Australia-Indonesia Research Summit on Urban Water Stream Session: “Engineering solutions in leapfrogging to water sensitive cities”, Surabaya, 23 August, 2016

Ecotechnology measures for sustainable urban water system in the Greater Jakarta basin

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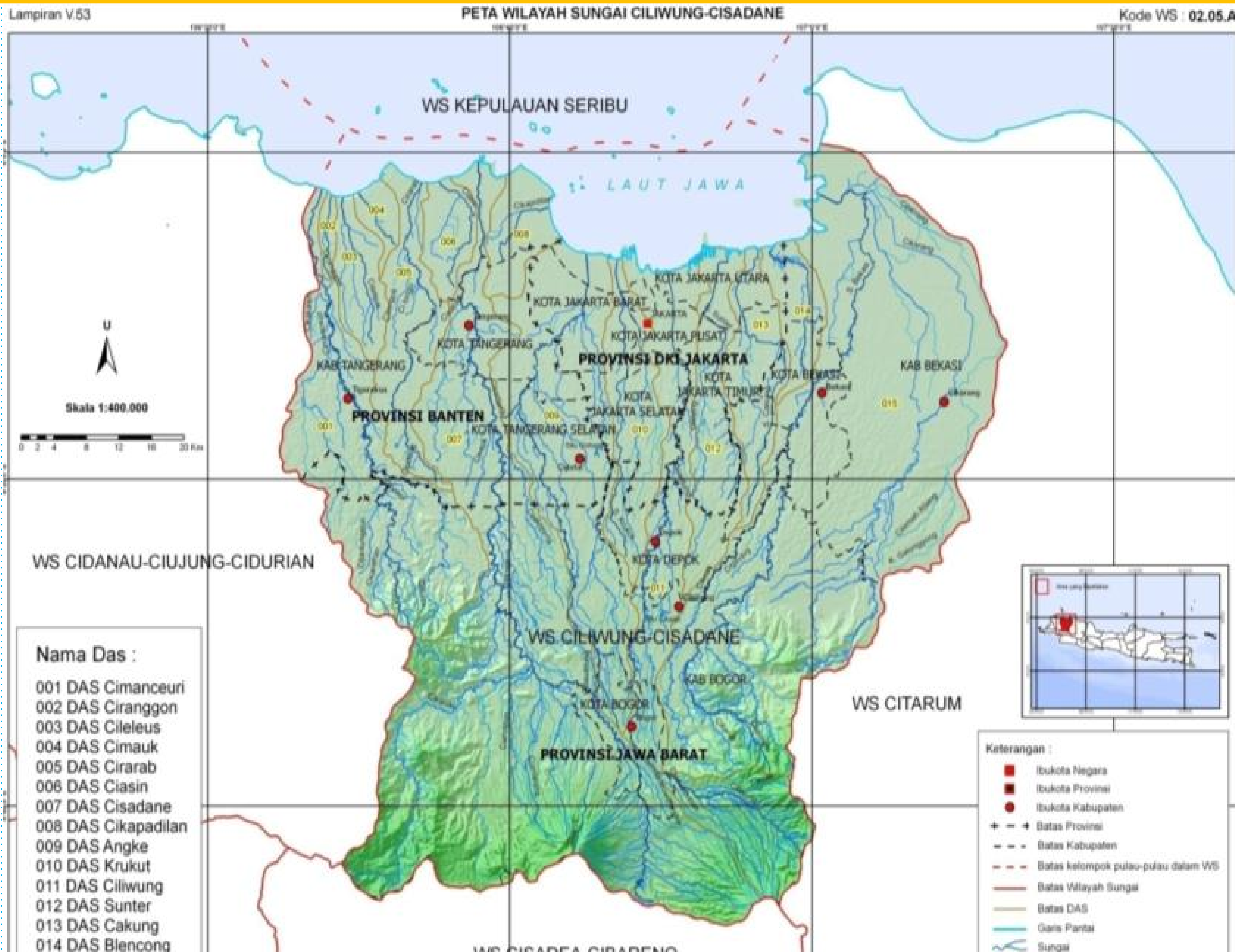
Presentation Outline:

- Objectives and scopes
- the Greater Jakarta **water environment**
- **Sustainable urban water system** *with ecohydrology approach*
- **Ecotechnology measures** for sustainable urban water system in the Greater Jakarta basin
- Concluding remarks

Objectives & Scopes

- **Expose of the Greater Jakarta water environment & Recent changes;**
- **Introduction of ecohydrology approach for sustainable urban water system;**
- **Expose of Ecotechnology measures and needs for implementation in the Greater Jakarta basin**

The Greater Jakarta basins

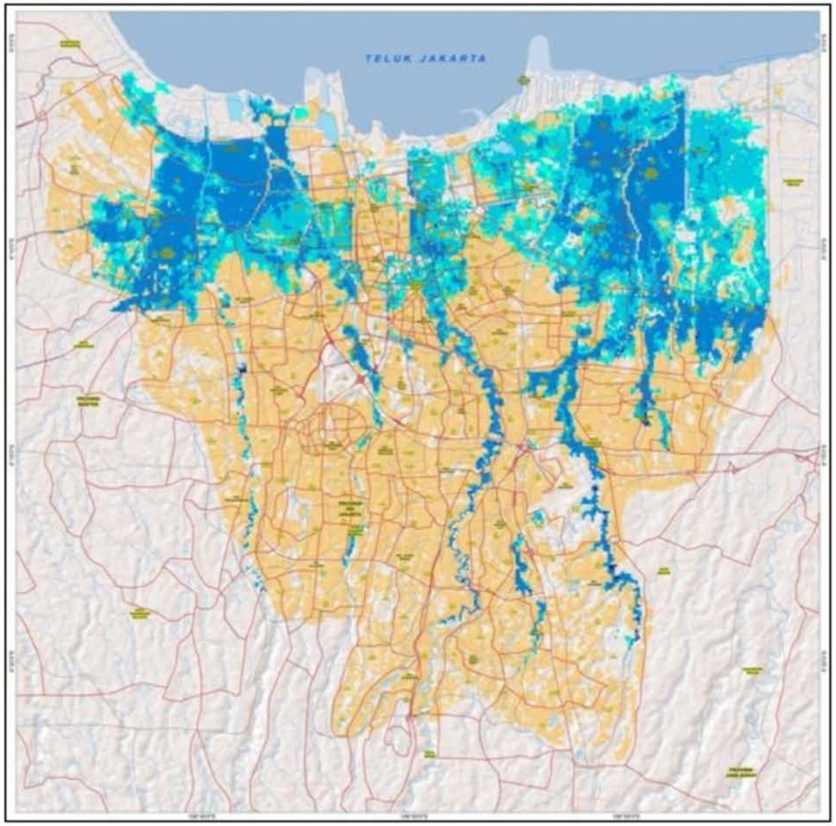


Changes in the water environment

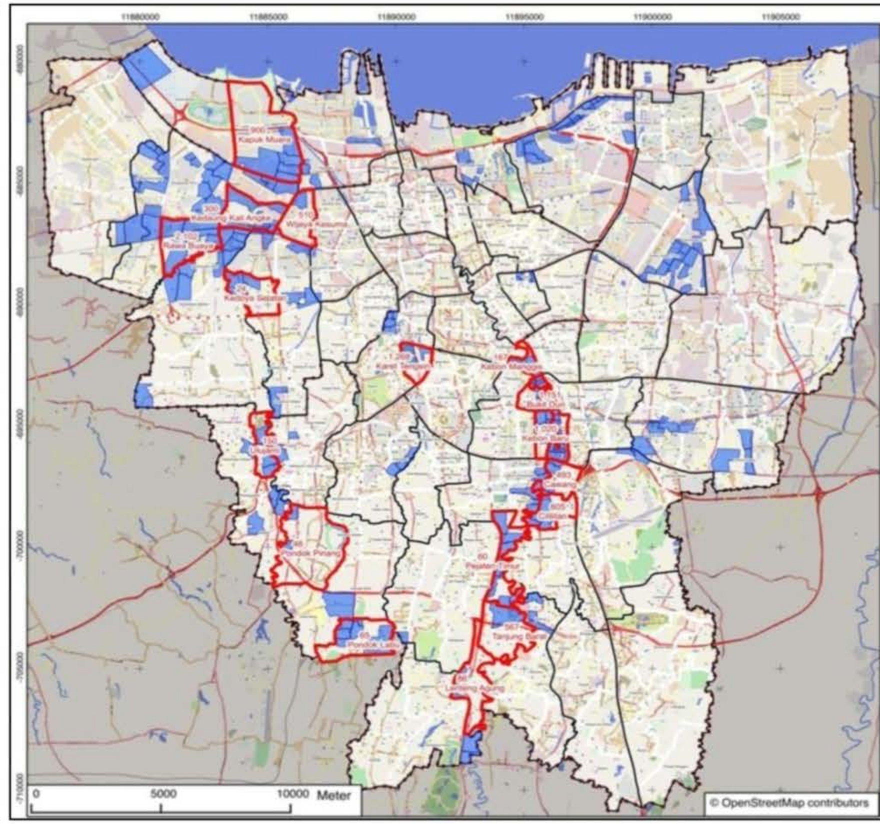
- Population pressure to land resources had increased storm runoff and modified river terrain geomorphometry;
- Increased pollutions from agricultural practices, domestic and industrial wastes as indicated from water quality parameters that intensify water demands; and
- Changes in river basin response system with more intense flooding in frequency and magnitude, as direct impact of land use changes, not to mention the impact of climate change.

COMPARISON OF 2007 AND 2013 JAKARTA FLOODS

GENANGAN BANJIR 2007

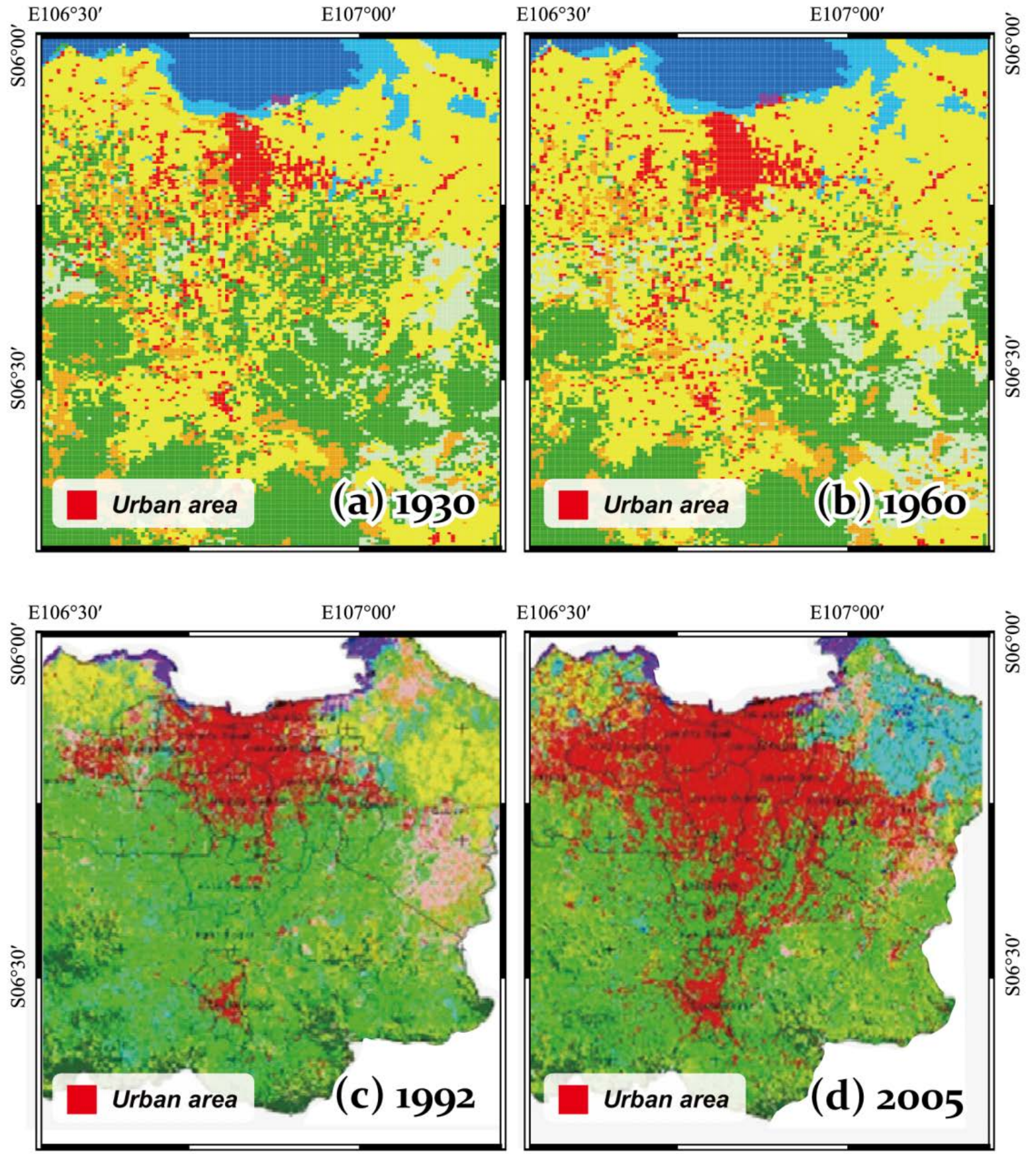


GENANGAN BANJIR 15 -17 JAN 2013



PERBANDINGAN BANJIR 2007 & 2013			
No.	KRITERIA	2007	2013
1	Luas Genangan	231,8 KM2	41 KM2
2	Prosentase terhadap luas DKI	45%	8%
3	Jumlah Pengungsi	320.000 jiwa	18.018 jiwa
4	Korban Meninggal	80 org	20 org

Rapid urbanization in the past two-to-three decades, encroaching upstream areas



Land use changes in the upper Ciliwung basin 1990-2004, increasing runoff coefficient about 10%

No	Land use type	Areal coverage					
		1990		1996		2004	
		Km^2	%	Km^2	%	Km^2	%
1	Forest	52.85	35.0	50.94	34	45.21	29.9
2	Garden	34.21	22.6	31.07	21	31.41	20.8
3	Settlements	6.25	4.1	19.26	13	26.62	17.6
4	Paddy fields	20.23	13.0	13.67	9	10.14	6.7
5	Scrubs	36.09	23.9	34.33	23	37.49	24.8
6	Others	1.50	1.0	1.85	1	0.21	0.001

Source: Pawitan et al. (2009)

Strong Increase In Urbanization As Compensated By Reduction In Forest, Garden And Dry Land Farming

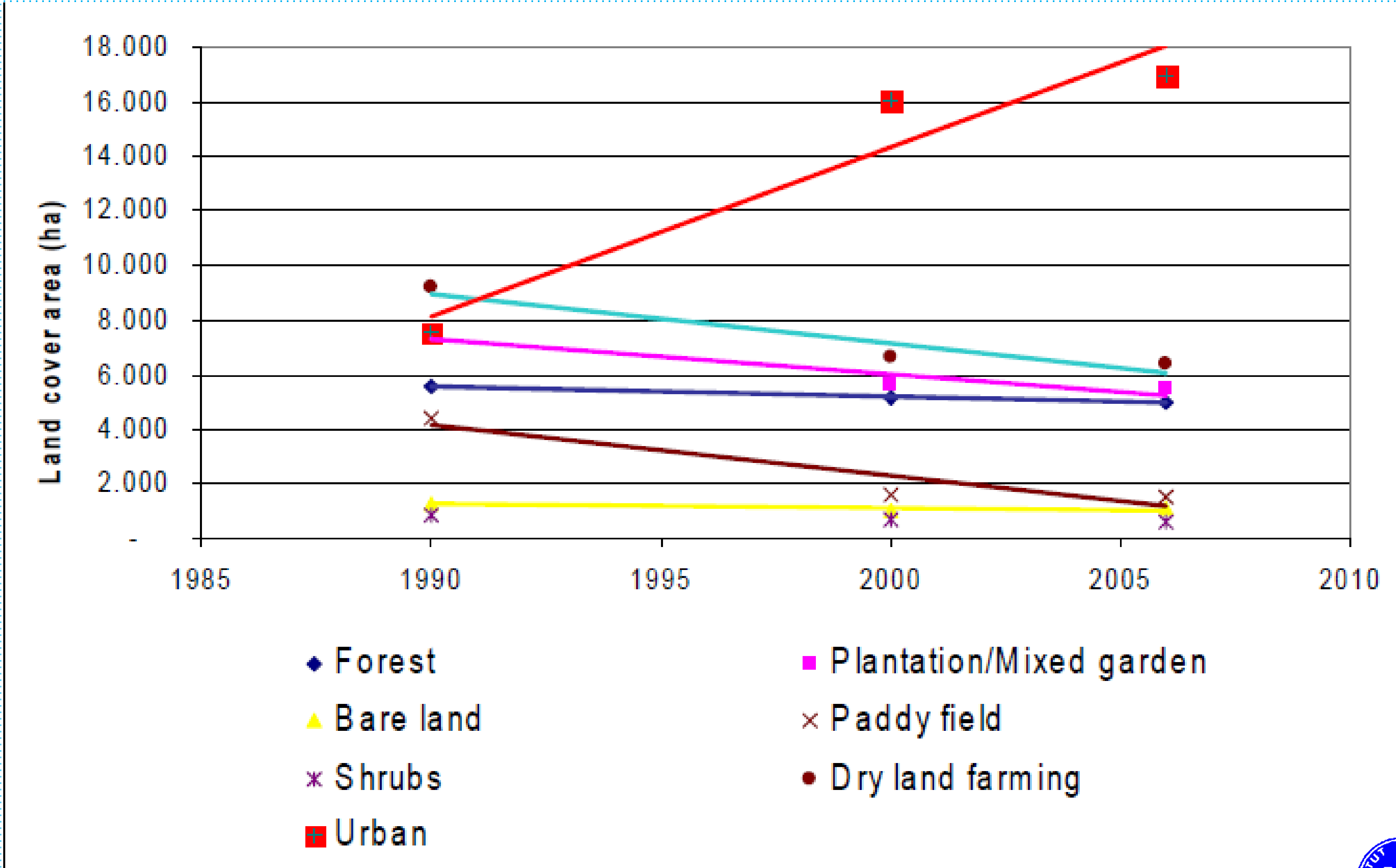


Fig. 7 Changes of land cover at Ciliwung watershed.


Down_No.7
Down_No.3, No4
Down_No.1, No.2
Down_No.2
Middle_No.6
Middle_No.7
Middle_No.9
Middle_No.1
Middle_No.2
Upper_No.17
Upper_No.12, No.13
Upper_No.2
KP_Pakuwon
N
Image © 2008 TerraMetrics
Image © 2008 DigitalGlobe
Image NASA
84 km
Google
Pointer 6° 41.059' S 106°42.352' E
Streaming |||||||||| 100%
Eye alt 286.78 km

POPULATION INCREASE IN MIDSTREAM AREAS

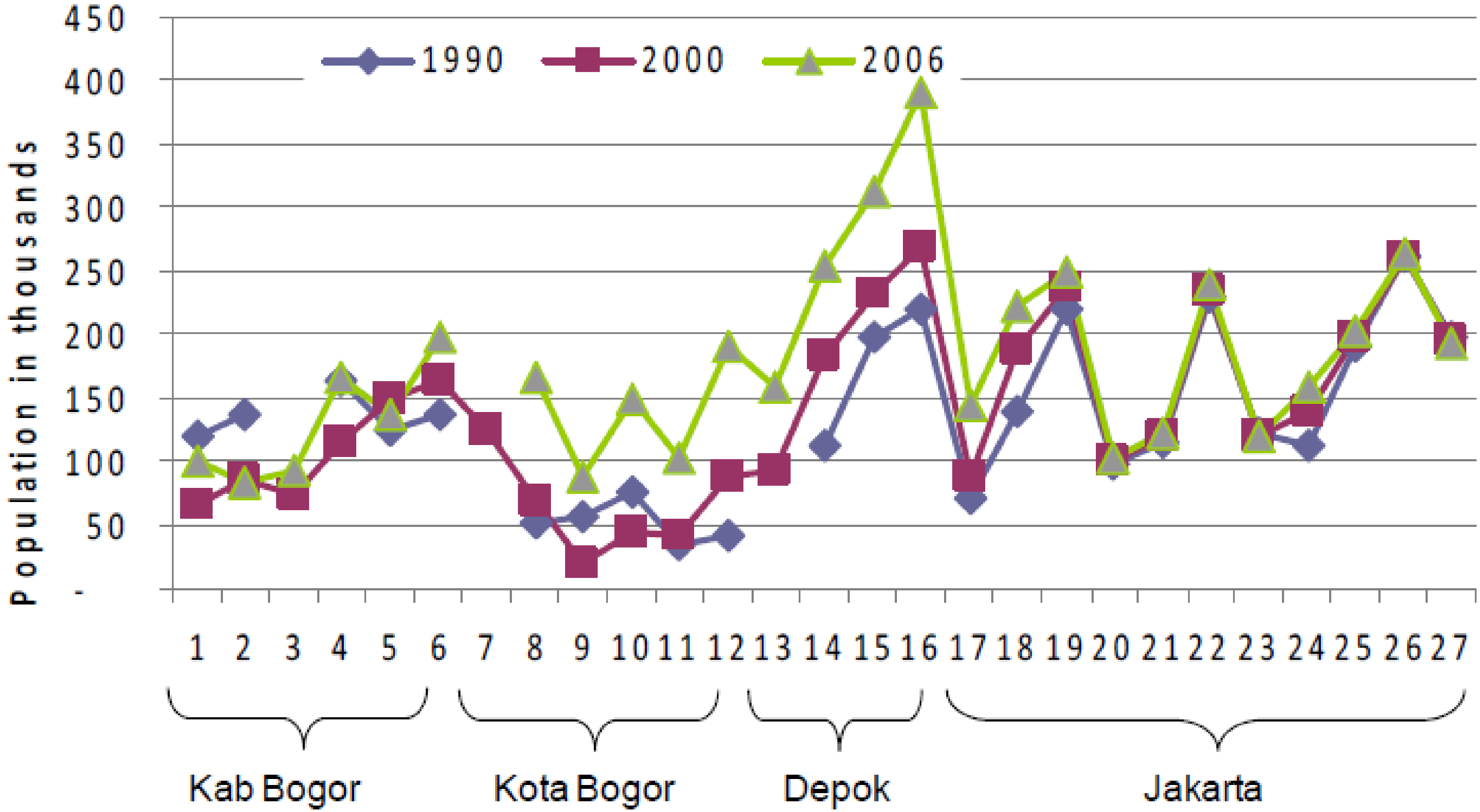
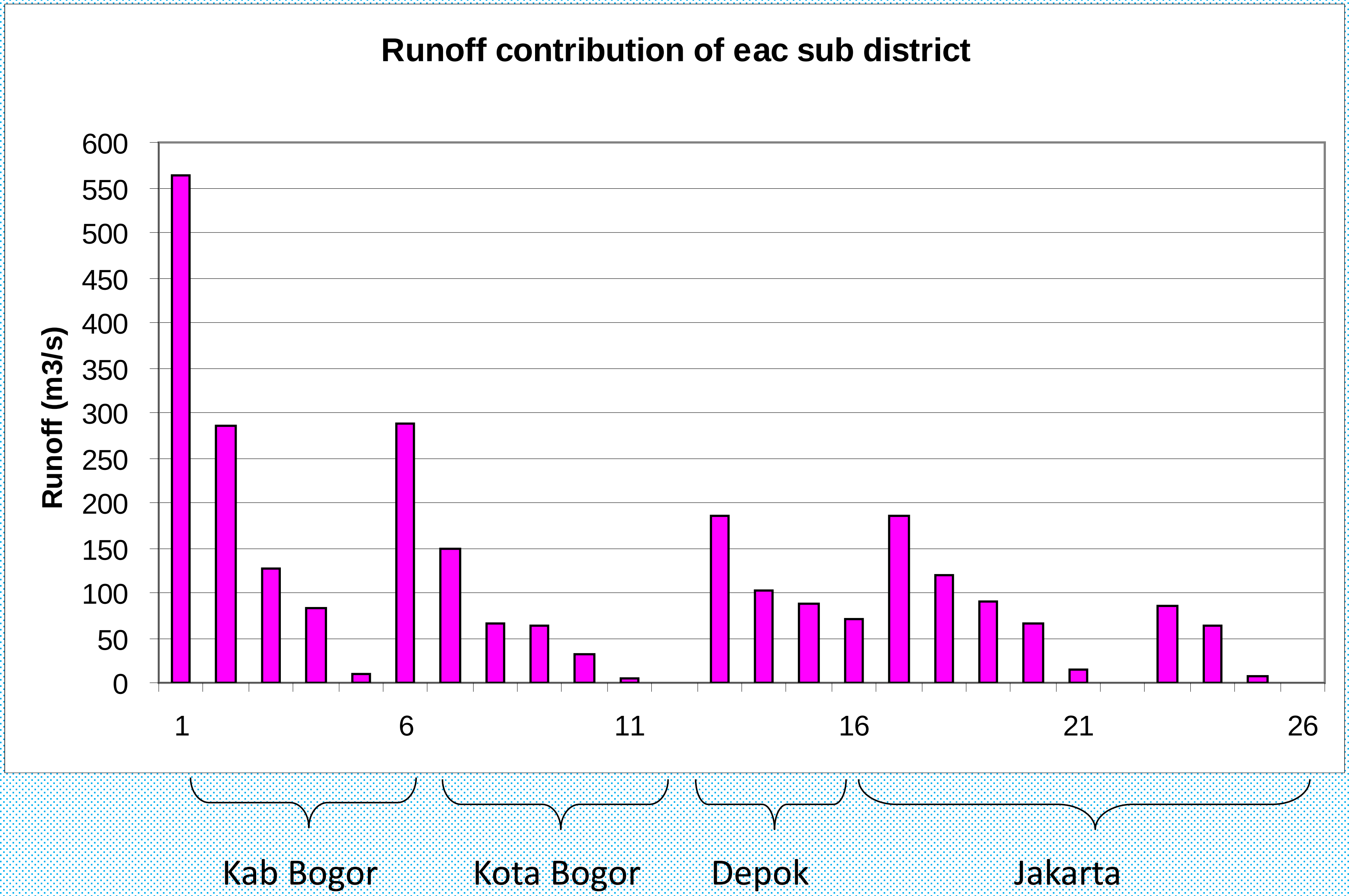
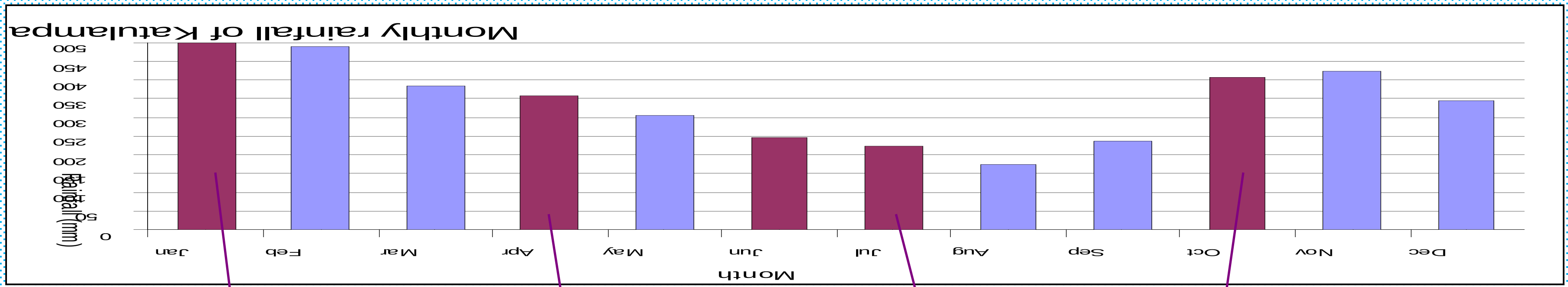
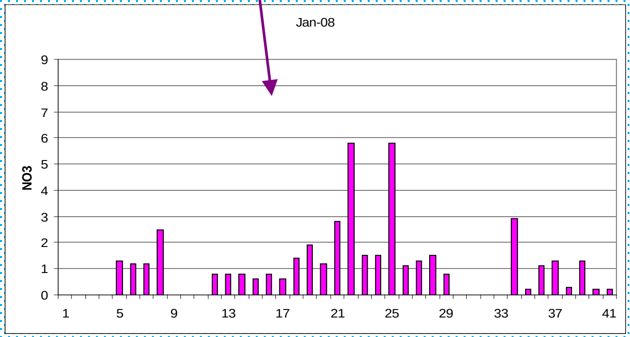


Fig. 9 Population by sub-district along the Ciliwung river.

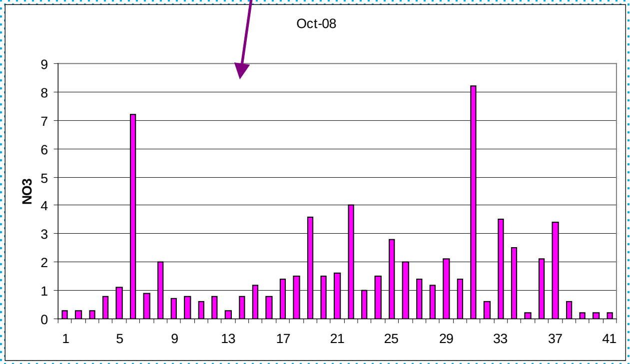

Runoff contribution of eac sub district
Runoff (m3/s)
600
550
500
450
400
350
300
250
200
150
100
50
0
1
6
11
16
21
26
Kab Bogor
Kota Bogor
Depok
Jakarta

NO_3 vs Seasonal rainfall distribution and along Ciliwung river sections

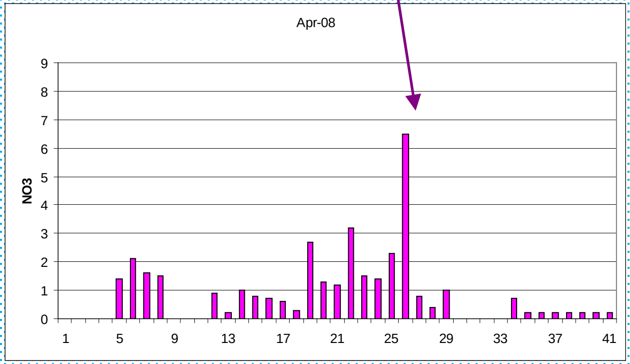


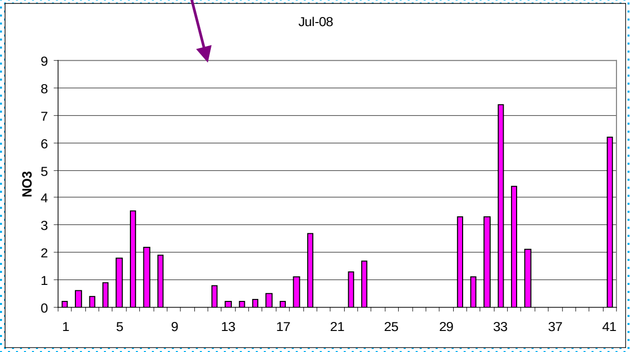


Rainy season



Transition





Dry season

SUSTAINABLE URBAN WATER SYSTEM IN GREATER JAKARTA BASIN

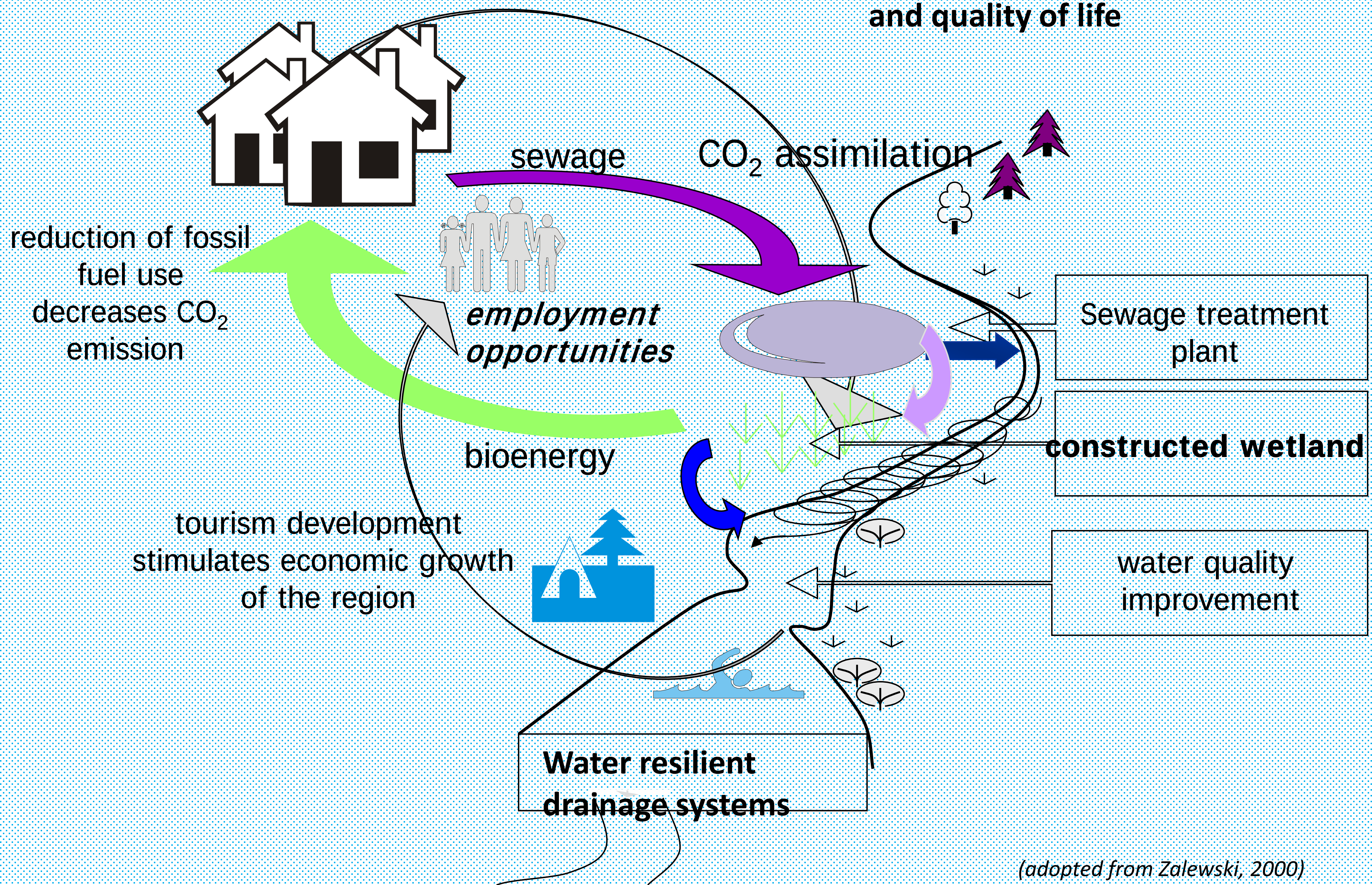
- **Ecohydrology concepts and theory provide an integrative science solution of IWRM** to ensure sustainable urban water system, however in present practices in Jakarta there are still some gaps between theory and reality that need to be resolved;
- A simple and practical guidance is necessary;
- Research and capacity building through water education still need to leapfrog and to boost sustainability of the Greater Jakarta urban water system.

ECOHYDROLOGY APPROACH

- **A new paradigm** in integrated water resources management (**IWRM**) that offers a sustainable development approach in understanding the environment and water resources system through understanding the interdependence of processes and components of hydrologic cycle in terrestrial and aquatic ecosystems
- **Key concepts and principles on ecohydrology have been developed worldwide, but barely implemented in Indonesia due to gaps in institutional capacity and education systems**

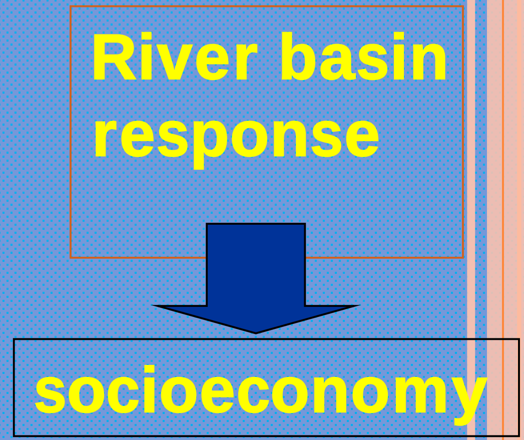
Adoption of Ecohydrology System solutions

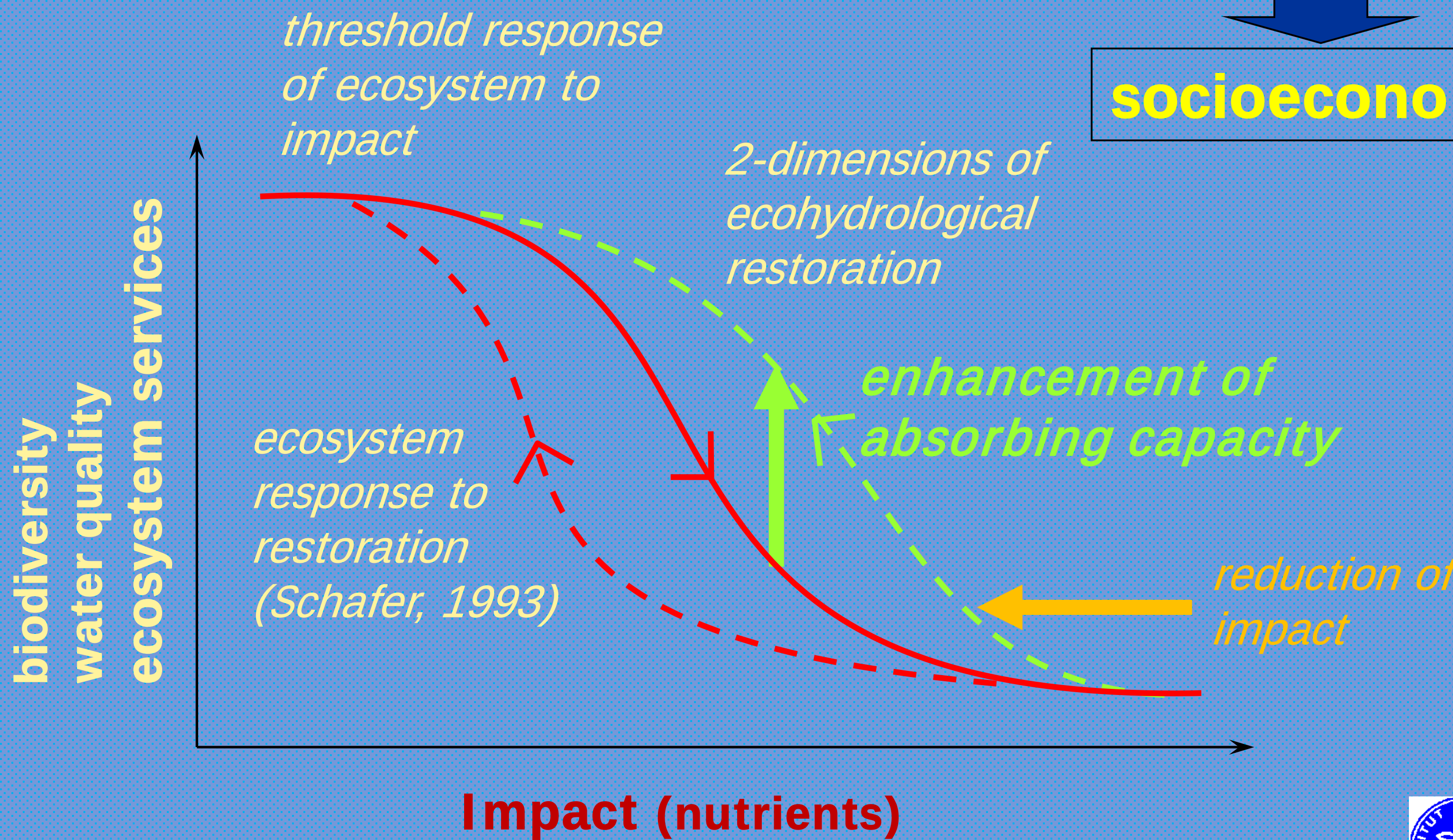
Improvement of water quality, ecosystem health and quality of life



(adopted from Zalewski, 2000)

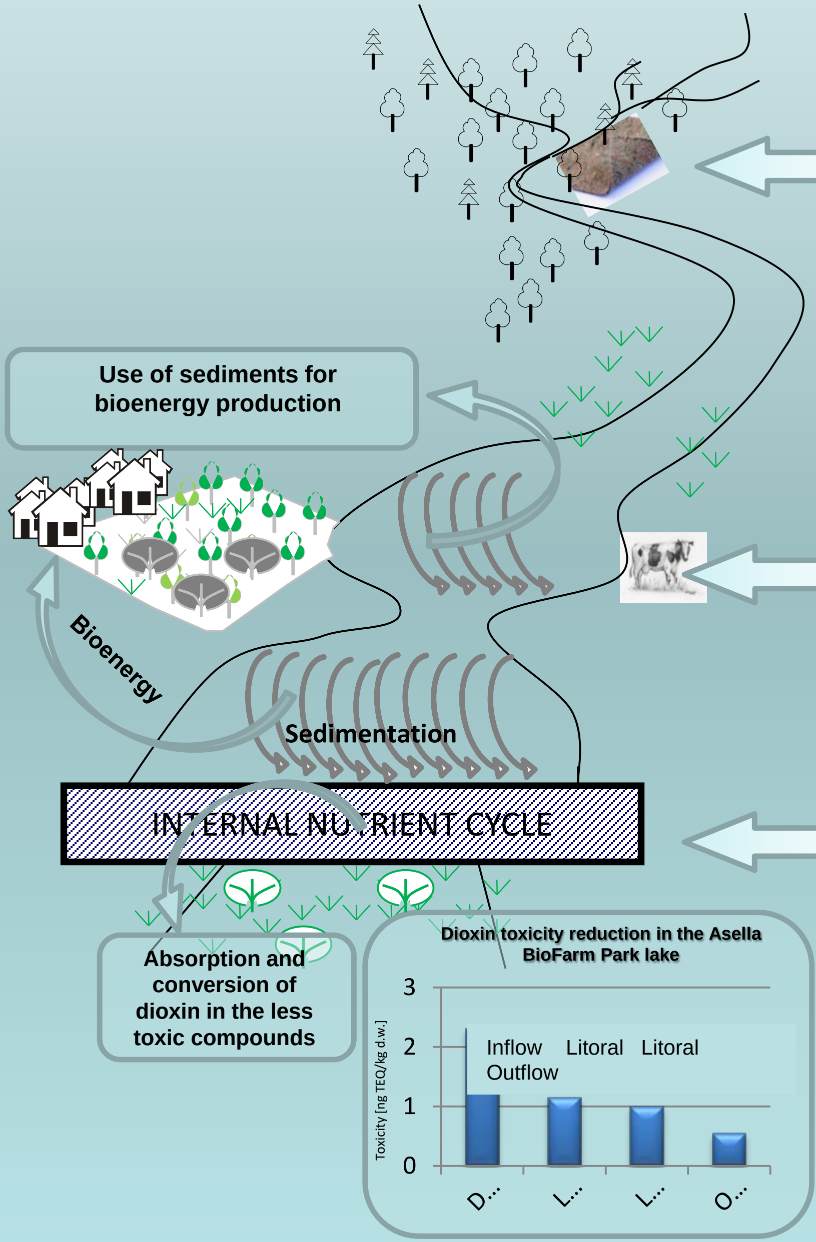
FOUR TYPES OF RESPONSES OF BIOLOGICAL SYSTEMS' DYNAMICS to catchment scale processes regulation





Zalewski 2011 ***The concept of EH sustainability threshold***

Use of ecohydrology based systemic solutions for reduction of turbidity, eutrophication and dioxin-induced toxicity in the Asalla BioFarm Park lake



Use of biodegradable geofibers for erosion controll

Stock watering site and use of manure collected at the site as a fertilizer

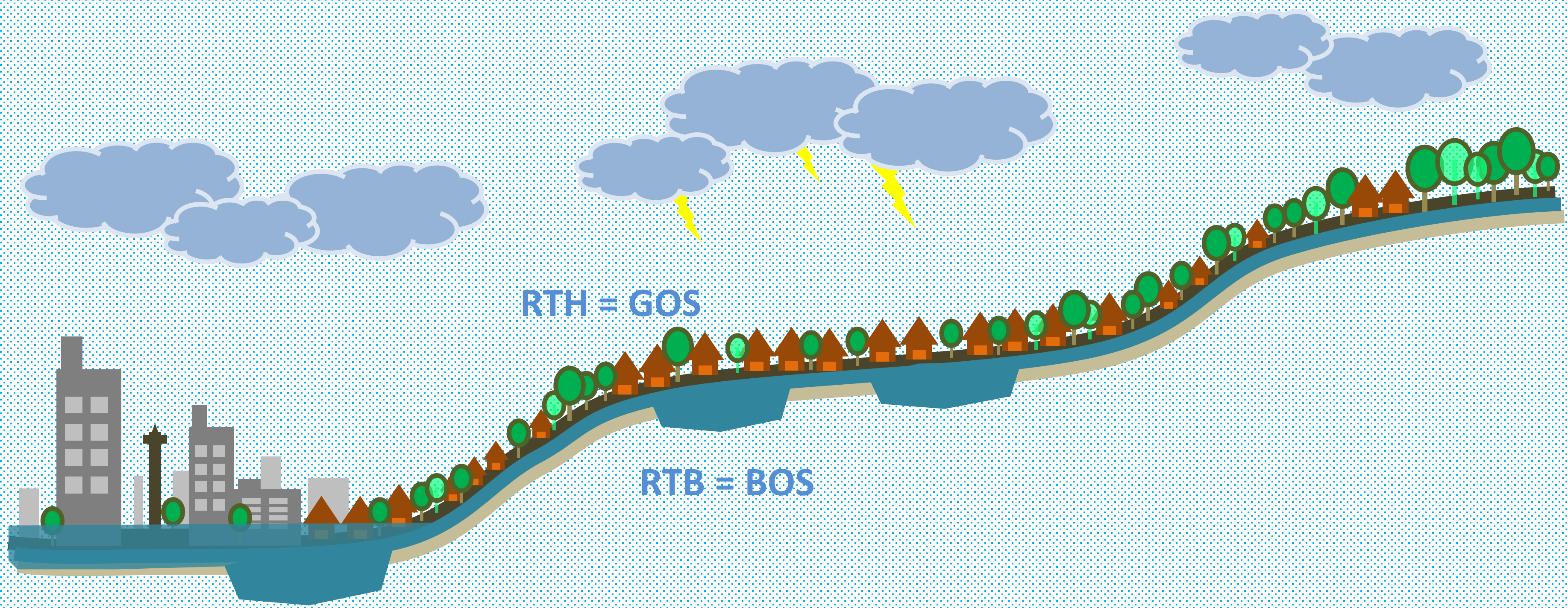
Construction of the sequentional biofiltration system for turbidity, eutrophication and dioxin toxicity reduction in the Asella BioFarm Park lake

Ecotechnology measures for sustainable urban water system in the Greater Jakarta basin

Zonations along the Ciliwung river basin (according to PP 47/1997 on spatial planning):

1. **Upstream:** covers conservation areas of Bopunjur (regreenning program, rainfall&runoff water harvesting, recharging wells, canal dams and revitalization of small lakes & villages water supply)
2. **Midstream:** buffer and utilization zones for downstream & Jabodetabek areas (conservation & utilization of water resources: regreenning, recharge wells & Revitalization of small lakes)
3. **Downstream:** utilization zones in Jakarta areas (urban drainage systems: river works, retension reservoirs (Polders) & flood control systems with Kanal Banjir (Flood Waterways); estuaries and reclamation works.

Function Blue Open Spaces (Arifin et al. 2014)



Jakarta - DOWN STREAM | Depok & Bogor - MIDDLE STREAM | Puncak - UPPER STREAM

WATERBASIN RESERVOIR

CARBON
SEQUESTRATION & STOCK

BIODIVERSITY CONSERVATION

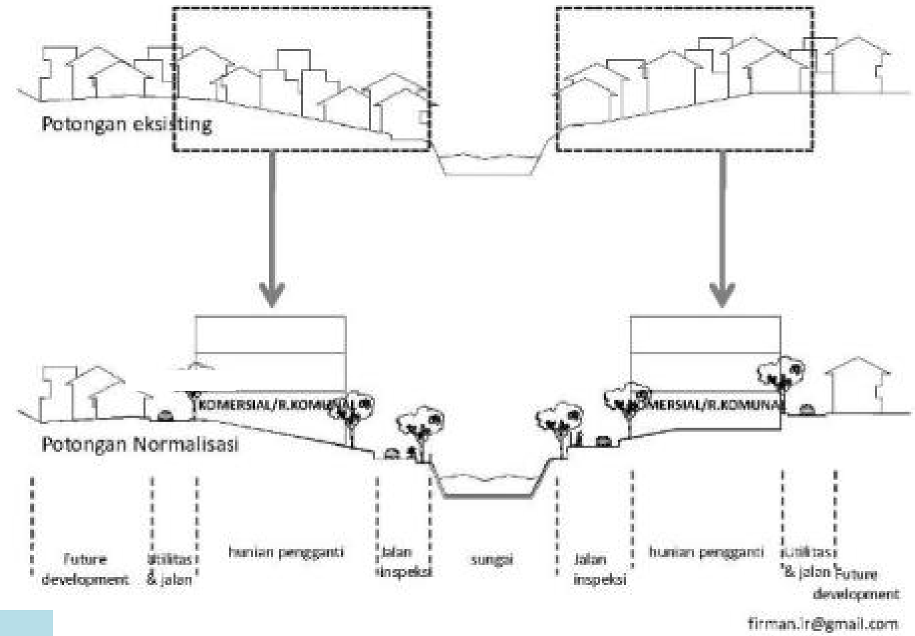
TOURISM RECREATION

AMENITIES & BEAUTIFICATION

PRODUCTION
FISHERY & AGRICULTURE

Water Back

(Courtesy of PLB 2014)



Water Front

Opportunity

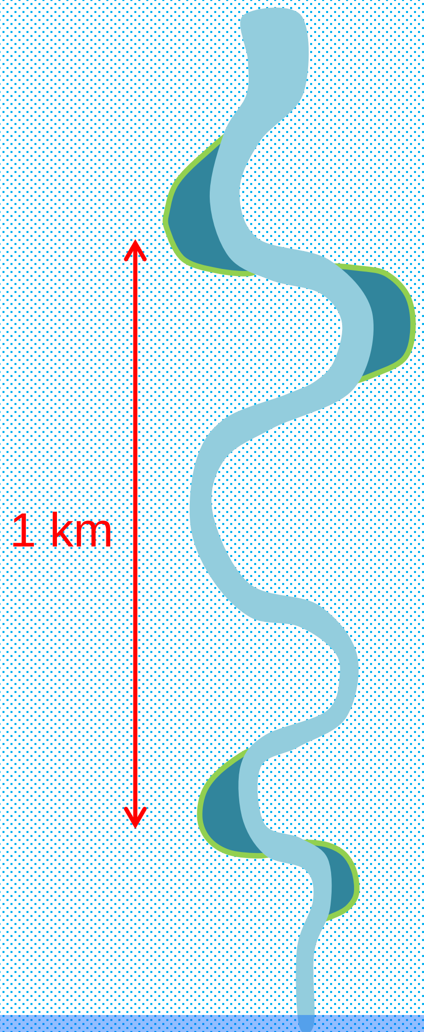
- Efficient on land use system.
- Providing *public open space*.
- River bank free.

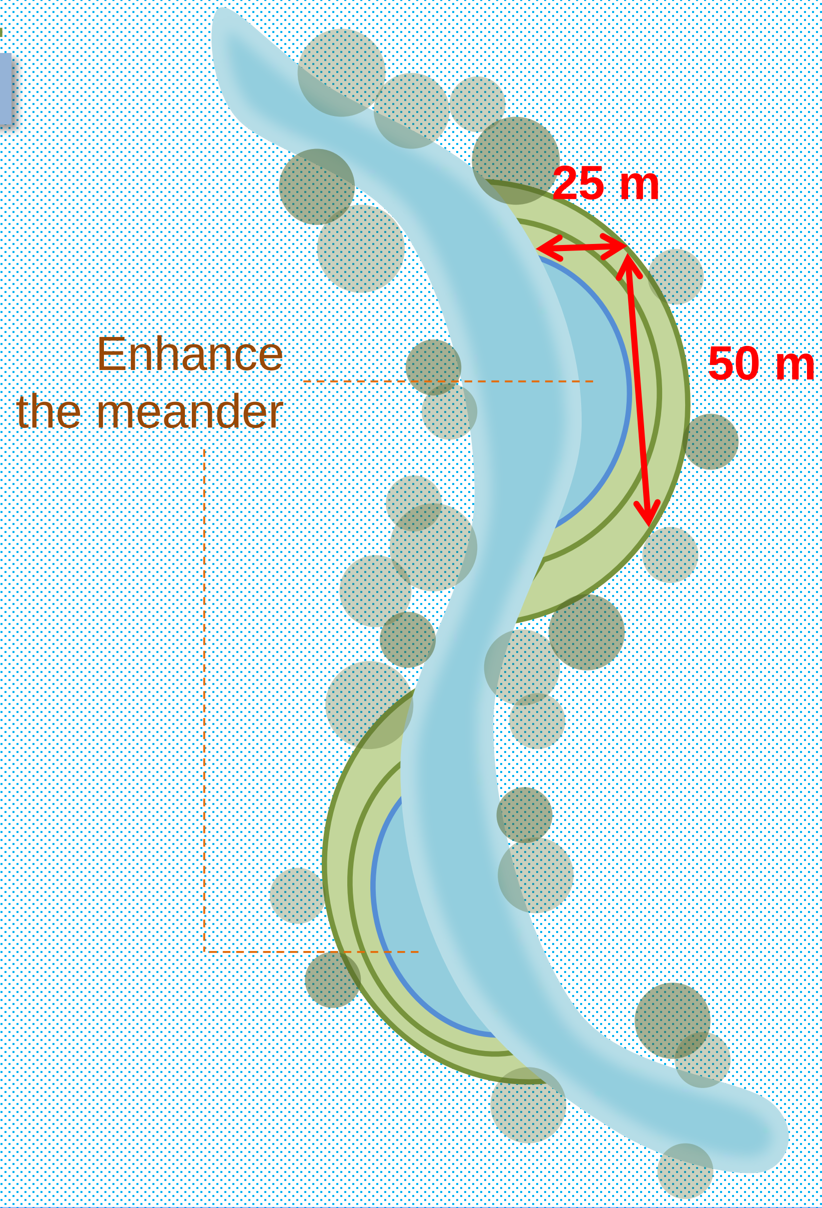
(Arifin et al. 2014)

RIVERSIDE CASCADE

CONCEPT

Source: Noviandi, Arifin, Kaswanto (2016)





Assumption

1 riverside cascade

Length 50 m

Width 25 m

Depth 5 m

Volume per cascade
± 6250 m^3

There are **2 ponds** riverside cascade per kilometer

Volume per km
(2 ponds)

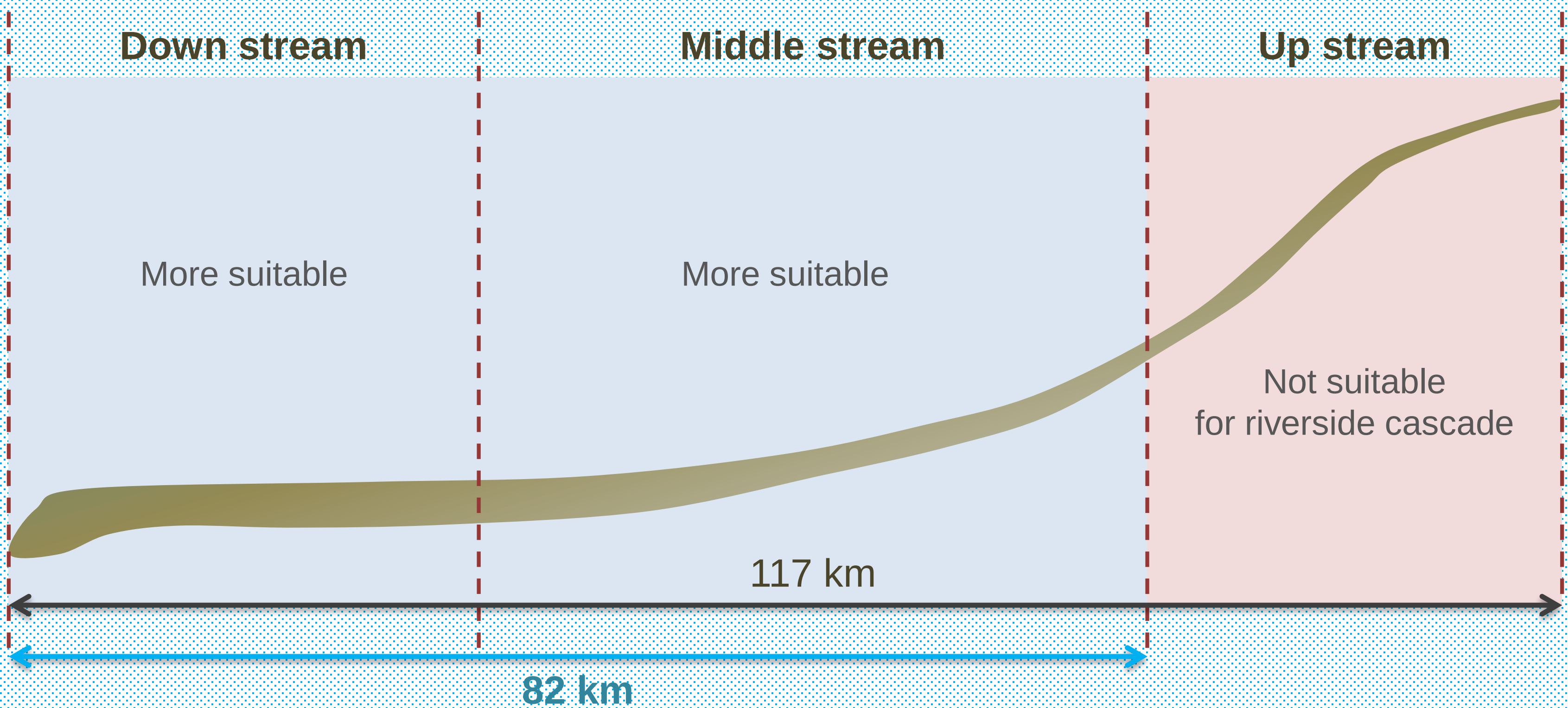
6250 m^3 x 2

12500 m^3 / km

RIVERSIDE CASCADE
CONCEPT

Source: Noviandi, Arifin, Kaswanto (2016)

Ciliwung Riparian section



Total volume

12500 m³ x 82 km = **1 025 000 m³**

CONCLUSIONS

(i) Apparent seasonal and spatial patterns could be recognized from water quality information due to population density, anthropogenic activities and land use changes.

(ii) Changing water environment of the Greater Jakarta basins rooted from population pressures to land use changes, that have modified river geomorphometries and downstream floodings; and

(iii) Ecotechnology measures still need to be introduced with ecoefficiency indicators to leapfrog and to boost sustainability of the Greater Jakarta water system.

Thank You

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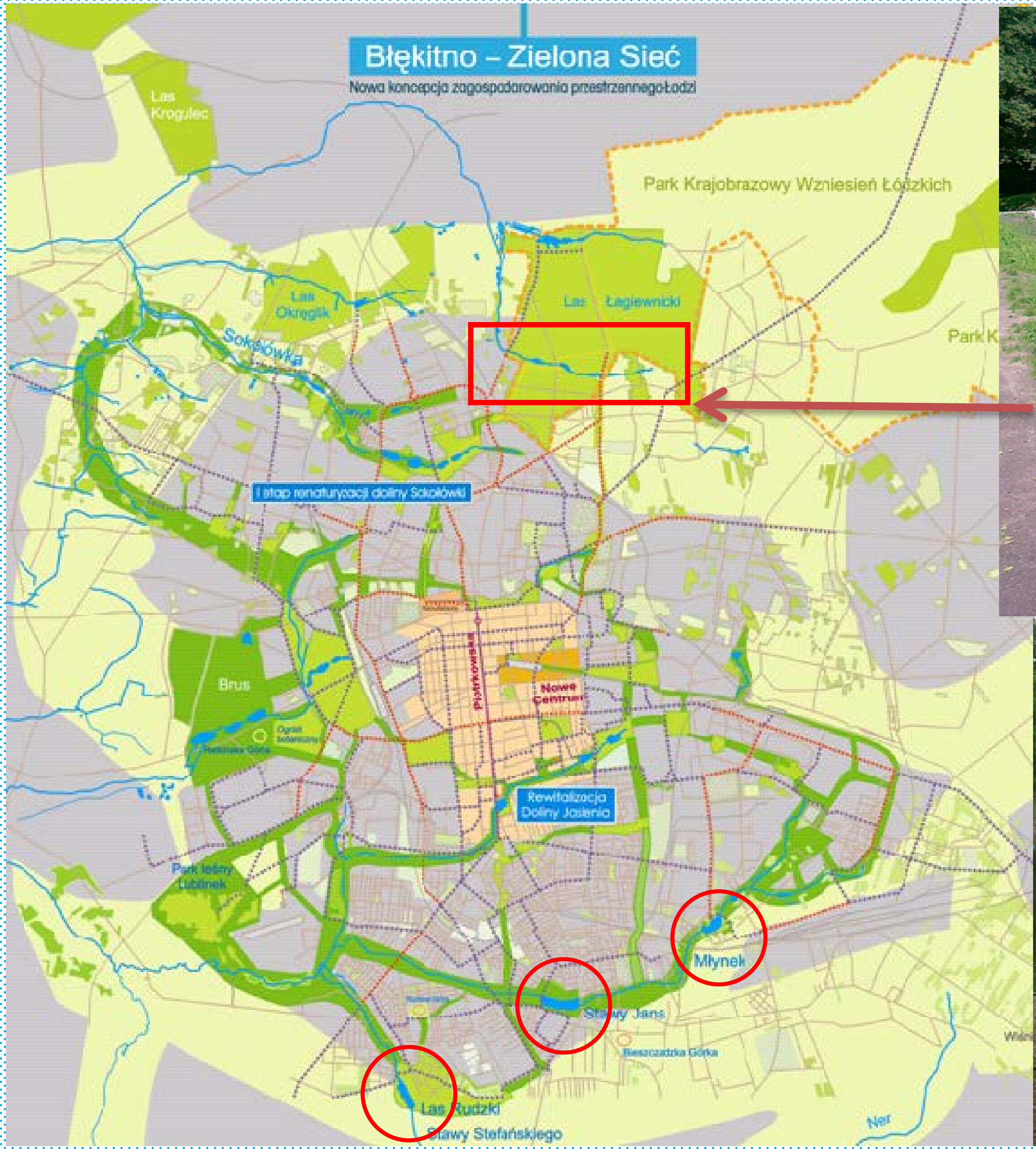
Lodz City Blue-Green Network



Source: Zalewski