem structure

physical background - *habitat suitability* - biological aspect

*space-peculiar elementary events production and decomposition*

material cycle

Ecological function →*Ecosystem service*

River basin complex.....multiple river basins connected by artificial networks

## Several Viewpoints on Integration in River Basin Management

### Functions:

Human activities:

Safety against flood (heavy rainfall) ←Flood mitigation (flood control, drainage, disaster management)

Water resources against draught ←Water resources management  
(demand management, supply management)

Preferable environments ←Basin environment management  
(pollution control, amenity & recreation, ecosystem)

Sustainability :

Resources depletion (fossil fuels)

Global warming ←Green gas emission

Bio-diversity loss

↑

Institutions (responsible organizations) *laws, funds, organizations* “Governance”

Central and/or local government, community, NGO, individuals

*Private* → *Public*

↑

### Scale:

Community - region - along a river - river basin - river basin complex

### Time:

Long term – short term

## Safety against Flood

### Local flood management

Levee (discontinuous) “Waju tei”=embankment asurrounding village against river flood

Drainage from agricultural area ←Agricultural administration

Urban drainage =Sewage system (drainage + waste water treatment) ←Municipality

Pumping station

←Local rainfall density (mm/hr) 50mm, Return period 1/10

Flood fighting team *bridging hardware and software*

Evacuation system ← Municipality, Community

↓ ↑ *Inter-villages along river, Inter-agency*

### Flood protection along a river

Flood protection of the area with higher activities in the downstream of major rivers

↓ (infrastructure equipped in upstream)

Continuous flood levee + Flood control dam ←River management

+ Sabo projects (erosion control) ←Mountain sediment management

### Planning procedures:

Design rainfall (basin average accumulated rainfall during an event) ←Return period 50-200yrs

↓ *Runoff analysis* (long term plan, master plan within 20-30years)

↓ ←rapid runoff due to land use of catchment *hostile land-use should be regulated!*

Design flood discharge without dam control (peak cut)

↓ *Design of dam & reservoir or Detention pond (Retarding basin)*

Design flood discharge after dam control

↓

HWL (high water level) → Levee design ←Channel design (cross section) ←*dredging*

*Height of levee (HWL+free board), cross section geometry*

→*channelization*

*discontinuity between river and floodplain →habitat degradation*

*Safe flood without over-topping and levee breach*

←revetment, groyns (overflow, erosion or scouring, seepage)

### Disaster management ←Local government, Municipality, Flood fighting team

Disaster = Discharge or rainfall > infrastructurally equipped level

Level of design, Achievement level

Depending on “Exposure” (population, property, productivity,...)

Local disaster→Propagation of inundation (wide area) vulnerable region

*Risky (masochistic) land-use should be regulated!*

Risk management, Incident Management

Risk = occurrence probability of hazard (magnitude)

Equipment level of infrastructure

Preparedness for evacuation (survival) ⇔Vulnerability

Self assist, community assist, public assist

Potential for rescue, recovery, restoration, ... (Resilience)

Hazard map

←Inundation map : Design flood (rainfall) in long-term vision

Present preparedness (infrastructures)

Appropriate guide for evacuation = evacuation order (command) by Mayor

↑ *coordination of city office and river manager*

Appropriate information on rainfall and river discharge (stage) by weather bureau river manager  
↓  
Appropriate performance for evacuation (inhabitants)

Extraordinary weather = guerilla heavy rainfall (locally concentrated heavy rainfall)  
(Not included in statistical discussion related to “return period”)  
Unrealized dangerous spots (dangerous tarp) ← *Risky action, masochistic land-use*  
Higher resolution of weather monitoring ← X band MP radar  
Difficulty of weather-runoff-flood forecasting → *no lead-time for response*  
Excess heavy rainfall or flood (including storm surge) for vulnerable area  
(super typhoon) (area below sea level with high population)  
※ catastrophe with lower frequency than designed return period  
accurate forecasting of super typhoon landing (1.5 days before)  
pre-evacuation strategy in wide area ← *agreements among communities*  
(evacuation means, shelter and refuge, emergency response resources) ↑  
*United command*  
Emergency response ← ESF (Emergency Support Functions)  
*Coordination of various organizations in various stages*

## Water Resources Management

← IWRM (Integrated Water Resources Management)  
Water resources management = Drought risk management  
Water resources: agriculture, industry, hydropower, city water, ..... ← “water rights”  
+ (many stakeholders)  
Traditional water use, navigation, environment, etc. = “normal discharge”  
↑ *10 days minimum discharge is shared by issuing “water rights” through river manager*  
River flow (surface flow) fairness = visible distribution (10 years return period for drought risk)  
New demand of water resources is authorized (*users’ side*)  
↓  
Dam & reservoir to release water to share water among users is planned, constructed and operated.  
(by river manager)

Integrated management of river flow discharge ← “New river law” (1964)  
“multi-purpose” dam with reservoir capacities for water-use (resources) and flood control (peak cut).  
From capacity of reservoir, two purposes are in “trade-off” relation.  
Integrated management (operation) in multi-purpose dam  
several dams along the same river system

↓ *Environmental impacts*  
No environmental flow (downstream of water withdrawal facilities)  
Instream flow discharge regulation in downstream river → *Degradation of habitat, scenery*  
Changes of water quality (turbidity, temperature, eutrophication)  
↑ ← *countermeasures in reservoir, release pattern improvement*  
*EIA (environmental impact assessment) before construction*  
*Mitigation of environmental degradation (follow-up)*

