Dam Asset Management Project

Sustainable Reservoir Sediment Management

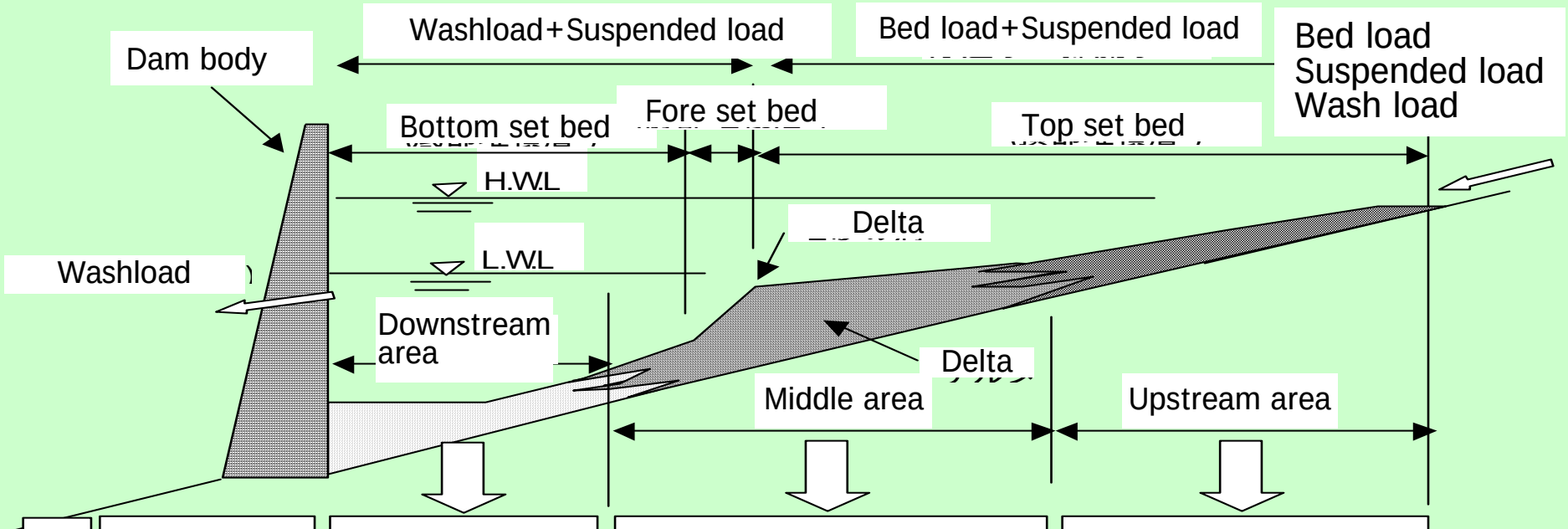
Kyoto University

Graduate School of Management

Tetsuya

SUMI

Reservoir Sedimentation



Sediment property	Clay, silt	Mainly sand	Sand and gravel
Size			
Grain size content(%)	Gravel=0, Sand=10, Clay=50, Silt=40	Gravel=10, Sand=45, Clay=30, Silt=15	Gravel=30, Sand=40, Clay=20, Silt=10
Fine sediment	Fc=over90%	Fc=45-50%	Fc=lower30%
Water content	w=over100%	w=50-60%	w=lower40%
Density, Porosity	Small ← → Large		
Ignition loss	Ig=over10%	Ig=ca.8%	Ig=ca.4%
Nutrients	Large ← → Small		

- National Inventory of reservoir sedimentation

2730 dams (>15m high) with 23 billion m^3 capacity.

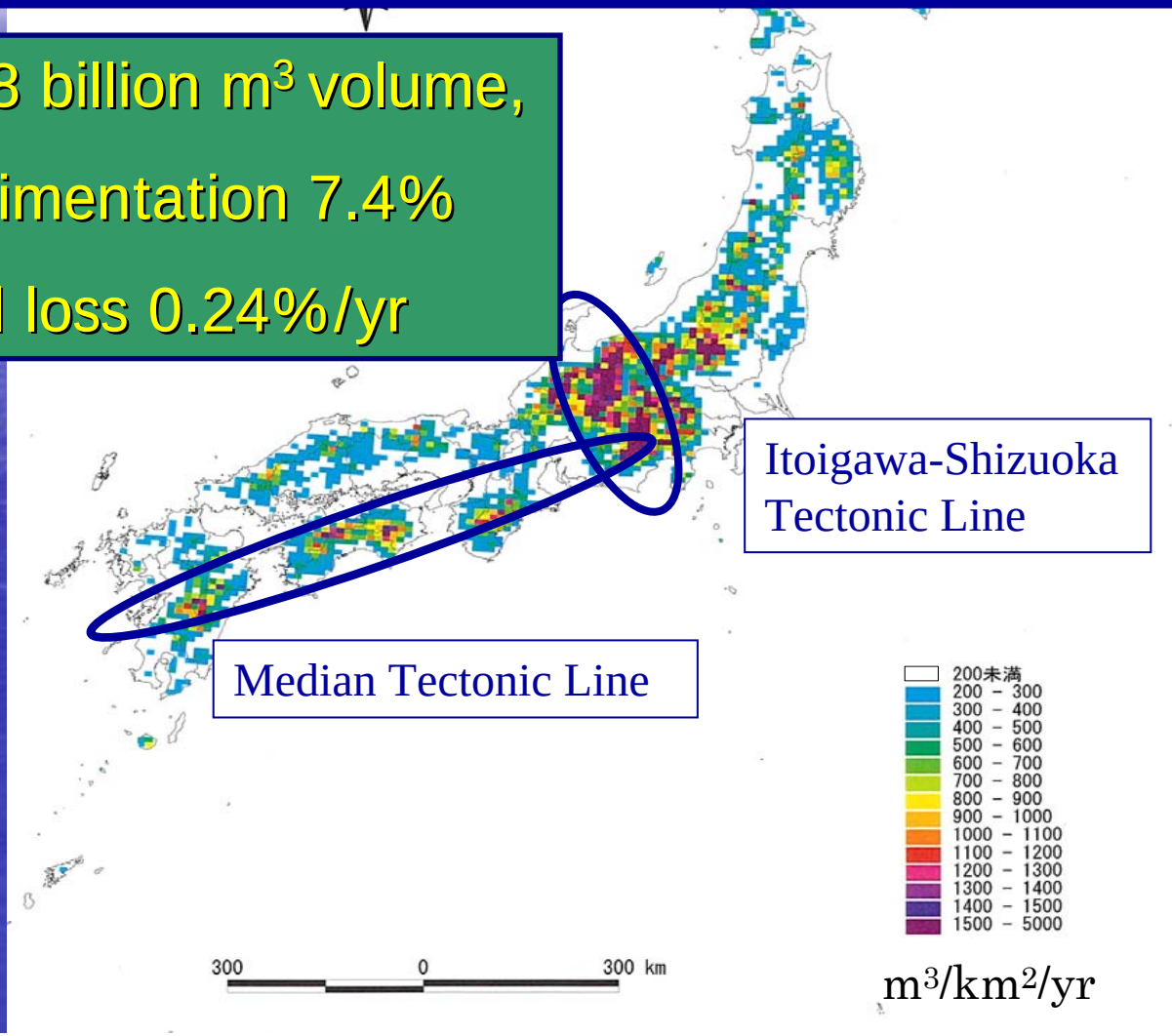
Sedimentation progress of all reservoirs over 1 million m^3 have been reported annually to the government from 1980s.

In 922 dams of 18 billion m^3 volume,

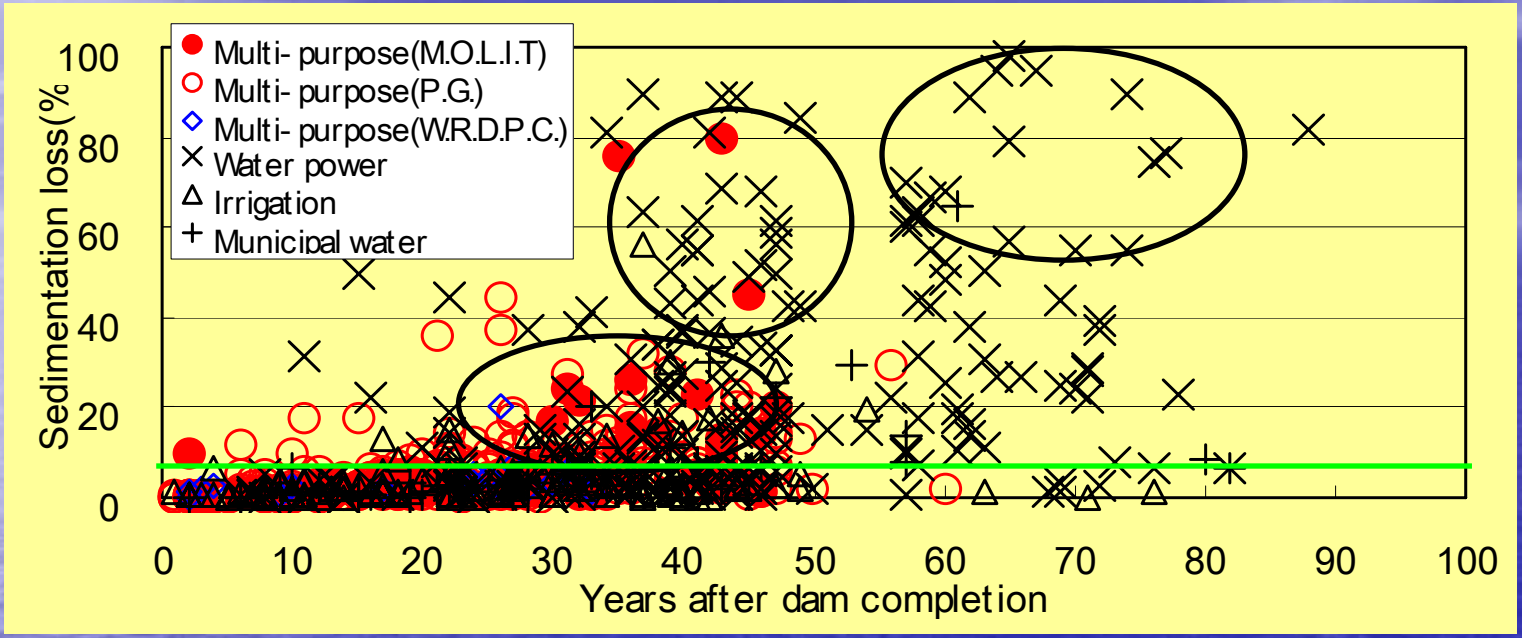
→ total sedimentation 7.4%

annual loss 0.24%/yr

Sediment yield potential map of Japan



Total sedimentation losses

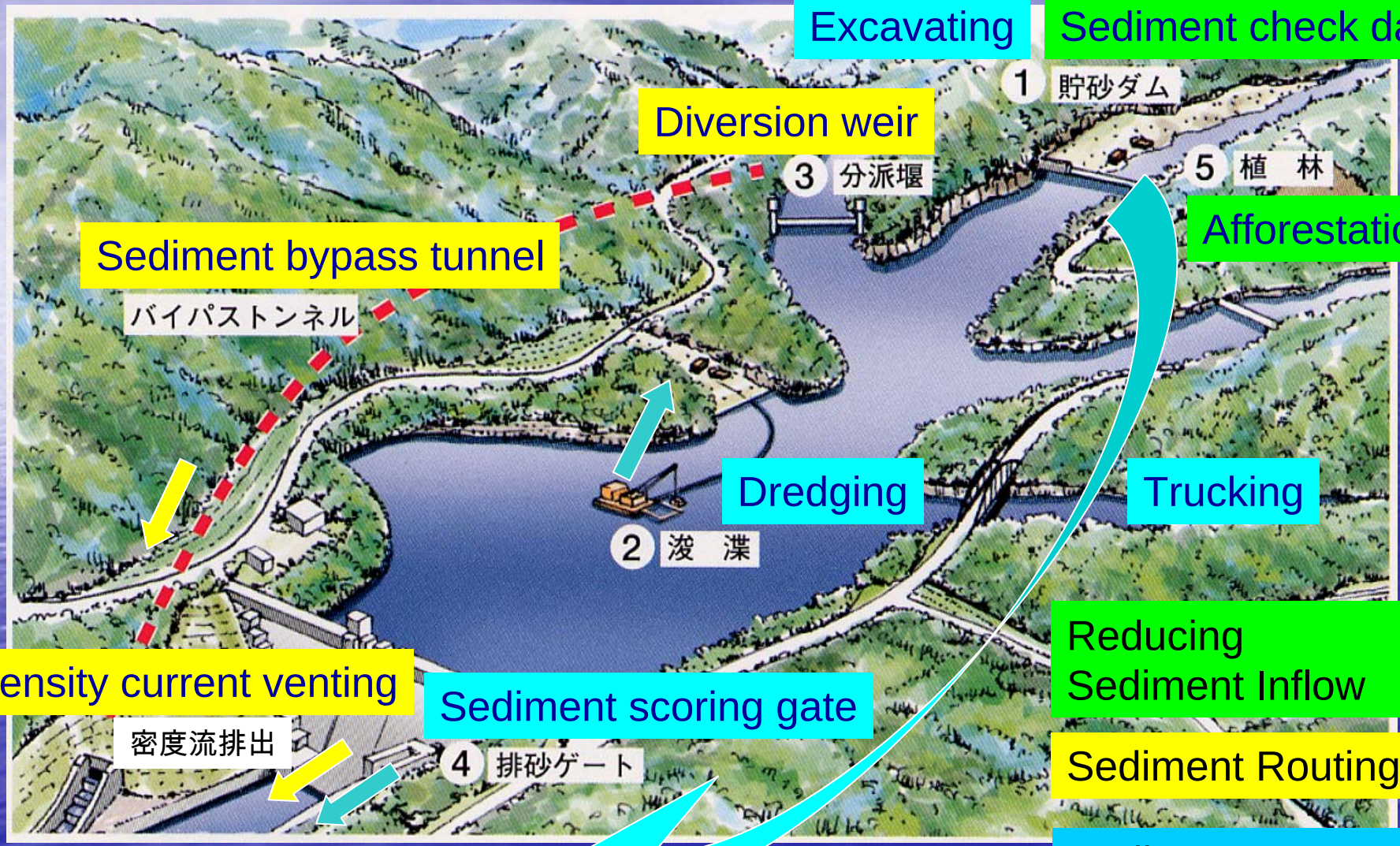


- Some hydroelectric dams constructed before World War II more than 50 years old → 60 to 80 %, but problems are depend on the cases.
- Many cases from 1950 and 1960 through the high economic growth period more than 30 years old → beyond 40 %.
- From 1960s, large numbers of multi-purpose dams → 10 to 30 %

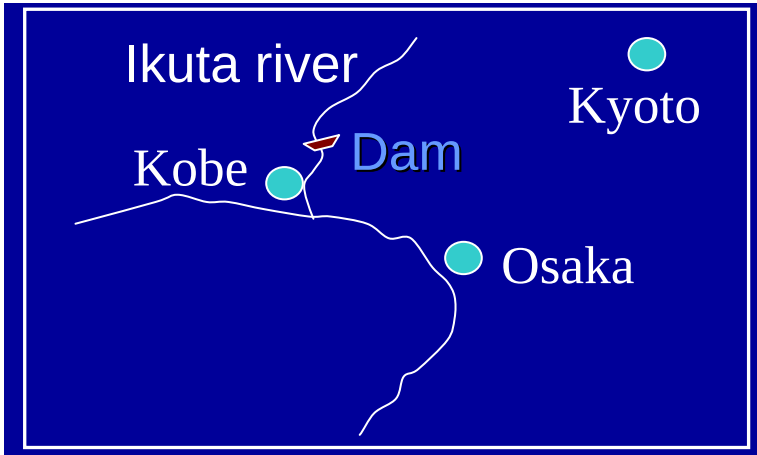
Maintaining effective storage capacity is critical for flood control and water supply.

Total average sedimentation rate 7.4% (1.35 /18.3 billion m3)

Reservoir sediment management measures in Japan



Nunobiki Dam



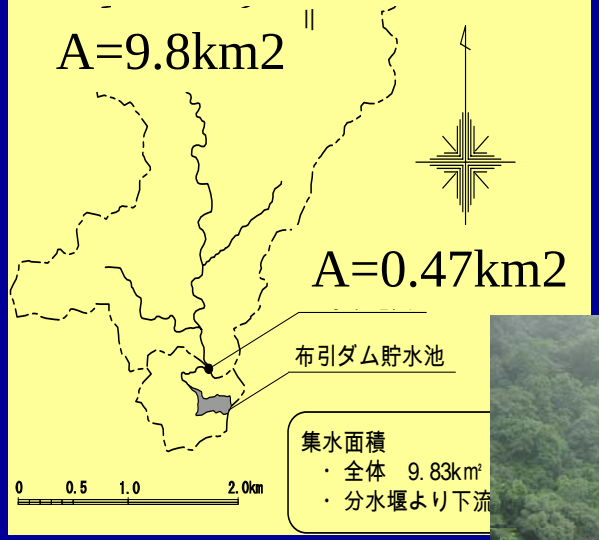
Purpose:

Drinking water supply

Dam: 1900

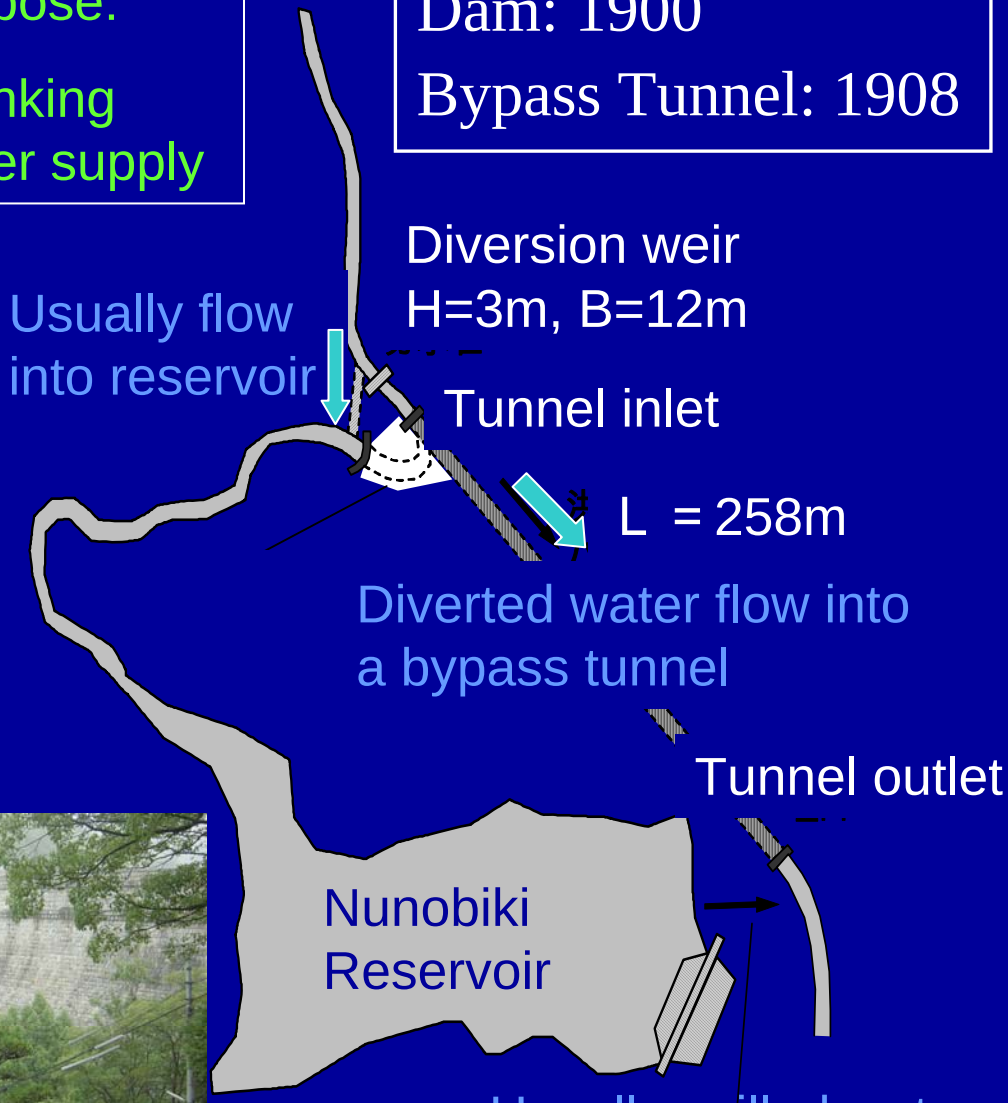
Bypass Tunnel: 1908

Rokko Mountains
deep weathered granite, steep slopes

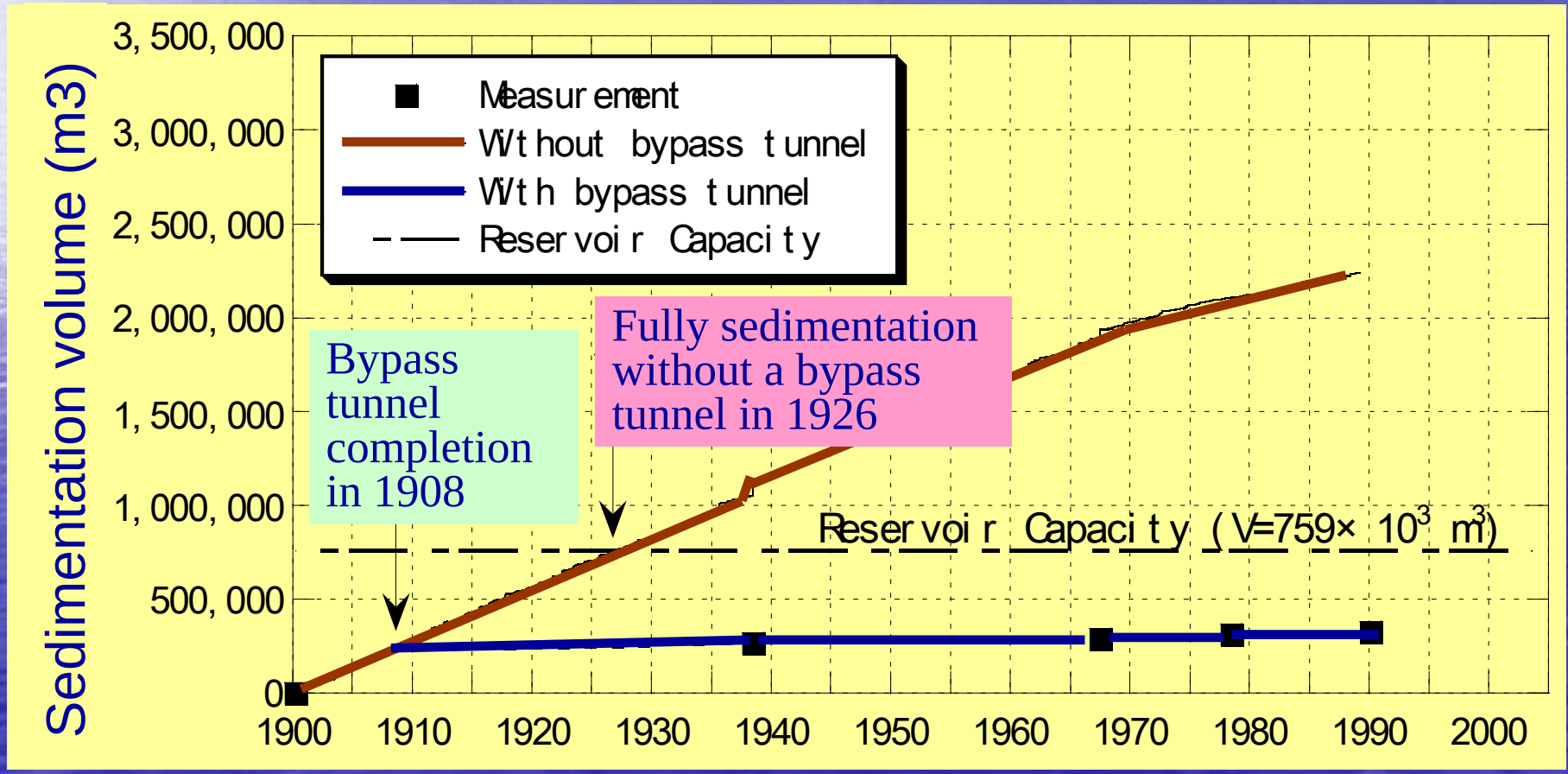


V=759,521m^3

H=33.3m



Comparison of sedimentation progress with and without a bypass tunnel



Need for reservoir sedimentation management

3 points

- Safety Management for Dams and Rivers

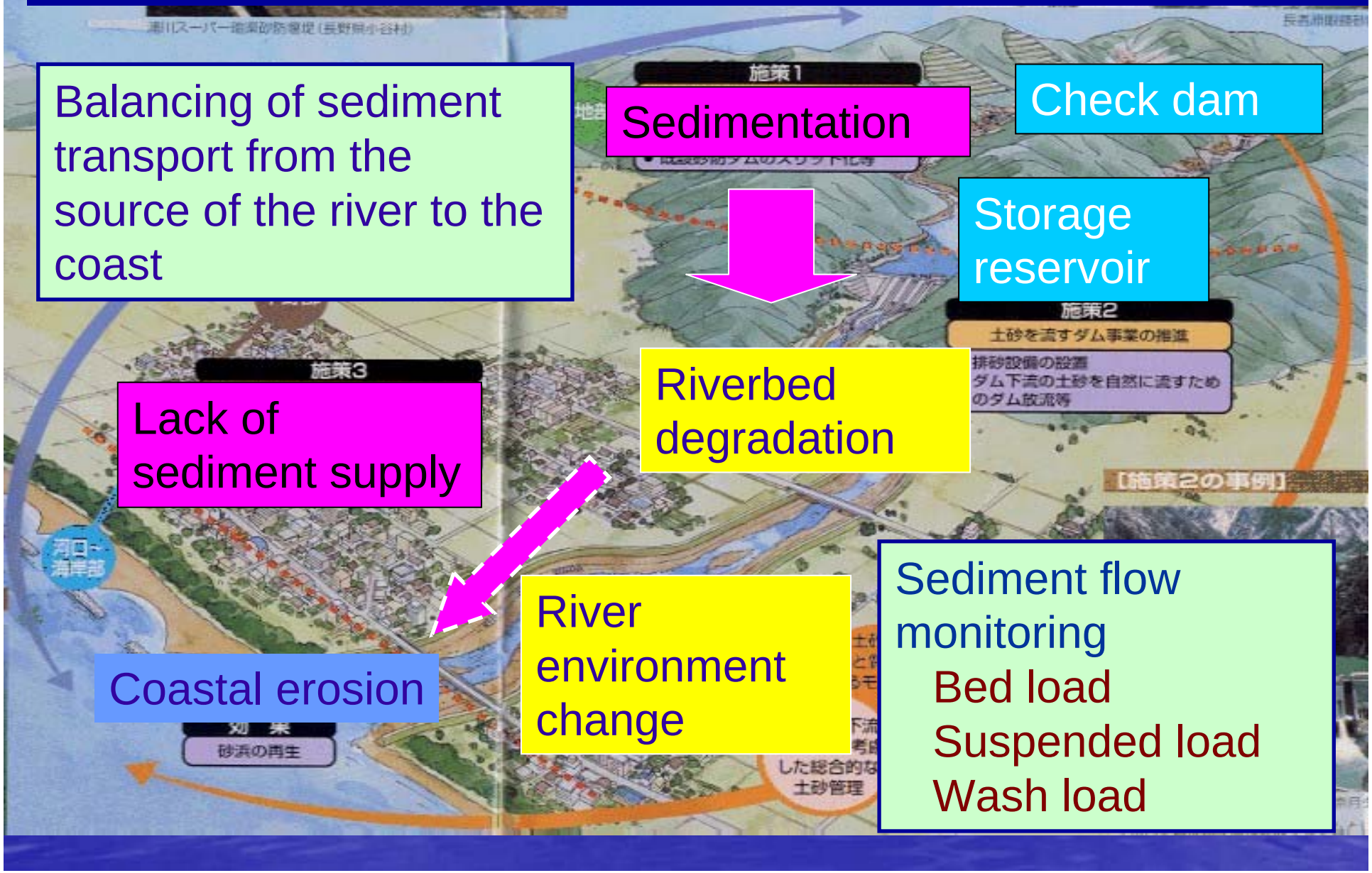
  To prevent the siltation of intake and other hydraulic facilities and aggradations of upstream rivers

- Sustainability of Water Storage Volume

- Comprehensive Management of Sediment Routing System in a River Basin and Connected Shoreline Scale

  To prevent riverbed degradation, river morphology change and coastal erosion caused by shortage of necessary sediment supply from upstream including dams

Comprehensive Management of Sediment Routing System in a River Basin and Connected Shoreline Scale



Balancing of sediment transport from the source of the river to the coast

Sedimentation

Check dam

Storage reservoir

Riverbed degradation

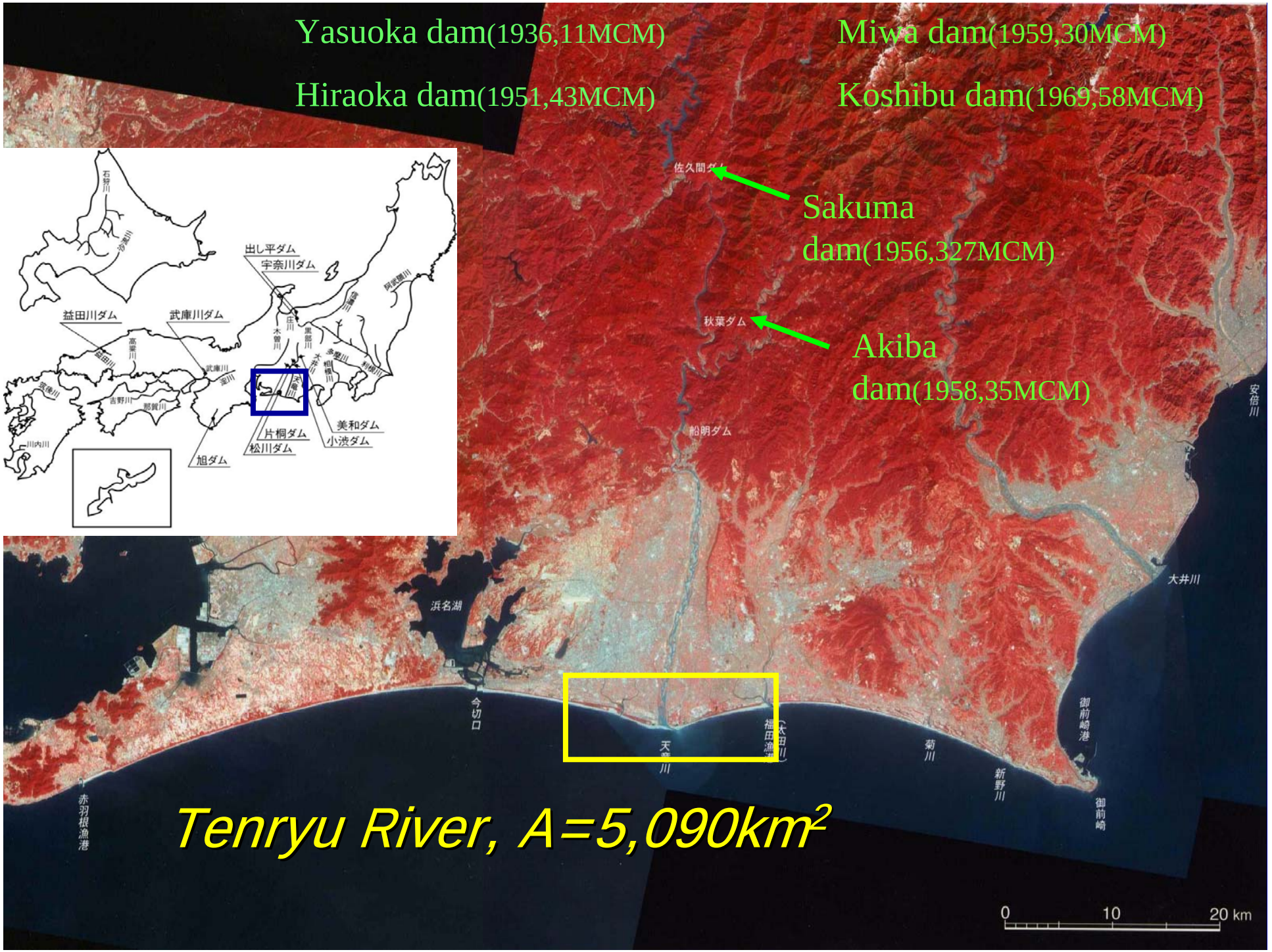
Lack of sediment supply

River environment change

Coastal erosion

Sediment flow monitoring

- Bed load
- Suspended load
- Wash load


Yasuoka dam(1936,11MCM)
Hiraoka dam(1951,43MCM)
Miwa dam(1959,30MCM)
Koshibu dam(1969,58MCM)
佐久間ダム
Sakuma dam(1956,327MCM)
秋葉ダム
Akiba dam(1958,35MCM)
船明ダム
出し平ダム
宇奈川ダム
益田川ダム
武庫川ダム
片桐ダム
松川ダム
美和ダム
小渋ダム
旭ダム
浜名湖
今切口
天竜川
福田漁港
菊川
新野川
御前崎港
御前崎
大井川
安倍川
赤羽根漁港
0
10
20 km
Tenryu River, A=5,090km²

Tenryu River Mouth

Yasuoka dam (1936)

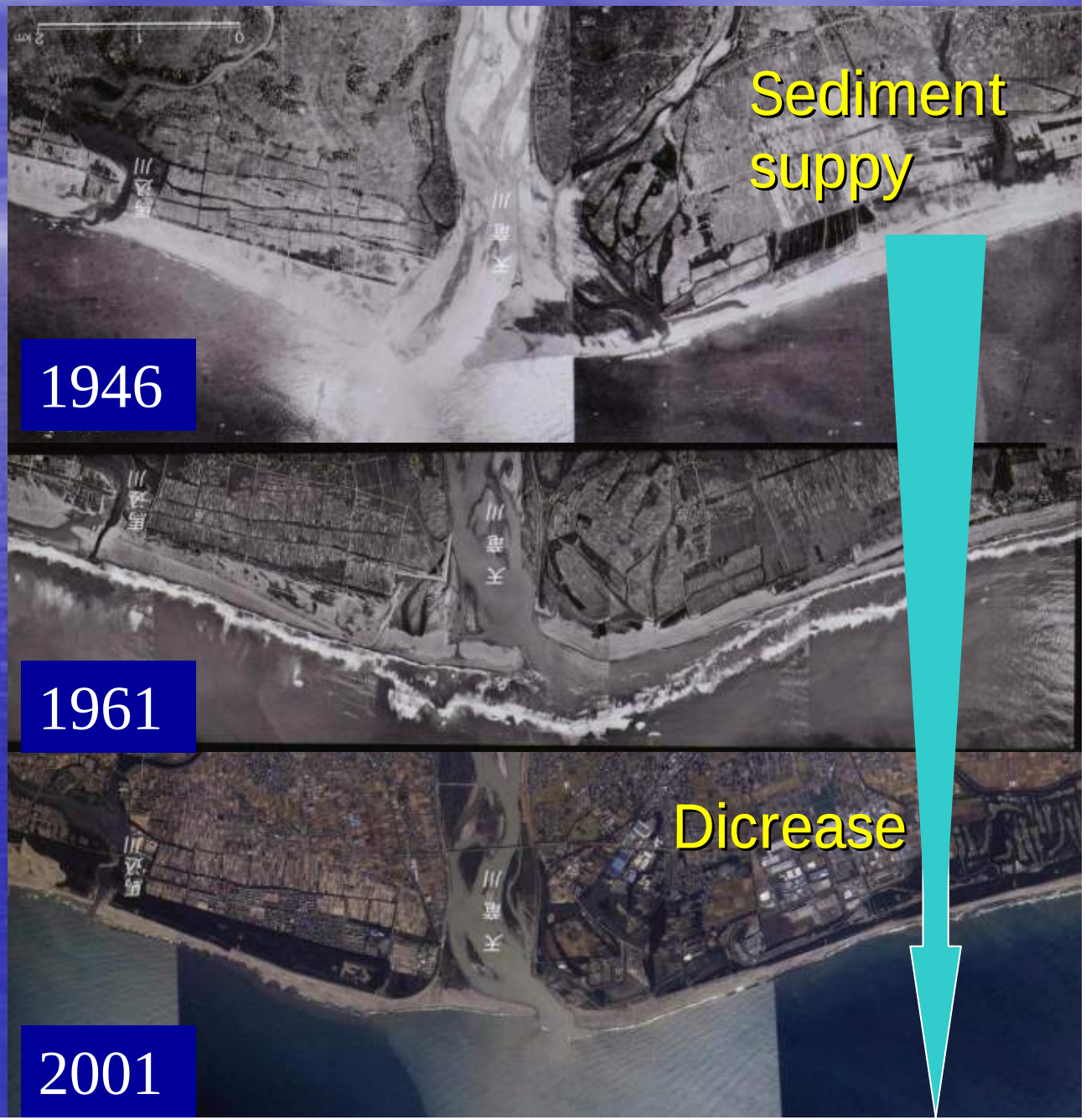
Hiraoka dam (1951)

Sakuma dam (1956)

Akiba dam (1958)

Miwa dam (1959)

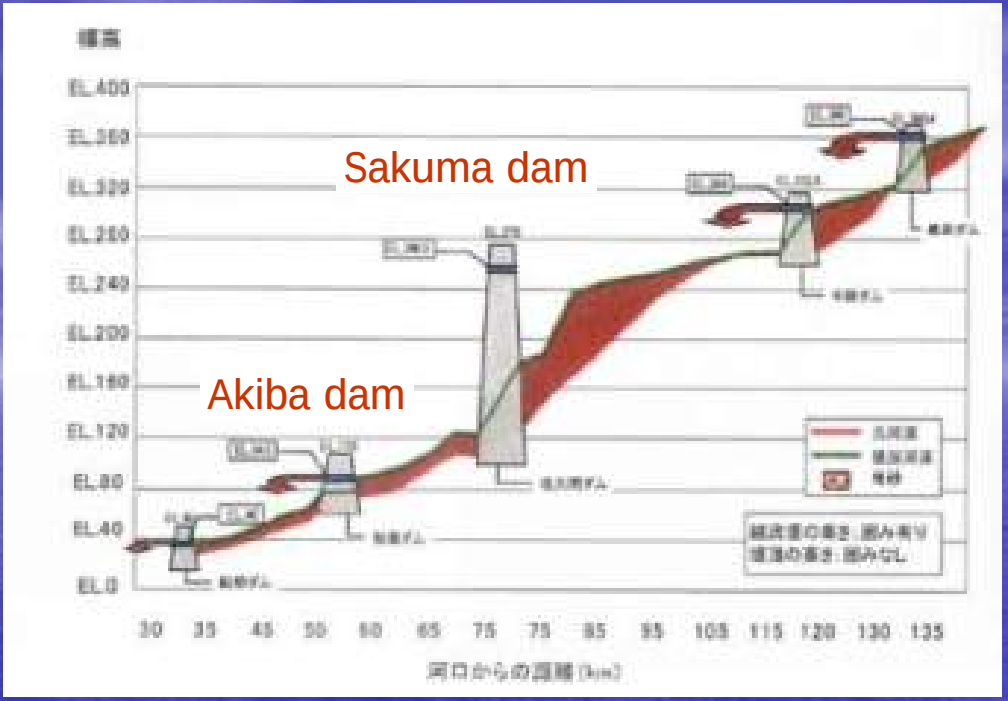
Koshibu dam (1969)

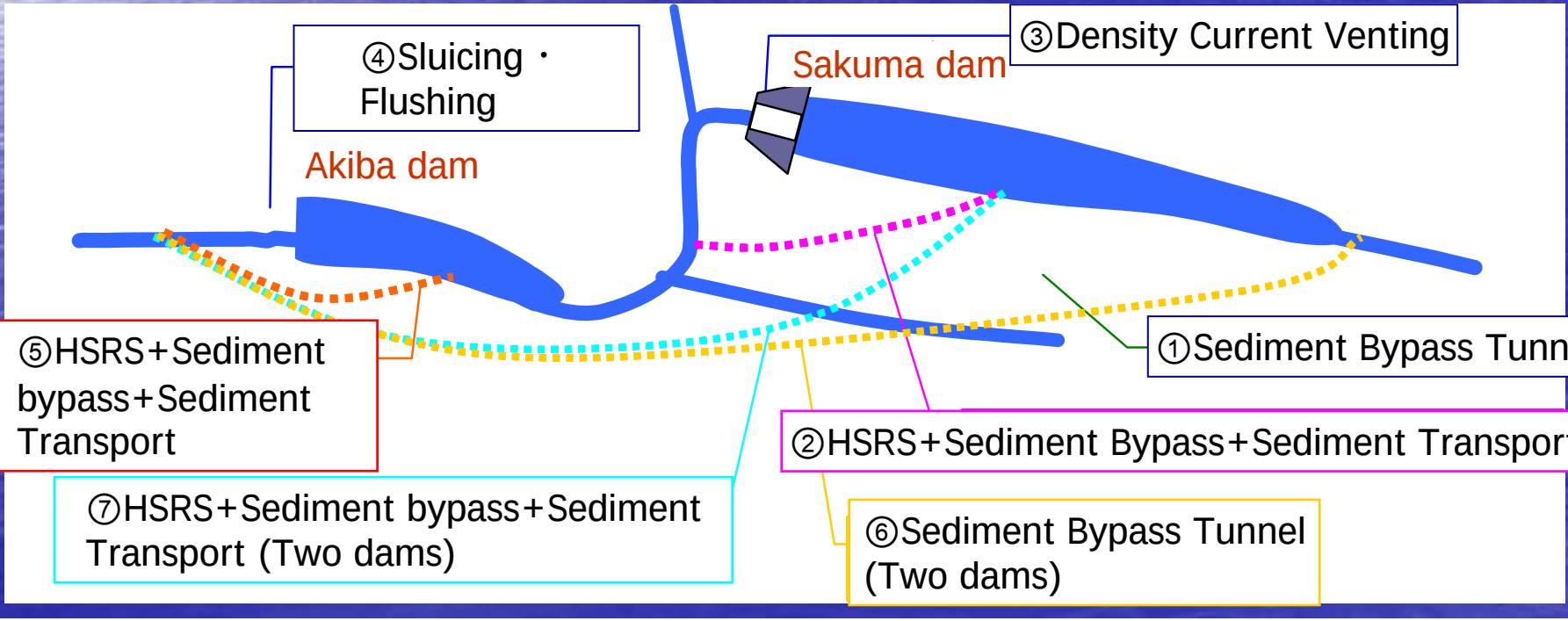


Tenryu River Dam Redevelopment Project

HSRS: Hydro-suction Sediment Removal System

Sediment Transport: Transport sediment in reservoir by dredging or other methods





Conclusion

- Analysis of each facilities and proper maintenance planning is necessary for the sustainable reservoir management under the limited budget.

  Asset Management

- Reservoir health is indispensable and, especially, sedimentation is the key factor for long term use.

  Sediment Management for Intergenerational Equity

- In order to solve sedimentation problems,

  1) Technically, economically feasible and environmentally compatible countermeasures are requested.

  2) Integrated river basin management considering sediment routing system is important.

- Coordinating sediment management of multiple reservoirs in a river basin is the next step.