Ministry of National Development Planning
National Development Planning Agency of Indonesia

The Simulation Study on Climate Change in Jakarta, Indonesia

Final Report

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Japan International Cooperation Agency (JICA)

Yachiyo Engineering Co., Ltd.

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EXECUTIVE SUMMARY

BACKGROUND AND OBJECTIVE

In 2010, Japan International Cooperation Agency (JICA), World Bank (WB) and Asian Development Bank (ADB) conducted a joint-study on impact analysis by climate change focusing on mega-cities in Asia which are highly vulnerable to climate related risks under global warming.

JICA has taken up this Study on mega-city Jakarta, Indonesia as a follow-up case study by applying the methodologies established in the above-stated joint study, with specific objectives such as i) to understand climate-related risks in Jakarta in 2050, ii) to assess impact of flood due to climate change and iii) to make policy recommendations which are worthy of being recommended for both the local and central government of Indonesia.

APPROACH AND METHODOLOGY

Two IPCC climate change scenarios were selected; viz., A1FI: a high emission scenario and B1: a low emission scenario. Non-climate change factors such as land use change and land subsidence were also considered, and these parameters were used as inputs to the flood simulation. In addition to this, assumptions and estimates were made regarding infrastructure scenario for flood control in 2050. As a result, a total of 45 cases of simulation under 3 different return periods (1/10, 1/30 and 1/100) was carried out and analyzed to provide information of area, volume and depth, etc. of flooding. Based on the results obtained from flood simulation analysis, impact of flood was assessed in terms of damage costs. It is noted that in the approach and methodology, various influential assumptions with regard to climate scenarios as well as socio-economy were applied.

In Jakarta, in 2009, approximately 320 thousand people live under the poverty level which is then called as the poor. The government has issued several assistance programs for the poor. Taking the importance of poverty issues into consideration, this Study conducted a household survey on the urban poor in the selected villages (Kelurahans) in Jakarta to figure out impacts of flood inundation on the poor and to make policy implications to be addressed by the governments.

KEY FINDINGS

From the result of the flood simulation analysis, it is found that;

- Analyzing its rainfall, inundation, topography, and the state of flood infrastructure, Jakarta is prone to floods especially due to inner water.
- It is found that land subsidence is in progress in Jakarta, which causes floods due to inner water because inundation water accumulated in urban area is not properly discharged to the sea. Therefore, the possibility that floods cause not only economic but also social damages in large scale has become extremely high.
- Increase of rainfall volume and sea level rise due to climate change would also cause flood damages due to inner water increase through the same process described above.
- Damages caused by floods can be exacerbated in line with the progress of urbanization, climate change, and land subsidence.
- Therefore, it is necessary to establish comprehensive flood management plans in Jakarta including countermeasures against climate change, land subsidence, land use regulations and improvement of river and storm drains etc., which cover the whole river basin.

From the results of damage cost assessment for 45 cases, it is found that;

- The damage costs in 2050 resulting from climate change and other factors such as land subsidence and land use change can range from Rp 56,660 Billion at minimum to Rp 143,786 Billion at maximum. This, in terms of the current GRDP in 2008, constitutes approximately 8.4 percent and 21.2 percent respectively.

- Flood damage cost caused by land subsidence is estimated to be larger than that by climate-related factors. In comparison of damage costs with climate-related factors and land subsidence in 1-in-30-year return period which is a medium-sized flood, of the total increase, approximately 79 percent is due to land subsidence. In terms of GRDP 2008, it accounts for about 9 percent.
- Damage to buildings and assets was estimated the largest among other sectors, with about 74 percent of the total damage costs.
- Among all the districts in Jakarta, the following are prone to severer flooding: the downstream area of the Cengkareng Channel in the northwest of Jakarta (Jakarta Barat), a part of Jakarta Utara and Jakarta Timur including the coastal areas of the Jakarta Bay.
- Pumping Station Project (PS Project) which was taken up as one of the adaptation options in this Study (760m^3/sec. in 12 drain districts) will result in a significant reduction of damage costs at approximately 30 percent compared to "without PS Project scenarios.

A number of problems and issues with regard to the poor in Jakarta are drawn out from our household survey and its analysis. Vulnerability includes physical factors such as small and fragile structure of houses and limited infrastructure, economic factors such as lack of savings, lack of insurance and low income, social factors such as high population density, low education levels. Thus, the survey concludes that these vulnerable conditions need to be addressed in order to formulate appropriate and effective policies for the poor.

RECOMMENDATIONS

- As the finding shows, land subsidence would contribute the largest share of damage cost from flood (about 79 percent). Thus, it is recommended that countermeasures to slow down land subsidence are the subject of urgency for the government. They may include, for example, control of extraction and use of groundwater, conversion of main water source to surface water from groundwater, resettlement of major consumers of groundwater like manufacturing industries in Jakarta, etc.
- Urban planning and flood control infrastructure need to be prepared with proper consideration on climate-related risks. This includes review/revise of the existing rules, regulations about urban planning and land use, such as zoning regulations, development permits and so on.
- In addition, it is effective to implement a comprehensive flood control measures, especially for inundation areas where frequent and severe flooding is expected due to increased runoff discharged from upper stream. It includes, for instance, some measures such as designation of flood-prone area or hazardous proximity, establishment of early warning system, construction of rainwater storage facilities to cope with flood caused by inner water, etc., which are now under discussion in the Project for Capacity Development of Jakarta Comprehensive Flood Management being implemented by JICA.
- Establishment of Flood Risk Management Plan will be of paramount importance in view to reduce the risk of floods of both regular flooding and a certain flooding beyond prediction. This plan needs to be prepared in relation to residential, commercial and industrial use.

From the result of analysis on the urban poor, at the central government level, it is recommended to introduce: i) control of urbanization process with consistent and continuous policies, ii) monitoring of the data on the urban poverty, and iii) land use mechanism utilizing spatial management by monitoring and evaluating condition of vulnerable areas.

Whereas, at the local government level, it is recommended to introduce: i) enhancement of community-led socialization and internalization of local environmental management, ii) enhancement of land use planning and zoning regulations in addition to the law enforcement of building code and land use permit, iii) development and spatial plans taking the vulnerability and adaptation assessment into consideration and iv) intervention by the government in increasing the adaptive capacity of the poor.

PRIORITY ACTIONS

We conclude this report with highlighting some actions to be taken by the governments (at central and local government levels) with priority as follows:

- Studies on status quo of extraction and use of groundwater and impacts by excessive amounts of groundwater drawing (local government level);
- Planning, implementation and completion of switching water resources to those other than groundwater (local government level);
- Intervention by the government in formulation and enactment of consistent and continuous policies and strategies that manage resettlement of business and industrial units, including improvement and development of adequate infrastructure and facilities associated with re-location (local government level);
- Implementation of flood control infrastructure based on the existing Master Plan 1997 (central government level);
- Implementation of countermeasures for runoff control to cope with inadequate channel capacity (local government level);
- Review and revise the existing rules, regulations and other instruments concerning land use planning and zoning regulation etc., including housing administration policies that seek to minimize vulnerability to flood and to improve housing and working conditions (local government level); and
- Carrying out Flood Risk Assessment for preparation of Flood Risk Management Plan (central and local government level).

Flood in GROGOL SELATAN (2007)

Flood in WBC Underpass (2007)

<Extract from Key Findings: Flood Damage in Jakarta>

In Jakarta, flood damage increases mainly due to the progress of land subsidence, climate change, and the urbanization of land use. Of the total increment of flood damage, flood damage derived from climate change accounts for 15%, while flood damage due to land subsidence in consideration of the condition of ground water and topography in Jakarta accounts for 65%.

Tables and figures below show the result of inundation analysis such as flood area, flood volume and flood depth by two factors: climate change and land subsidence. The upper tables and figures indicate the impact of climate change, and the lower indicate that of land subsidence.

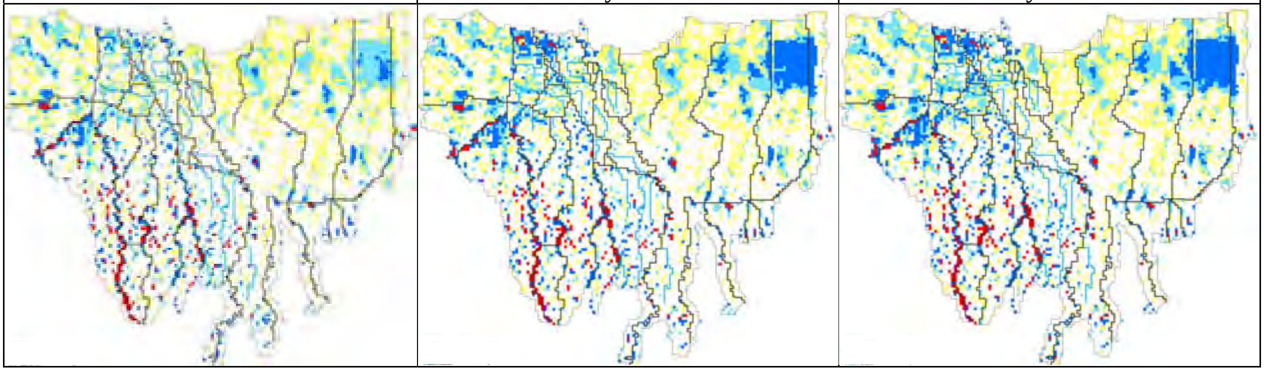
Case name in Tables below is composed of [Year]_[Land Use]_[Flood Infrastructure Scenario]_[Climate Change Scenario]_[Land Subsidence]_[Return Period]. For example, the case "2050_F_MP_A1FI_v0_100" indicates [2050]_[Future Land Use Condition]_[Master Plan Scenario]_[Growth-Oriented Society Scenario]_[No Land Subsidence Compared to 2008]_[1-in-100-year flood].

In each factor, the extent of flood damage increases from case (A) to case (C).

Impact of Climate Change

Case Name	(A) 2050_F_MP_**P**_v0_100	(B) 2050_F_MP_**B1**_v0_100	(C) 2050_F_MP_**A1FI**_v0_100
Flood Area	243.4 km^2 (100%)	264.0 km^2 (108%)	277.1 km^2 (114%)
Flood Volume	$159.7 \times 10^6 m^3$ (100%)	$190.0 \times 10^6 m^3$ (119%)	$210.0 \times 10^6 m^3$ (131%)
Flood Depth	0.66m (100%)	0.72m (110%)	0.76m **(115%)**

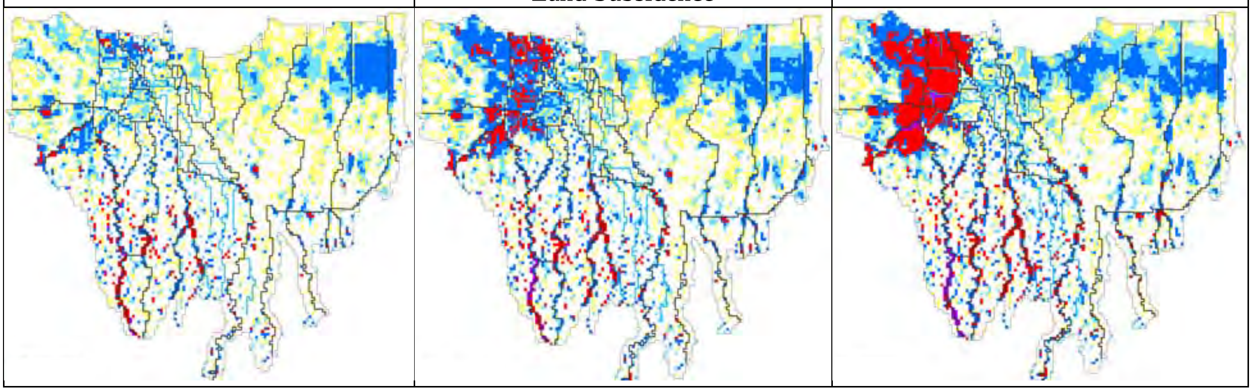
(A) Present Condition	(B) Sustainable Development Society Scenario	(C) Growth-Oriented Society Scenario



Impact of Land Subsidence

Case Name	(A) 2050_F_MP_A1FI_**v0**_100	(B) 2050_F_MP_A1FI_**v1**_100	(C) 2050_F_MP_A1FI_**v2**_100
Flood Area	277.1 km^2 (100%)	317.3 km^2 (115%)	331.2 km^2 (120%)
Flood Volume	$210.0 \times 10^6 m^3$ (100%)	$314.3 \times 10^6 m^3$ (150%)	$410.5 \times 10^6 m^3$ (195%)
Flood Depth	0.76m (100%)	0.99m (131%)	1.24m **(164%)**

(A) No Land Subsidence	(B) Relatively Stable Land Subsidence	(C) Severe Land Subsidence



<Legend of Case Name>

Land Use **F**: Future condition in 2050

Flood Infrastructure Scenario **MP**: Master plan scenario

Climate Change Scenario

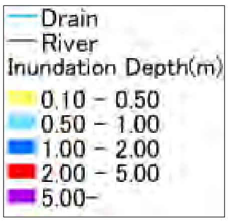
P: Present condition, **B1**: Sustainable development society scenario,

A1FI: Growth-oriented society scenario / Set importance on fossil energy resources

Land Subsidence **v0**: No land subsidence relative to 2008,

v1: Relatively stable land subsidence, **v2**: Severe land subsidence

<Map Legend>



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List of Abbreviations and Acronyms

Abbreviation	Official Name
A1FI	A High Emission Scenario
ADB	Asian Development Bank
ALOS	Advanced land observation satellite 'Daichi'
B1	A Low Emission Scenario
BAPPENAS	Ministry of National Development Planning/National Development Planning Agency, *Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional)*
BMKG	Meteorological, Climatological and Geophysical Agency, *Badan Meteorologi dan Geofisika*
COP13	Conference of the Parties 13th
DGWR	Director General of Water Resources
DKI Jakarta	Special Capital Region of Jakarta
EBC	East Banjir Canal
F/S	Feasibility Study
GDP	Gross Domestic Product
GIS	Geographical Information System
GHG	Greenhouse Gas
GRDP	Gross Regional Domestic Product
IC/R	Inception Report
IPCC	Intergovernmental Panel on Climate Change
IR3S	the University of Tokyo's Integrated Research System for Sustainability Science
JICA	Japan International Cooperation Agency
JABODETABEK	Jakarta, Bogor, Depok, Tangerang and Bekasi
JMA	Jakarta Metropolitan area
M/P	Master Plan
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
ODA	Official Development Assistance
PLN	the State-owned Electricity Company, *Perusahaan Listrik Negara*
PU	Ministry of Public Works, *Kementerian Pekerjaan Umun*
RANPI	National Action Plan Addressing Climate Change
RPJMN	The National Medium-Term Development Plan
RT	Neighborhood Association, *Rukun Tetangga*
RW	Community Association, *Rukun Warga*
WB	World Bank
WBC	West Banjir Canal

CHAPTER 1 Overview of Study

1.1 Background of Study

Awareness of high possibility on further global warming in this century has been raised by the report of Intergovernmental Panel on Climate Change (IPCC) and so on. Greenhouse gases (GHG) including carbon dioxide and methane, which are bringing in global warming, are emitted by social and economic activities of human beings. The increase in atmospheric GHG causes temperature rise and sea level rise through greenhouse effect, and then ecological system and human society suffered large-scale and composition effects. International society has begun to recognize global warming as the most critical issue of this century and works on the reduction of GHG emission (mitigation) as well as adaptation to the effect of global warming.

Mega-cities will suffer from the most composite effect by global warming. The effects of global warming are divided into direct impacts such as submergence caused by sea level rise, and indirect impacts including residents' relocation by submergence and functional disturbance of infrastructures. The latter effects will lead industrial conversion, alteration of water resources, hygiene issues and infectious diseases, and environmental contamination.

Especially in Asia, since mega-cities along the coasts are expected to increase in number and grow in size in accordance with the development of economy, implementation of global warming impact analysis and establishment of measures for mitigation and adaptation to the global warming influences in such mega-cities are subjects of urgent.

In this situation, Japan International Cooperation Agency (JICA), World Bank (WB) and Asian Development Bank (ADB) conducted the joint study "Climate Risks and Adaptation in Asian Coastal Megacities" in 2010 focusing on mega-cities in Asia which may be influenced greatly by global warming, for the purpose of (1)impact analysis by temperature rise and sea level rise, (2)impact analysis on socio-economy, (3)preparation of measures for "adaptation" and "mitigation", (4)establishment of "package of measures for global warming" that public sector should accomplish proactively in the process of development, and (5)consideration about the role of Official Development Assistance (ODA).

In this Study, socio-economic impact in Jakarta Metropolitan area due to climate change including temperature increase and sea level rise was analyzed by applying the methodologies developed in the previous joint study, with eyeing the possibilities of simplifying the methodologies. Moreover, policy recommendations were made for future infrastructure development, etc. based on the results of the above analysis. The Government of Indonesia presented National Action Plan Addressing Climate Change (RANPI) for overall mitigation and adaptation measures toward climate change at COP13 in December, 2007. In response to this, JICA signed the loan agreement of "Climate Change Program Loan" with the Government of Indonesia. This Study is expected to be useful as a research for the promotion of "Climate Change Program Loan (phase 3)".

1.2 Objectives of Study

This Study was implemented as the follow-up case study of WB-ADB- JICA joint study (JICA was in charge of Manila, WB was in charge of Bangkok and Kolkata, and ADB was in charge of Ho Chi Minh City) and employed the methodologies of this joint study (importance of flood measures, necessity of land subsidence containment and comprehension of impacts on the poor, etc.).

The main objectives of this Study is to define and evaluate climate-related risks in Jakarta, to assess the impact of flood due to climate change on Jakarta's socio-economy, and to formulate policy recommendations for structural as well as non-structural adaptation measures.

1.3 Scope of Works

The Study consists of components as summarized below:

a. Estimate the scale of disaster from flooding based on the collected data including historical climate information etc.;
b. Model climate scenarios that are related to rainfall change, sea water level rise, high tide and land subsidence;
c. Estimate, with different climate and flood control infrastructure scenarios for 2050, potential areas to be affected and magnitude of damages by river flooding and flooding in the coastal zone caused by sea level rise, high tide as well as land subsidence;
d. Identify the most vulnerable urban resources to flooding, including communities, infrastructure, utilities etc., by means of collecting sector information (energy, transportation, water supply/sanitation, public health, building and housing etc., including present and future socio-economic conditions in Jakarta;
e. Estimate damage costs from floods in 2050 based on the result of flood simulation and assess direct and indirect impacts on socio-economy of Jakarta;
f. Conduct household survey on the urban poor and assess direct and indirect effects on the urban poverty group; and
g. Make policy recommendations for potential adaptation measures.

1.4 Study Area

Study areas are shown in Figure- 1.4.1.

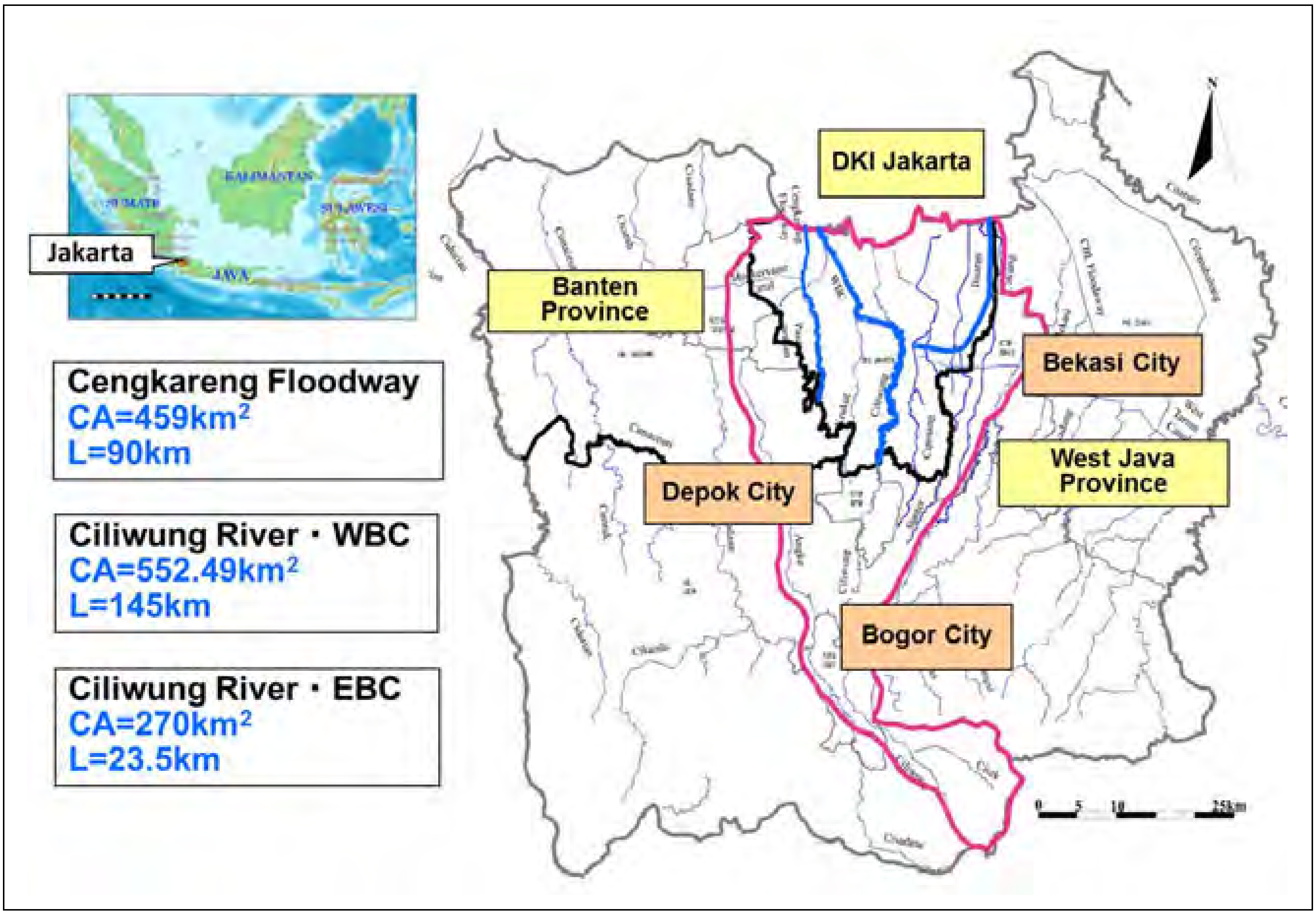


Figure- 1.4.1 Study Area

CHAPTER 2 Present Condition of Study Area

2.1 Topographical Feature

2.1.1 General Conditions of river basin in the Study area

The study area includes three rivers of which total size of catchment areas is 1,281km^2 and the total length is 258.5km extending over West Java Province, Special Capital Region of Jakarta (DKI Jakarta), and Banten Province. The number of total population in three Provinces is approximately 63 million.

2.1.2 Topographic Feature

Figure- 2.1.1 shows the average ground level in the Study area which ranges from -1m to 3,000m. The general conditions from upstream area to downstream area are as follows:

- Upstream area from Bogor to Mt. Pangrango is mountainous area with an altitude of 300~3,000m;
- Midstream area from Manggarai to Bogor shows a gradual slope with an altitude of 20~300m;
- Downstream area is lowland area with an altitude of -1m~20m; and
- About 20 percent of DKI Jakarta located in the lowland area is below sea level with an altitude of less than 2m.

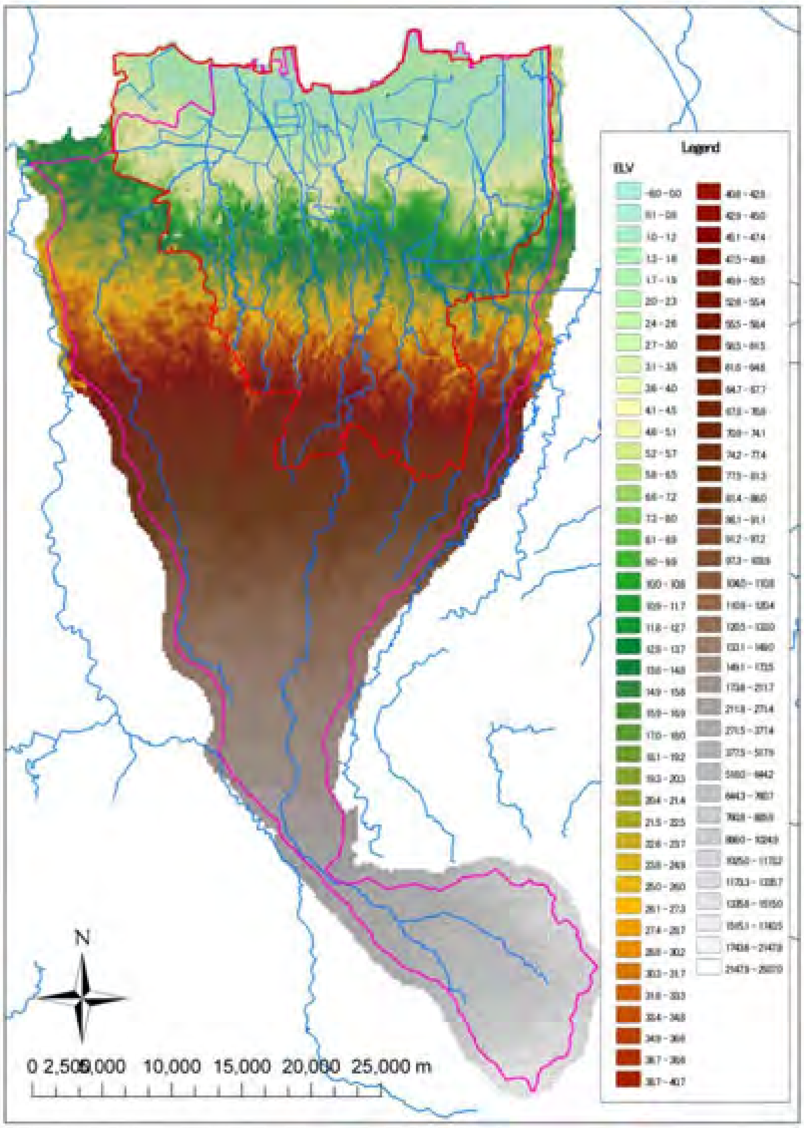


Figure- 2.1.1 Average Ground Level (by 230m mesh)

Source: JICA Study Team

2.2 Flood Inundation Status

Table- 2.2.1 shows the scale of main floods occurred in recent years and the state of damage due to the floods. The details of floods in 2002 and in 2007 are described below.

Table- 2.2.1 Main Floods Occurred in Recent Years

Occurrence Date/Period	Highest Water Level at Manggarai (m)	Average Rainfall over Basin Manggarai				Type of Disaster	Damages
		1 hour (mm)	24 hour (mm)	48 hour (mm)	168 hour (mm)	Dike Break/ Overflow/ Inundation	Area of Wetted Surface* (km^2)
5th Jan. 1996	9.70	31.8	130.5	156.9	296.7	Overflow/ Inundation	
26th Jan. 2002~ 20th Feb. 2002	10.50	16.6	132.4	194.9	397.8	Overflow/ Inundation	87.1
30th Jan. 2007~ 7th Feb. 2007	10.61	21.5	179.5	254.6	445.6	Overflow/ Inundation	300.0

*DKI Jakarta, Urgent Inventory Study on Damage of Flood 2002 in JABODETABEK

2.2.1 Flood in 2002

From January to February in 2002, the JABODETABEK suffered from tremendous inundation damages not only by inland water but by river water. After this flood, JICA Study “Urgent Inventory Study on Damage of Flood in JABODETABEK, 2002” was intensively conducted to identify the flood damage and causes of flooding. According to this report, inundation area was 526 km^2 or equivalent to 8.6 percent of the total area of JABOTABEK and disaster areas with flooding depth exceeding 0.5m for more than 1 week were 53 km^2. Inundation area in DKI Jakarta was 87km^2, and total inundation area of Tangerang, Bekasi, and Depok city reached about 15.2km^2 (see Figure- 2.2.1).

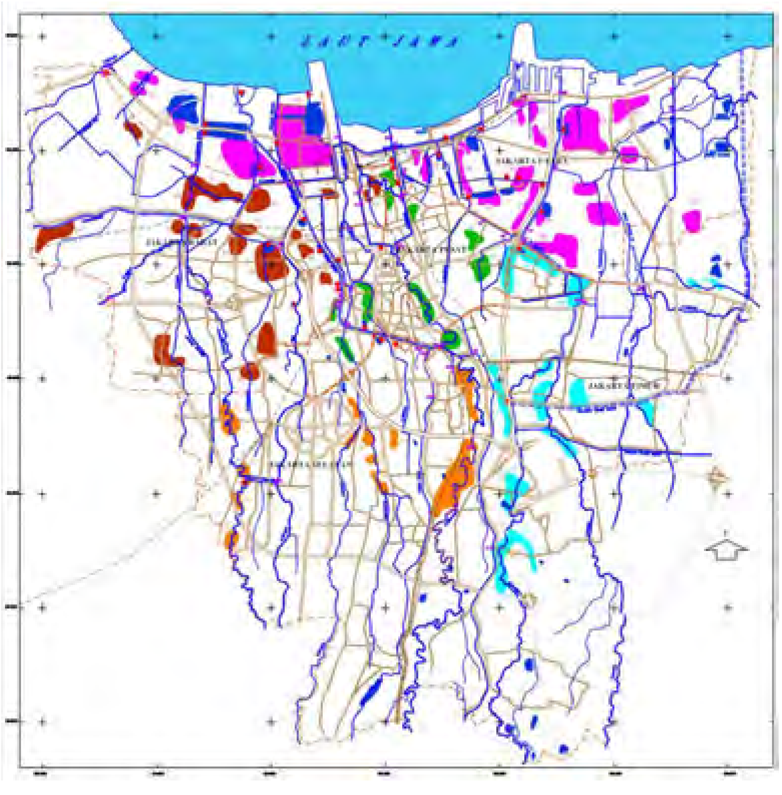


Figure- 2.2.1 Inundated Area in DKI Jakarta (Flood in 2002)

Source: DKI Jakarta

Figure- 2.2.2 shows hyetograph and hydrograph at the observation points of Katu Lampa, Depok, and Manggarai in Ciliwung River. The water level at Manggarai reached maximum 10.5m which was 1.0m higher than bank-full stage of 9.5m at 1:00 AM on 2nd February, and the excess of bank-full stage lasted every other day for about three and a half days in total: from 11:00 AM on 28th January to 2:00 PM on 29th January , from 10:00 AM on 30th January to 2:00 PM on 31th January , and from 0:00 PM on 1st February to 4:00 PM on 2nd February.

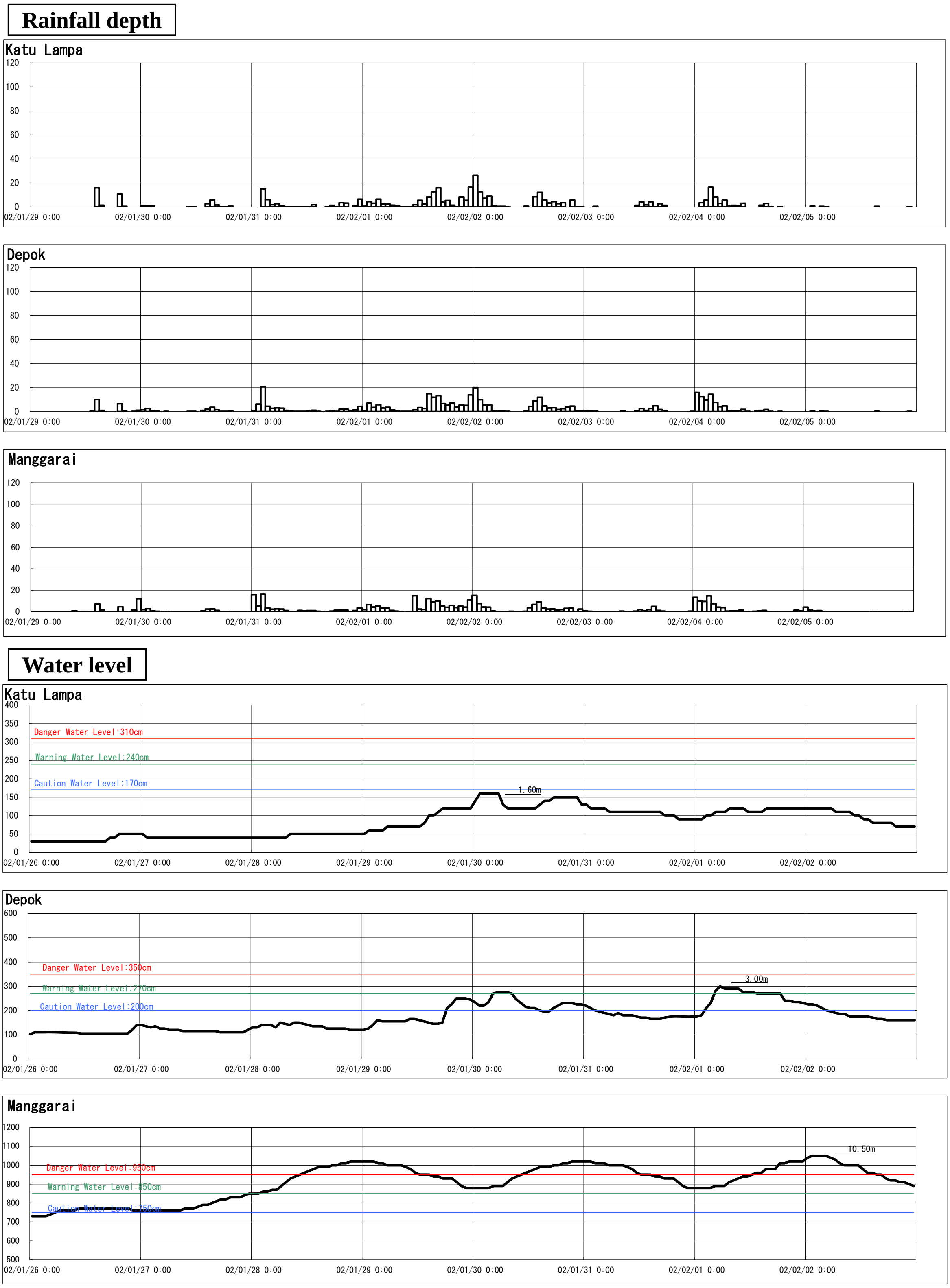


Figure- 2.2.2 Hyetograph and Hydrograph (Flood in Feb. 2002)

2.2.2 Flood in 2007

In 2007, DKI Jakarta severely suffered from flood due to the rainfall from 30th January to 7th February. Inundated area reached 300km^2 accounting for about 45 percent of the whole area as shown in Figure- 2.2.3. Figure- 2.2.4 shows the situation of flood damage in February 2007.

Figure- 2.2.5 illustrates hyetograph and hydrograph at the observation points of Katu Lampa, Depok, and Manggarai in Ciliwung River. The water level at Manggarai reached 10.61m at maximum height which was 1.11m higher than bank-full stage of 9.5m at 6:00 AM on 4th February, and the excess of bank-full stage lasted for about one and a half days: from 3:00 AM on 4th February to 2:00 PM on 5th February.

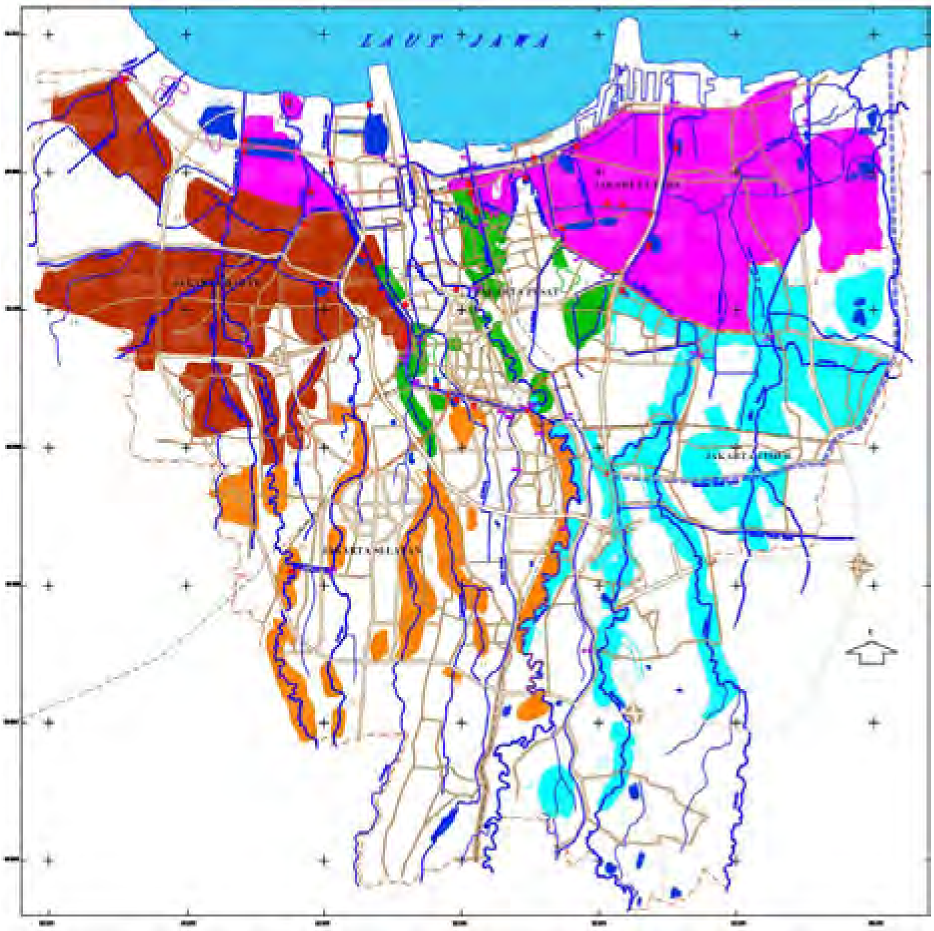


Figure- 2.2.3 Inundated Area in DKI Jakarta (Flood in 2007)

Source: DKI Jakarta

Banjir Kanal Barat (04 Feb 2007)

Banjir Kanal Barat Undepass from Top to Downstream (04 Feb 2007)

Figure- 2.2.4 Situation of Flood Damage (Flood in February 2007)

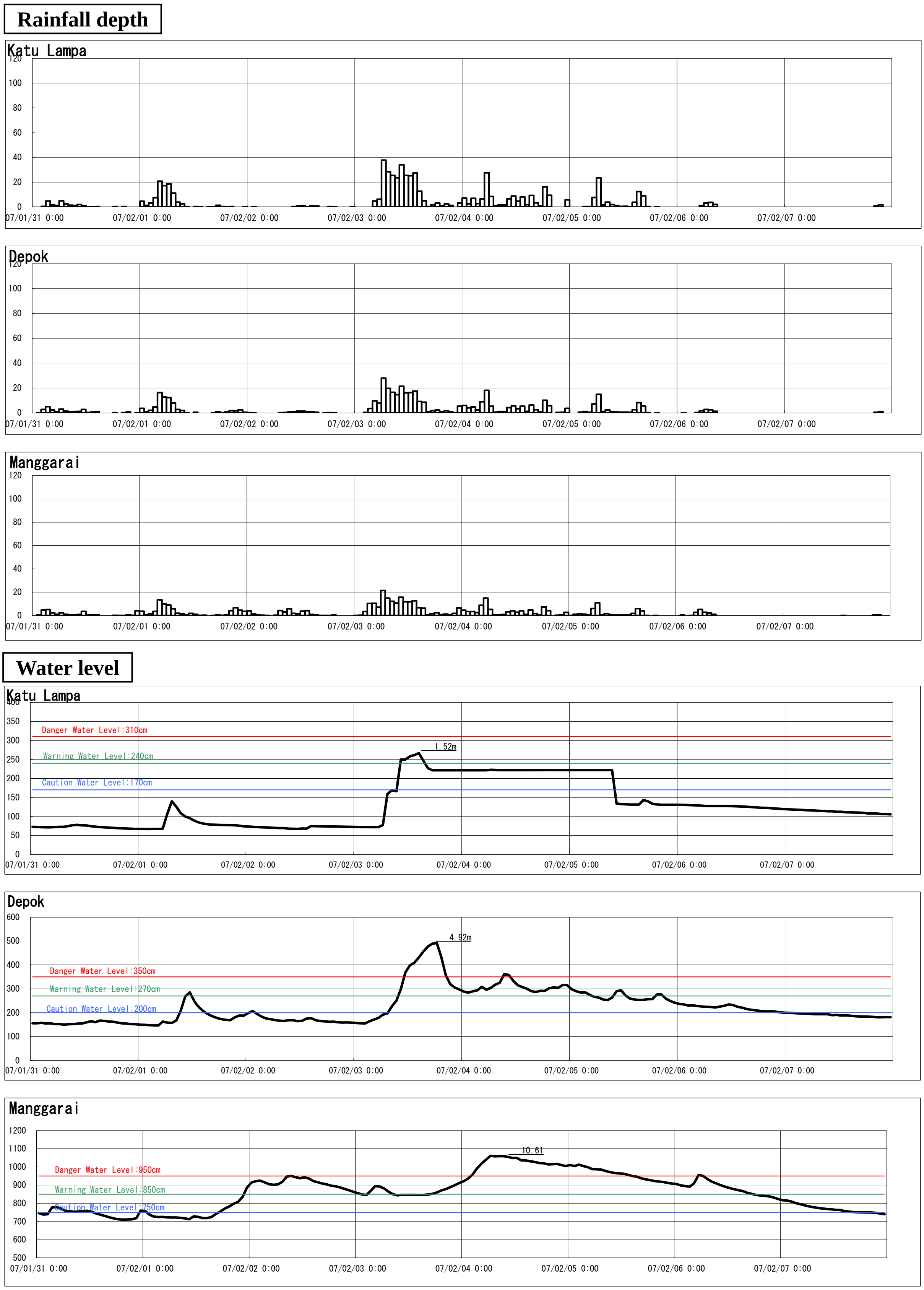


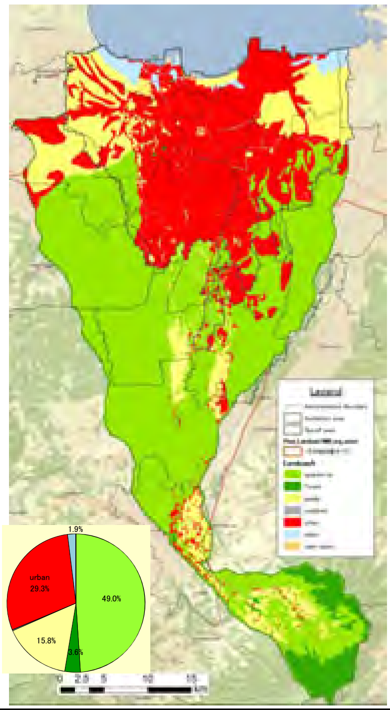
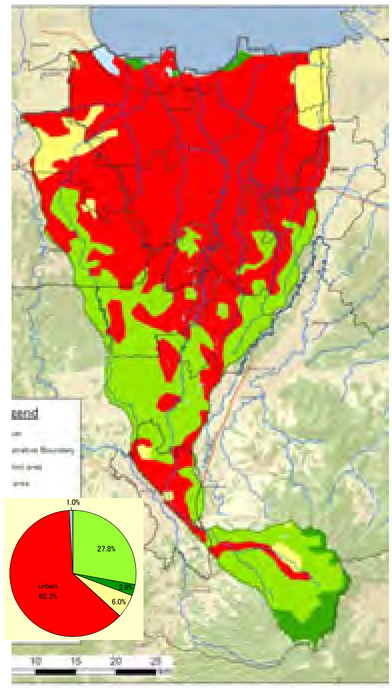
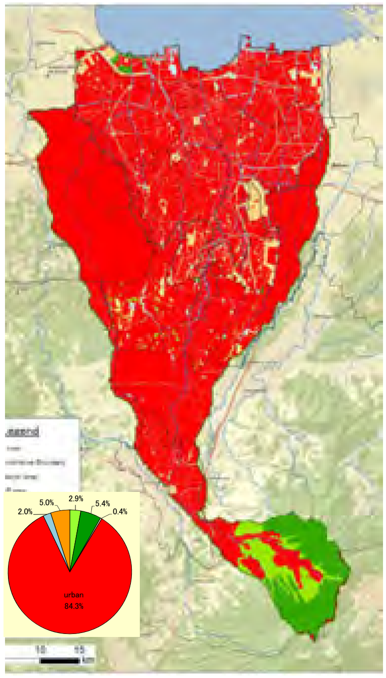
Figure- 2.2.5 Hyetograph and Hydrograph (Flood in February 2007)

Source: JICA Study Team

2.3 Land Use Change

In the basin of rivers flowing down in DKI Jakarta, land development has reached to the upper and middle stream areas owing to the accelerating concentration of population and industries, and then it results in the increase of water discharge. The relation between outflow quantity of inundation and transitions of land use in the Basin of Ciliwung River, which flows down in the central area of Jakarta, is presented in Figure- 2.3.1. Such progress of land development can also be observed in the other river basin.

- Urbanization ratio of the target river basin rose from 29.3 percent in the 1980's to 62.3 percent in 2008, and is expected to reach 84.3 percent in 2030.
- Runoff coefficient in 2008 is predicted to increase from f=0.74 to 0.79 in 2030 according to the increase of urbanization ratio, and as a result, the total amount of outflow of flood is expected to increase by approximately 10 percent in 2030. It is attributed to reduction in the infiltration area of river basin due to the land development.

1980s Urbanization Rate: 29.3% Discharge Rate: f=0.69	2008 Urbanization Rate: 62.3% Discharge Rate: f=0.74	Future Forecast (2030) Urbanization Rate: 84.3% Discharge Rate: f=0.79

Figure- 2.3.1 Land Use Transition of the Target River Basin

Source: JICA Study Team

2.4 Condition of Climate Change

2.4.1 Increase of Rainfall

In recent years, changes in annual rainfall patterns probably caused by global warming have become conspicuous, and it is forecasted that climate change risks such as prolonged dry seasons, decrease in rainfall volume, and increase in concentrated downpours would be higher in the future. It is concerned that escalation in scale and frequency of disasters derived from future climate change will trigger economic and social losses such as the stagnation of economic activities and increasing poverty, etc., and it would be a critical risk factor for sustainable development of the country.
In Jakarta Metropolitan area, Figure- 2.4.1 indicates that the average annual maximum rainfall increases by 1~9 percent by rainfall duration compared 1989-1998 to 1999-2008.

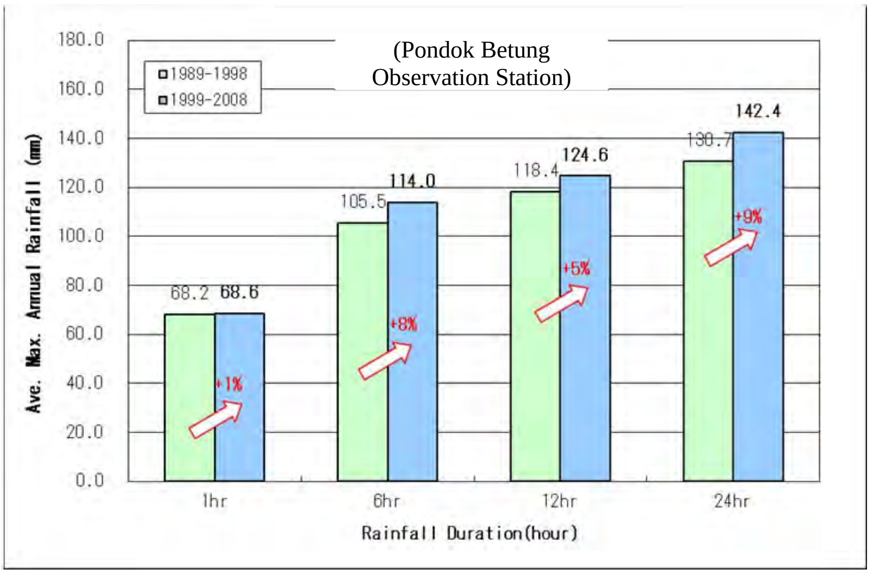


Figure- 2.4.1 Trend Comparison of Maximum Annual Rainfall

Source: JICA Study Team

2.4.2 Sea Level Rise

According to the official release by the Ministry of Environment of Indonesia, sea level at Jakarta Bay is increasing at a rate of 7mm per year. As a result, it is predicted that existing tide gates located in low land areas would be forced to be permanently closed and dysfunctional due to sea level rise.

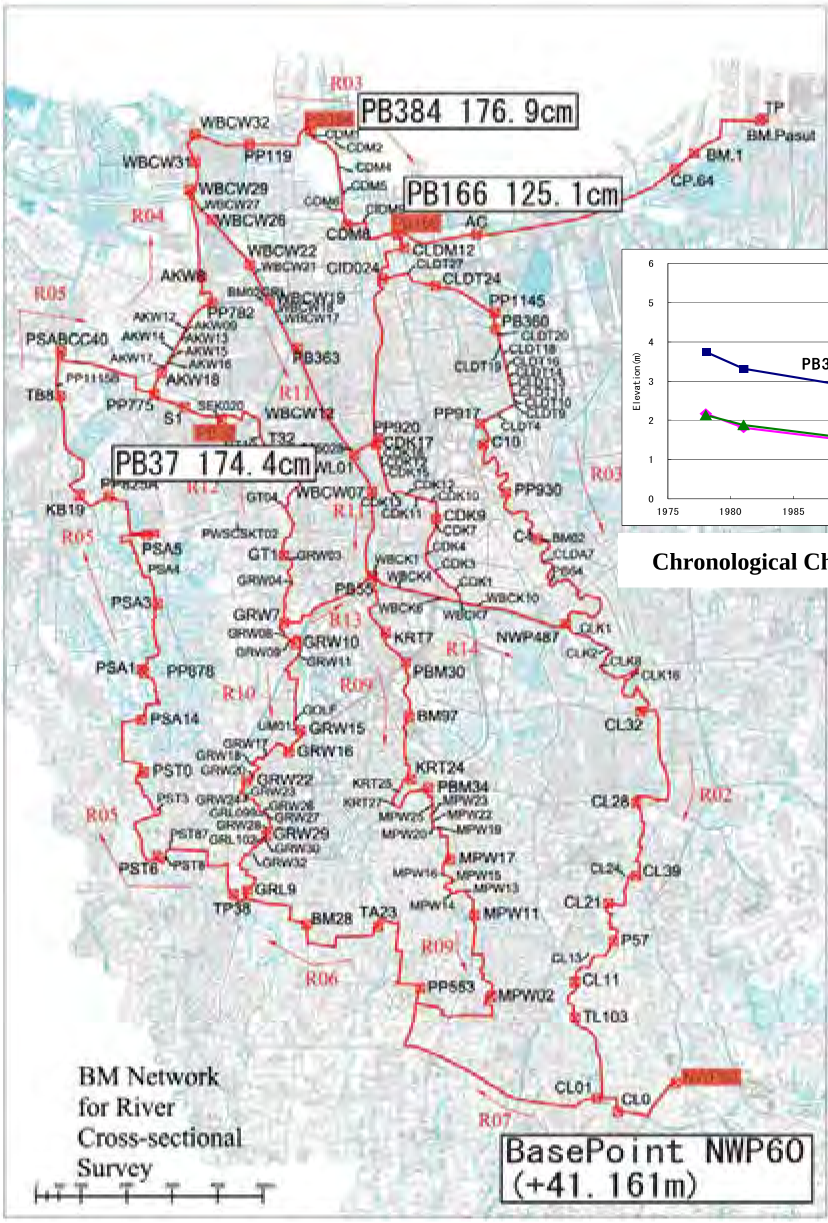
Figure- 2.4.2 Trend of Sea Level Rise in Indonesia

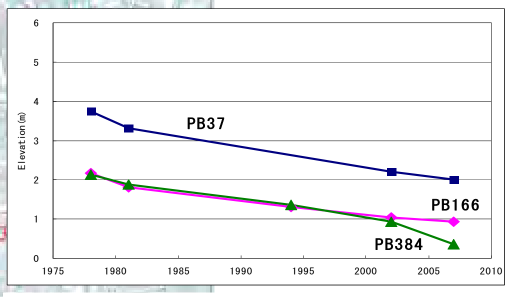
Source: The Economics of Climate Change in Southeast Asia: A Regional Review April 2009 ADB

2.5 Condition of Land Subsidence

The Ciliwung-Cisadane river basin is experiencing extensive land subsidence according to the development of JABODETABEK area in downstream areas (the northern metropolitan areas of Jakarta). The main factors behind this phenomenon are supposedly excessive extraction of groundwater in urbanized areas and the decrease of the volume of groundwater recharge owing to the residential development of the southern part of the metropolitan area. According to the result of observations since 1978, maximum 177 cm of subsidence has already proved as shown in Figure- 2.5.1. The subsiding area expands to approximately 20 km inland from the coast, and the subsidence doesn't appear to be ceasing judging from the trend of yearly changes.

Under these circumstances, Pluit in the north of the metropolitan area experienced dike break and inundation by high tide in May 2008. The dike was originally designed with height of +2.1m, but it had been lowering to +1.35m~+1.55m due to land subsidence. Accordingly, due to the combination of extensively progressing land subsidence and sea level rise caused by climate change, potential flood areas in the lower reaches of the Ciliwung River are expanding and the damages caused by high tide and floods have become more critical.





Chronological Change in Land Subsidence

Figure- 2.5.1 Land Subsidence in Jakarta

Source: JICA Study Team

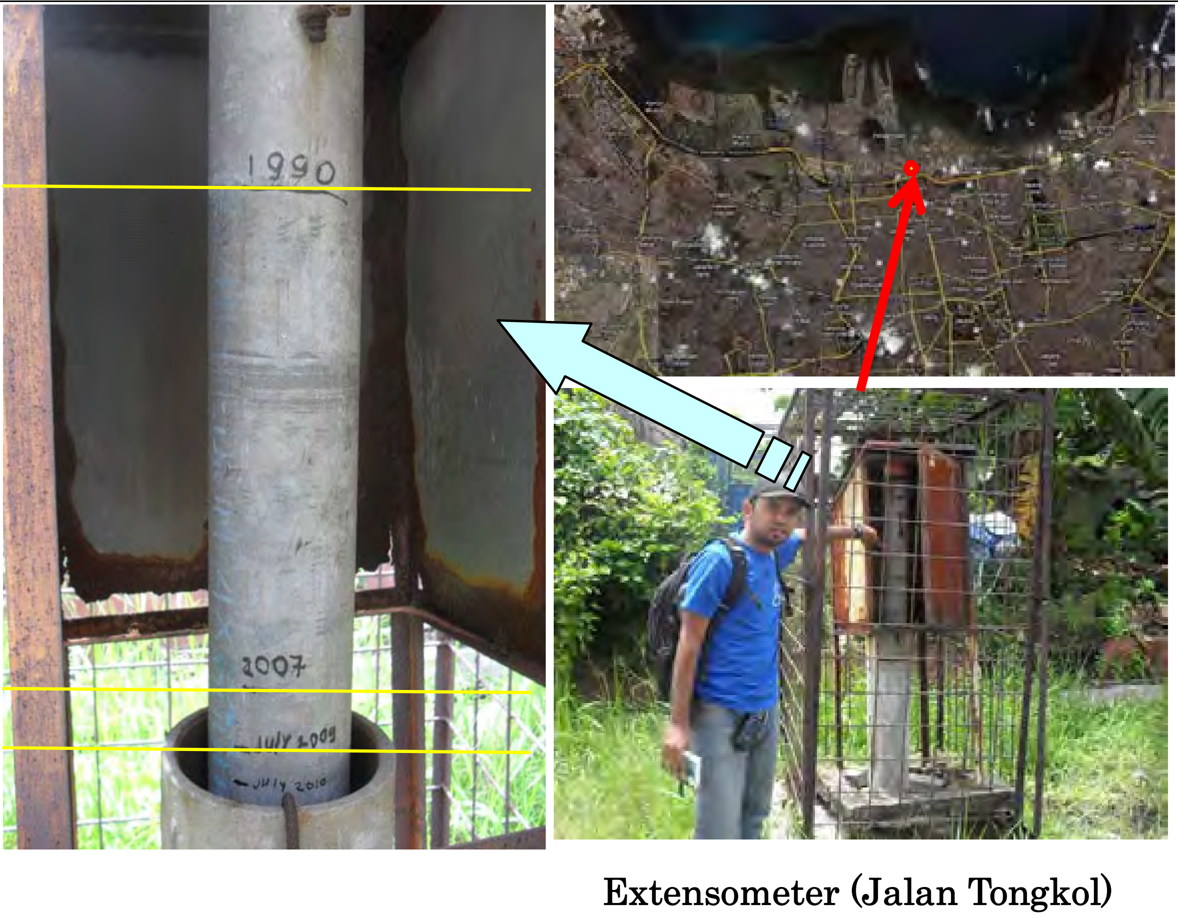
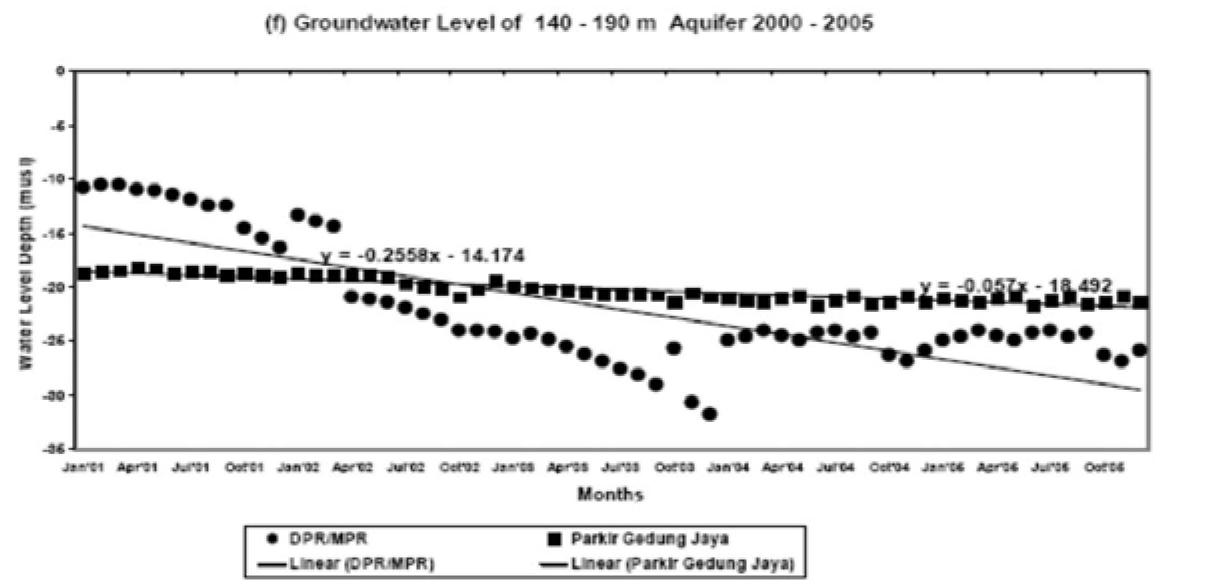


Figure- 2.5.2 Current Status of Groundwater Pumping and Land Subsidence in JABODETABEK

In JABODETABEK, since water demand is remarkably increasing along with population growth and development of industrial sectors, groundwater has been excessively extracted in the whole coastal area where quality groundwater can be obtained.

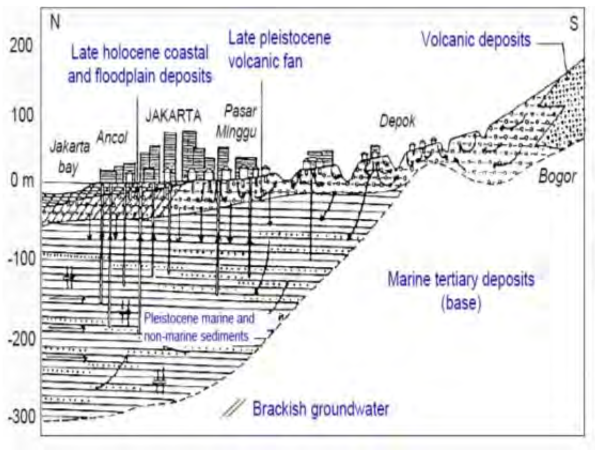
Meanwhile, quality of tap water is improving but penetration rate of water is only around 50 percent and residents without water supply are depending on water from primitive wells or water sellers. So demand for water of both shallow and deep wells remains high, and interfusion of seawater is occurring due to lowering of hydraulic head between seawater and groundwater. Excessive extraction of groundwater results in the progress of ground consolidation and subsidence of surrounding soil.

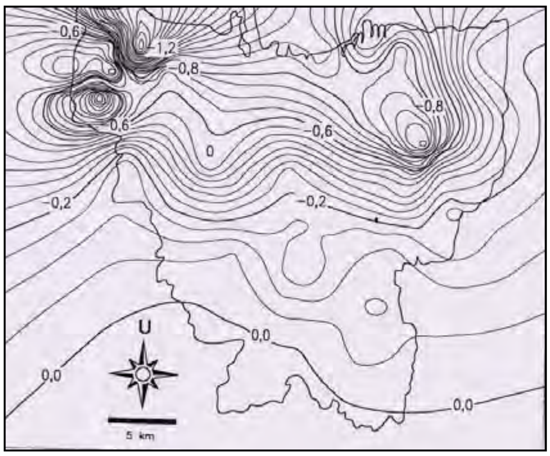
According to the observation wells in Jakarta, groundwater level in JABODETABEK is generally included in 6 aquifers, ①0-20m, ②20m-40m, ③40-95m, ④95-140m, ⑤140-190m, ⑥190-250m, however, drawdown is occurred in all aquifers. ① belongs to alluvium and ②-⑥ belong to diluvium. Figure- 2.5.3 shows changes in water level of 140-190m aquifer observed from 2000 to 2005.



Source: Research Centre for Geotechnology, Indonesian Institute of Sciences (LIPI)

Figure- 2.5.3 Changes of Water Level at 140–190m Aquifer (2000–2005)





Schematic Hydro-Geological Cross Section of Jakarta	Status of Land Subsidence (Observed by Leveling, 1982‑1997)

Figure- 2.5.4 Land Subsidence in JABODETABEK

Source: Hasanuddin Z. Abidin, 2001

Judging from current usage situation of groundwater and coverage of water supply, drawing groundwater from alluvium and diluvium will be keeping on and extensive land subsidence caused by consolidation settlement is considered to be advanced.

2.6 Flood Disaster Risks in Jakarta

Major factors which cause flooding in Jakarta are as follows: (1)Land subsidence, (2)Urbanization, (3)Sea water level rise due to climate change, (4)Increasing rainfall due to climate change. Discharge volume, land subsidence, and sea water level rise in 2050 can be estimated as shown in Figure- 2.6.1 based on the consideration of the factors above. It is concerned that flood damage in Jakarta would be worse in 2050 due to simultaneous negative effects of those factors.

- Discharge volume is estimated to increase by 10~20 percent due to the progress of urbanization (estimated to increase discharge volume by approximately 10 percent) and rainfall increase derived from climate change (estimated to increase discharge volume by approximately 10 percent) in 2050.

- The amount of land subsidence is estimated at 4.0m in 2050, if the land constantly subsides 10cm per a year for 40 years.
- Sea level is to rise by 40cm in 2050, if the sea level rises 1cm per a year for 40 years.

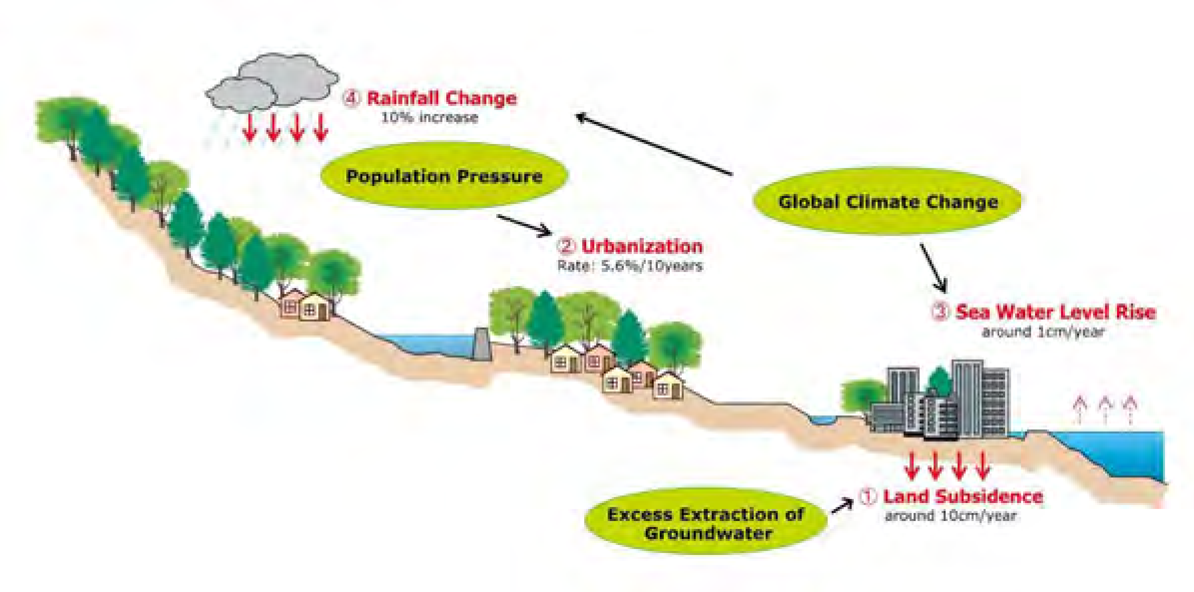


Figure- 2.6.1 Image of Flood Risk

The factors described above and general countermeasures against them are shown in Table- 2.6.1.

Table- 2.6.1 Factor of Flood and Countermeasures

Risks and Main Causes	Hard Counter-Measures
①Land Subsidence ● At Coastal Plain ● Around 10cm/year *Due to:* ■ Excess Extraction of Groundwater	✧ **Reduction or Prohibition on Groundwater Extraction** at Coastal Plain *(Water Use Conversion from Groundwater to Surface Water)* ✓ New Development of Surface Water by Dam, etc. ✓ Use of Reclaimed Waste Water ✧ **Coastal Dikes** ✧ **Drainage Pump Stations**
②Urbanization ● Increase Rate: 5.6% by 10years ● Runoff Rate: 0.74 → 0.79 *Due to:* ■ Population Pressure or Explosion	✧ **ΔQ=Zero by Infiltration and Storage Regulation** at the New Development Areas ✧ **River Course Improvement** at the downstream course of the New Development Area
③Sea Water Level Rise ● 0.7cm/year *Due to:* ■ Global Climate Change	✧ **Coastal Dikes** ✧ **Drainage Pump Stations**
④Rainfall Change ● Increase of Rainfall in Volume, Intensity and Frequency *Due to:* ■ Global Climate Change	✧ **River Course Improvement by** ✓ River Dikes ✓ Short-cut and etc. ✧ **Diversion Channel** ✓ To Cisadane River ✓ To East Flood Canal ✧ **Flood Control by Reservoir** ✓ Multi-purpose Dam ✓ Small-scale Dams

2.7 Socio-Economic Condition

2.7.1 Administration/Role and Function of DKI Jakarta

The provincial Government of Special Regional Capital of Jakarta which is then called DKI Jakarta Special Province (DKI Jakarta) has 662.33 km^2 of land area. In the Northern part, there is a coastal area which extends about 35 km from west to east. This shore is a place which 13 main rivers and 2 canals run into (Jakarta in Figures 2010).

DKI Jakarta is divided administratively into five municipalities (Kota) and one regency (Kabupaten)[1]. They are Kota Jakarta Selatan (South Jakarta), Kota Jakarta Timur (East Jakarta), Kota Jakarta Pusat (Central Jakarta), Kota Jakarta Barat (West Jakarta), Kota Jakarta Utara (North Jakarta) and Kepulauan Seribu (Seribu Islands). These municipalities and the regency have 44 districts (Kecamatan) and 267 villages (Kelurahan) in total.

The roles and functions of DKI Jakarta are summarized as follows (RTRW DKI Jakarta 2030):

- Capital of the nation
- Economic center
- Center for business and trade
- Main gate of Indonesia
- City tourism and socio-culture
- Core city in JABODETABEK[2] area

Figure- 2.7.1 Map of DKI Jakarta

(Source: Jakarta in Figures 2010)

2.7.2 Population and Households

The total population of DKI Jakarta has grown from 8,361 thousand in 2000 to 9,588 thousand in 2010. This translates to an average increase of approximately 1.39 percent per year (1.12 percent from 2000 to 2005, 1.63 percent from 2005 to 2010). The average population density of DKI Jakarta in 2010 was 145 persons per hectares with a range of 112 persons in Jakarta Utara to 187 persons in Jakarta Pusat.

The number of households has also increased from 2,232 thousand in 2000 to 2,548 thousand in 2010. The average increase rate of households from 2000 to 2010 was estimated at approximately 1.33 percent per year.

Some details are presented in Table- 2.7.1 and Table- 2.7.2.

Table- 2.7.1 Population and Households of DKI Jakarta, 2005-2010

	2000	2005	2010
Population (Thousand)	8,361.1	8,842.3	9,588.2
Average Growth Rate Per Year (%)	-	1.12	1.63
Population Density Per Hectare	126	134	145
Households (Thousand)	2,232.1	-	2,548.2
Household Density per Hectare	34	-	38
Average Household Member	3.76	-	3.76
Land Area (Hectare)	66,233	66,233	66,233

Source: Based on Statistical Yearbook of Indonesia 2010

[1] Municipality (Kota) is an administrative division which is set in urban area, and regency (Kabupaten) is the same in rural area. Both are at the same level on the administrative system in Indonesia.

[2] JABODETABEK is the area of DKI Jakarta and parts of the provinces of West Java and Banten, specifically the three regencies of those provinces which surround Jakarta-Bekasi and Bogor in West Java, and Tangerang in Banten, also included are the independent municipalities of Bogor, Depok, Bekasi, Tangerang and South Tangerang.

Table- 2.7.2 Land Area, Population and Population Density by Regency/Municipality, 2010

Regency/ Municipality	Population (Thousand)			Area (hectare)	Population Density (Person/Ha)
	Male	Female	Total		
Kep. Seribu	10,695	10,376	21,071	870	24
Jakarta Selatan	1,039,677	1,017,403	2,057,080	14,127	145
Jakarta Timur	1,368,857	1,318,170	2,687,027	18,803	143
Jakarta Pusat	453,505	445,378	898,883	4,814	187
Jakarta Barat	1,162,379	1,116,446	2,278,825	12,954	176
Jakarta Utara	824,159	821,153	1,645,312	14,666	112
DKI Jakarta	4,859,272	4,728,926	9,588,198	66,233	145

Source: Based on Results of Population Census 2010

According to RTRW DKI Jakarta 2030, the population of Jakarta in 2030 is expected to increase to 12.5 million. This projection is based on the past trend of population growth for the period from 1943 to 2005 and the result of population census in 2010.

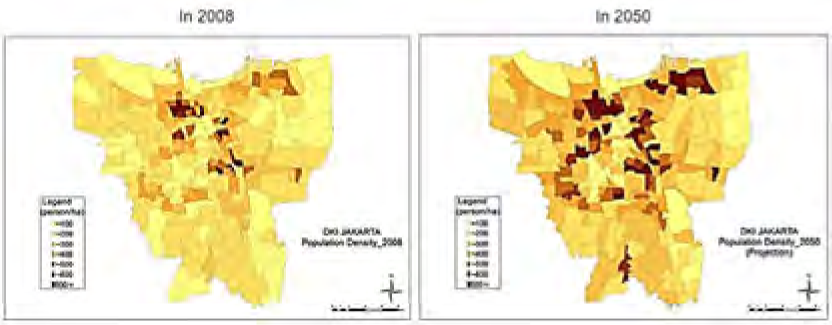


Figure- 2.7.2 Population Density of DKI Jakarta in 2008 and 2050

If population in Jakarta further increases up to 2050 as high as ever or even at a half of the recent increase rates, it is likely to increase in a range of approximately 14 – 16 million by 2050 (estimation by JICA Study Team).

This implies that an average population density of Jakarta in 2050 is expected to be more than 200 persons per hectares which is set as estimated population density in the RTRW DKI Jakarta 2030 for the most part of the city as shown in Figure- 2.7.2. Thus, Jakarta may not have enough land to accommodate such increasing population with the existing settlement and housing pattern. Therefore, the RTRW DKI Jakarta 2030 strongly suggests the optimization of urban land use taking into account a proper settlement and housing development.

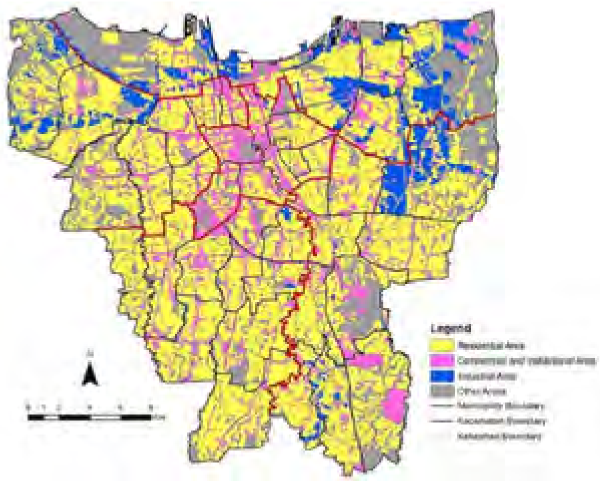
2.7.3 Land Use Condition

As presented in Table- 2.7.3, in 2007, most of the land in Jakarta is used for housing and settlement, commercial and industrial purposes. As shown in Figure- 2.7.3, it is distinguished in Jakarta that manufacturing activities are mostly occurred in Jakarta Utara and Jakarta Timur, while business and office administration are widely developed in Jakarta Barat, Jakarta Pusat and Jakarta Selatan (Jakarta in Figures 2010).

Table- 2.7.3 Land Use in DKI Jakarta, 2007

Land Use	Hectares	Percentage
Residential Use	34,360.0	53.4
Commercial and Business Use	10,533.6	16.4
Industrial Use	4,670.8	7.3
Others Uses	14,727.8	22.9
Total	64,292.1	100.0

Source: The Project for Capacity Development of Wastewater Sector through Reviewing the Wastewater Management Master Plan in DKI Jakarta



Source: The Project for Capacity Development of Wastewater Sector through Reviewing the Wastewater Management Master Plan in DKI Jakarta

Figure- 2.7.3 Land Use Pattern in DKI Jakarta, 2007

2.7.4 Economic Factor

(1) Economic Growth

In the period of 1997-1999, the economic crisis resulted in an economic decrease of 2.9 percent per year. In the period of 2000-2004, also known as the period of economic recovery, the Indonesian economy again had a positive growth of 4.5 percent (The National Medium-Term Development Plan, RPJMN 2010-2014, Achievement of National Development in 2004-2009).

The overall trend of GDP annual growth in Indonesia has been still steadily positive over the years since 2005. According to the Statistical Yearbook of Indonesia 2010, the average growth rate in the period of 2006-2009 reached approximately 5.6 percent per year.

As given in Table- 2.7.4, the average growth rate of DKI Jakarta from 2006 to 2009 has grown by 5.8 percent per year which is a little bit higher compared to the national average.

Table- 2.7.4 GRDP and GRDP Growth Rate of DKI Jakarta at 2000 Constant Prices, 2006-2009

	2006	2007	2008	2009
GRDP (Billion Rp)	312,827	332,971	353,694	371,399
Per Capita GRDP (Million Rp)	34,837	36,733	38,671	40,268
Growth Rate of GRDP (%)	5.95	6.44	6.22	5.01
Growth Rate Pere Capita GRDP (%)	4.93	5.44	5.28	4.13

Source: BPS-Statistics Provinsi DKI Jakarta 2010/Statistical Yearbook of Indonesia 2010

(2) Economic Structure by Industrial Origin

Figure- 2.7.4 shows the real GRDP by main industrial origin in 2009. Financial sector was the largest contribution in the formation of GRDP in 2009 (29.4 percent), followed by trade/hotel/restaurant sector (21.7 percent) and manufacturing sector (16.5 percent). On the lower end sectors were agriculture (0.1 percent), mining/quarrying (0.3 percent), and electricity/gas/water supply (0.7 percent). The growth rates by main industry from 2006 to 2009 are shown in Figure- 2.7.5.

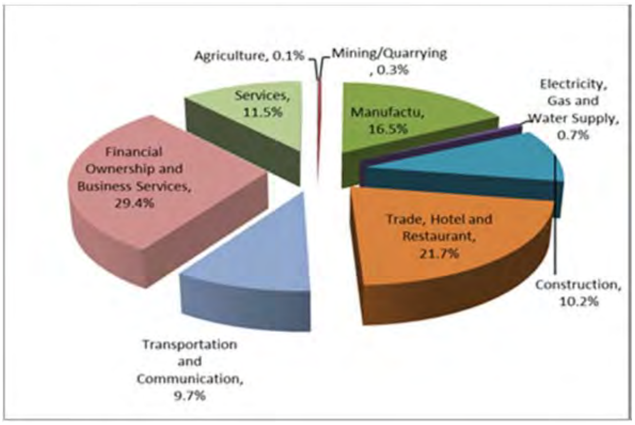


Figure- 2.7.4 GRDP (Real) by Main Industrial Sector of DKI Jakarta, 2009

Source: BPS-Statistics Provinsi DKI Jakarta

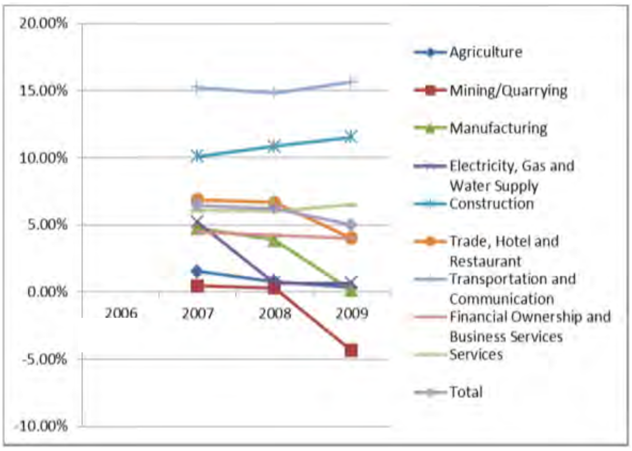


Figure- 2.7.5 Growth Rate of GRDP (Real) by Main Industrial Sector of DKI Jakarta, 2007-2009

Source: BPS Statistics Provinsi DKI Jakarta 2010

(3) GRDP by Municipality

The structure of GRDP by municipality of DKI Jakarta has always remained almost the same in the period 2006 to 2009. For instance, as shown in Figure- 2.7.6, GRDP by regency/municipality in 2009, Jakarta Pusat had the highest contribution of 26 percent of the total GRDP, followed by Jakarta Selatan (23 percent), Jakarta Utara (19 percent), Jakarta Timur (17 percent) and Jakarta Barat (15 percent). The least contributing was Jakarta Barat (15 percent) except Kep. Seribu (less than 1 percent).

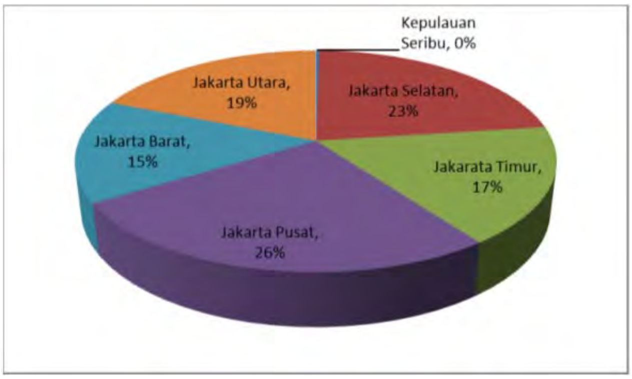


Figure- 2.7.6 GRDP (Real) by Regency/Municipality of DKI Jakarta, 2009

Source: BPS- Statistics Provinsi DKI Jakarta 2010

(4) Employment Status

Provincial employment status by regency/municipality is given in Table- 2.7.5. In 2009, approximately 4,688 thousand people or 49 percent of the population were economically active. Approximately 4,188 thousand people or 88 percent of the total economically active were employed. The rest 569 thousand people or 12 percent of the total economically active were not employed.

As shown in Figure- 2.7.7, in 2009, approximately 37 percent of the employed worked in trade/hotel/restaurant sector. It was followed by services sector (24 percent), manufacturing sector (16 percent) and transportation/communication sector (10 percent).

Table- 2.7.5 Employment Situation by Regency/Municipality of DKI Jakarta, 2009

Regency/ Municipality	Total Population (Thousand)	Economically Active Population (Thousand)	Employment Status of Economically Active Population (Thousand)		
			Employed	Unemployed	
				Number	percent
Kep. Seribu	21.1	8.4	7.4	1.0	11.9
Jakarta Selatan	2,057.1	1,089.5	961.9	127.6	11.7
Jakarta Timur	2,687.0	1,200.6	1,025.1	175.5	14.6
Jakarta Pusat	898.9	480.7	421.1	59.5	12.4
Jakarta Barat	2,278.8	1,129.4	1,020.3	109.1	9.7
Jakarta Utara	1,645.3	779.1	682.6	96.6	12.4
DKI Jakarta	9,588.2	4,687.8	4,118.4	569.3	12.1

Source: Based on August 2009 National Labor Survey

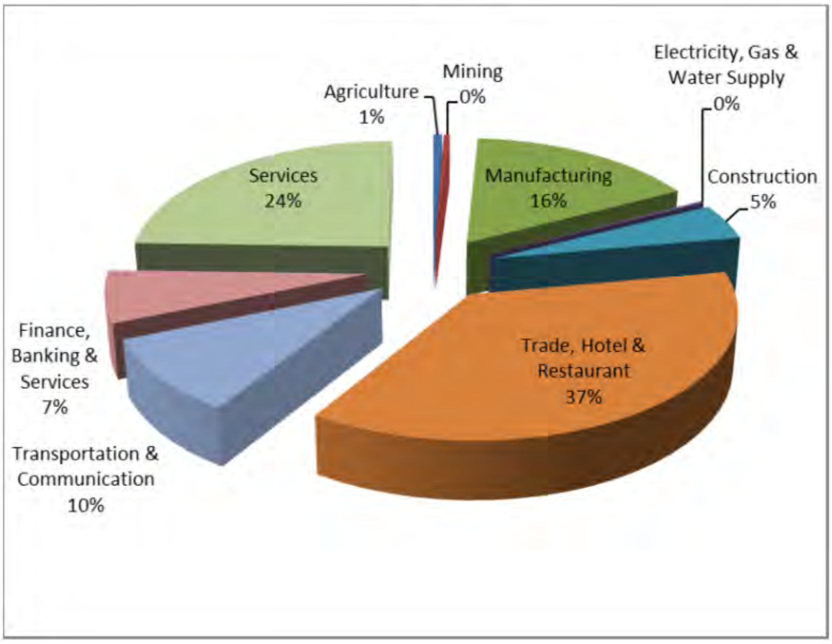


Figure- 2.7.7 Population of Economically Active by Main Activities, 2009

Source: Based on August 2009 National Labor Survey

(5) Future Economic Growth (National Overview)

The 2010-2014 National Medium-Term Development Plan (RPJMN 2010-2014)[3] reveals the economic prospect in 2010-2014 as follows:

In the period of 2010 – 2014, Indonesian economy is expected to gradually grow from 5.5-5.6 percent in 2010 to 7.0-7.7 percent in 2014, at the average growth rate of 6.3-6.8 percent per year over the next five years.

[3] The second phase of implementation of the 2005-2015 National Long-Term Development Plan (RPJPN 2005-2015)

2.8 Infrastructure Condition

2.8.1 Road Network

In Indonesia, statistics on roads are categorized into toll road, state road, provincial road and municipality road in terms of the status of road. Toll roads of approximately 112km length in Jakarta are operated by PT. Jasa Marga and other private companies. State, provincial, and municipal roads are constructed and maintained by the national, provincial and municipal government respectively. Most of municipal road are small streets which have about 5 meters width on the average.

Figure- 2.8.1 Transportation in DKI Jakarta (taken by the Study team)

The main transportation modes for the people in Jakarta and its suburbs are road transportation such as private cars and buses, and rail transportation. Traffic volume which exceeds the capacity of road infrastructure as a direct factor and concentration of economic activities in Jakarta and its surrounding municipalities (JABODETABEK) as an indirect factor result in serious traffic congestion problems on several main roads and critical crossings, particularly in the central business districts and causes adverse effects on regional economy.

Under these circumstances, the improvement of road network has been undertaken by the national and local governments responsible for road infrastructure. However, it does not catch up with rapid increase in number of vehicles.

Table- 2.8.1 presents data on length and area of road by type of road in Jakarta. The same is shown on the map (see Figure- 2.8.2).

Table- 2.8.1 Length and Area of Road by Municipality and Type of Road, 2009

	Toll Road	State Road	Provincial Road	Municipal Road	Total
A. Road Length (m)					
Jakarta Selatan	21,884	65,940	299,632	1,506,269	1,893,725
Jakarta Timur	37,222	31,458	323,950	1,248,765	1,641,395
Jakarta Pusat	6,380	13,810	244,627	614,860	879,677
Jakarta Barat	12,882	29,075	242774	1,194,495	1,479,226
Jakarta Utara	34,592	29,440	193,398	1,057,084	1,314,514
Total	112,960	169,723	1,304,381	5,621,473	7,208,537
B. Road Area (m^2)					
Jakarta Selatan	430,512	1,039,888	3.323,377	10,043,964	14,837,741
Jakarta Timur	997,736	694,468	3,706,307	6,086,419	11,484,930
Jakarta Pusat	114,840	343,014	3,759,535	4,029,110	8,246,499
Jakarta Barat	231,876	464,404	2,322,070	5,674,992	8,693,342
Jakarta Utara	697,716	520,720	1,976,614	4,890,432	8,085,482
Total	2,472,680	3,062,494	15,087,903	30,724,917	51,347,994

Source: Sub Dinas Bina Program, Dinas Pekerjaan Umum Provinsi DKI Jakarta

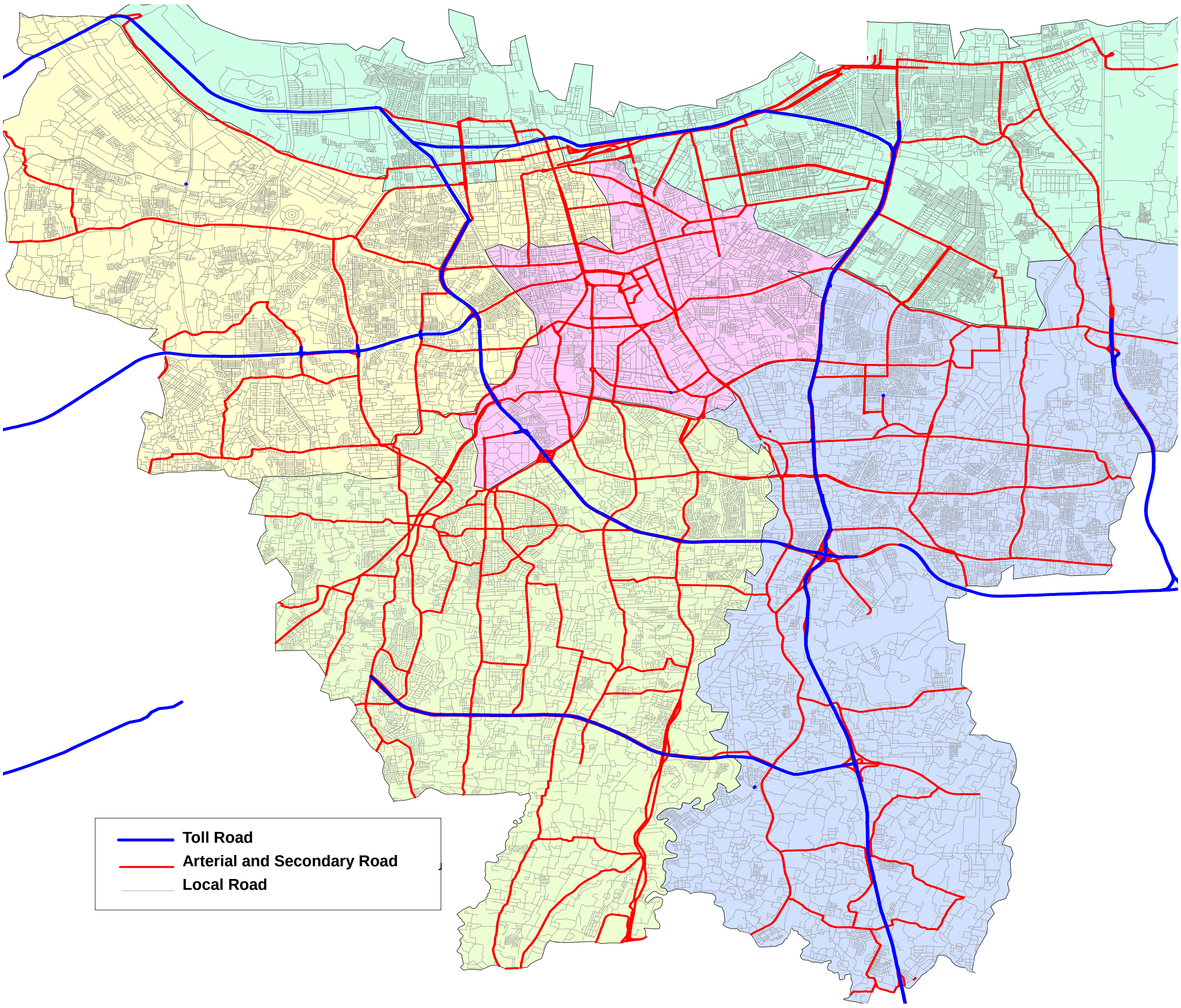


Figure- 2.8.2 Road Network in Jakarta

2.8.2 Railway Network

KRL Jabodetabek has the responsibility for rail commuter services in JABODETABEK. Nowadays, the commuter railway network in JABODETABEK comprises approximately 160km of electric double lane track. The number of commuter railways in the period of 2005-2009 is given in Table-2.8.2. In view of passengers' destinations, approximately 130 million passenger or 83 percent of the total passengers were the inter-provincial passengers within JABODETABEK in 2009.

Table- 2.8.2 Number of Railway Passengers by Region of Destination, 2009

Year	Outside Jakarta	JABODETABEK	Inside Jakarta	Total
2009	9,115,987	130,632,466	17,318,336	157,066,789
2008	8,447,704	126,699,747	16,356,631	151,504,082
2007	6,897,517	118,094,971	12,679,019	137,671,507
2006	7,676,839	104,579,720	10,931,711	123,188,270
2005	7,582,946	100,960,700	7,690,889	116,234,535

Source: PT. KAI Cabang Jakarta

2.8.3 Bus Way Network

Rapid bus services with two-lane road dedicated for exclusive public and mass transportation service that runs over the principal trunk roads in Jakarta are managed and operated by PT. Trans Jakarta. As shown in Table- 2.8.3, the number of passengers has increased year by year and reached approximately 82 million passengers a year or more than 200 thousand passengers a day on the average by 2009.

Table- 2.8.3 Number of Buses and Passengers by Bus Ways in DKI Jakarta, 2009

Corridor	Routes	Bus	Passenger
Koridor I	Blok M - Kota	91	25,383,722
Koridor II	Pulo Gadung - Harmoni	55	10,749,327
Koridor III	Harmoni - Kalideres	71	11,026,266
Koridor IV	Pulo Gadung – Dukuh Atas	48	7,303,215
Koridor V	Kp. Melayu - Ancol	23	10,505,953
Koridor VI	Ragunan - Kuningan	53	7,573,273
Koridor VII	Kp. Rambutan – Kp. Melayu	85	5,601,468
Koridor VIII	Lebak Bulus - Harmoni	30	4,234,446
	Total	456	82,377,446

Source: PT. Trans Trans Jakarta

2.8.4 Electricity

Electricity in DKI Jakarta is largely supplied by PT. PLN (Electricity State Enterprise). Electricity need is increasing every year (Jakarta in Figures 2010). The total amount of electricity sold/distributed to customers in Jakarta and Tangerang region in 2009 was 30.39 Billion Kwh as shown in Table- 2.8.4.

The number of PLN customers has also steadily increased in line with the increasing demand for electricity. The total number of customer in 2009 was 3,572 thousand. By customers' composition, the largest group was household category which was 3,246 thousand accounting for about 91 percent of the total customers as shown in Table- 2.8.5.

Table- 2.8.4 Number of Electricity Sold (Thousand kWh) by Branch Office, 2009

Tariff Classification	Gambir	Priok	Jatinegara	Kebayoran	Kramat Jati	Tangerang	Total
Social	331,730	58,847	71,643	188,547	107,750	102,404	860,924
Household	1,963,499	951,371	1,179,230	2,688,122	1,730,185	2,179,079	10,691,489
Business	4,056,042	615,281	540,955	2,180,930	667,506	1,175,097	9,235,815
Manufacture	493,945	1,756,325	913,597	95,558	282,417	4,630,825	8,172,669
Offices	551,174	63,635	85,680	257,930	171,310	136,375	1,266,106
Others	60,041	11,875	11,026	22,121	15,909	39,639	160,614
Total	7,456,434	3,457,337	2,802,133	5,433,211	2,975,079	8,263,422	30,386,619

Source: PT. PLN (Persero) Distribusi DKI Jakarta dan Tangerang

Table- 2.8.5 Number of PLN Customer by Branch Office, 2009

Tariff Classification	Gambir	Priok	Jatinegara	Kebayoran	Kramat Jati	Tangerang	Total
Social	6,672	3,843	4,788	7,193	6,535	11,646	40,677
Household	427,053	294,407	349,033	662,417	580,615	932,462	3,245,987
Business	70,182	21,929	21,611	42,161	41,215	57,114	254,212
Industry	3,075	590	848	418	285	5,362	10,578
Government	1,352	407	434	761	932	769	4,655
Public illumination	1,764	1,168	1,480	1,414	1,489	1.361	8,676
Train traffic	8	0	1	3	2	6	20
Others	2,206	573	264	752	228	3,565	7,588
Total	512,312	322,917	378,459	715,119	631,301	1,012,285	3,572,393

Source: PT. PLN (Persero) Distribusi DKI Jakarta dan Tangerang

2.8.5 Water Supply

Figure- 2.8.3 shows a layout plan of clean water supply system of the water supply companies. Total production capacity and the amount of water supply distributed to customers for the period of 2002-2009 were given in Figure- 2.8.4. The number of PDAM (Water Supply Company) customers increased continuously in accordance with the awareness of people to consume clean water brought by the spread of public water supply network. The total number of customers in 2009 was 795,149 customers.

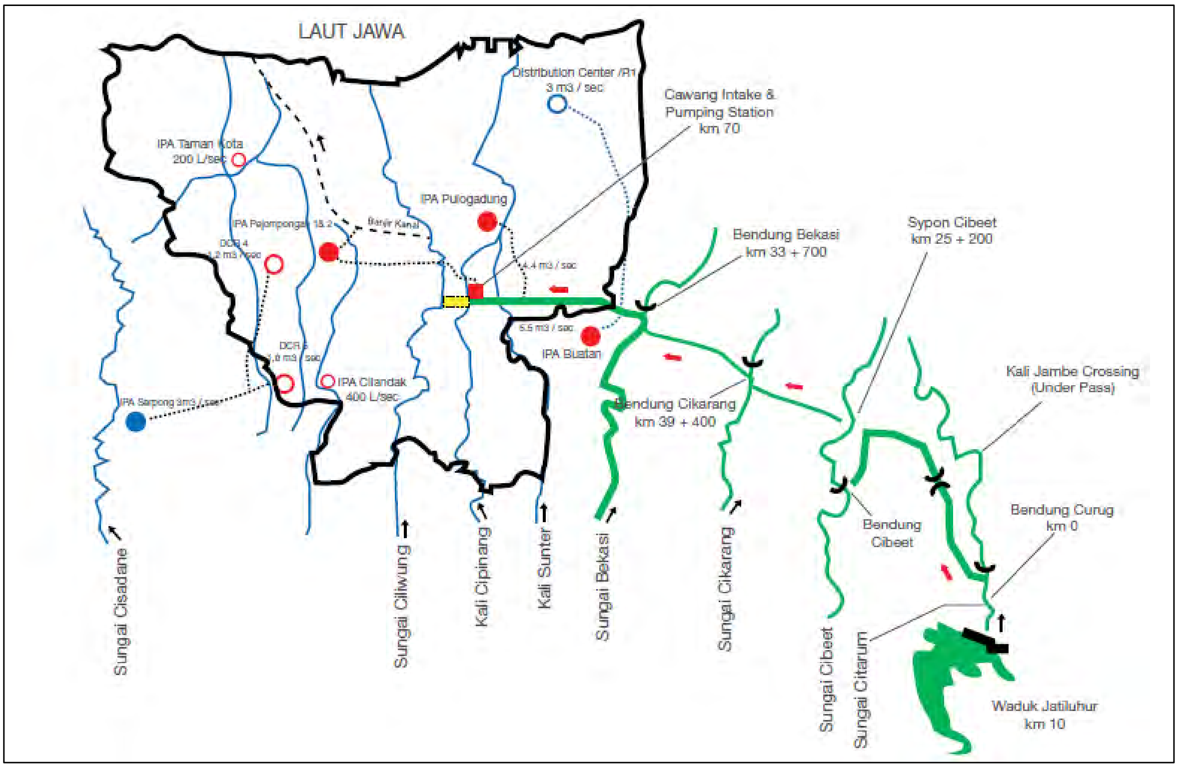


Figure- 2.8.3 Layout Plan of Clean Water Supply System

Source: PAM Jaya

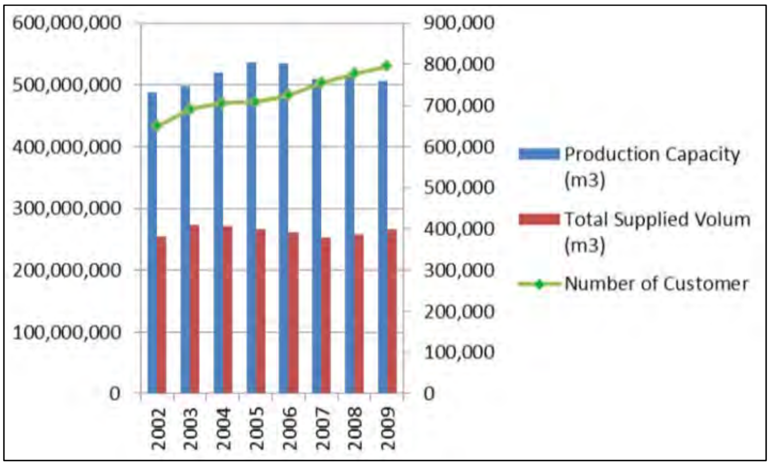


Figure- 2.8.4 Water Volume Produced and Sold, 2002-2009

Source: PAM Jaya

As presented in Figure- 2.8.5, non-business household category is the largest group of customers which has 690 thousand or approximately 87 percent of the total customers. While, other type of group of customers such as social, business, industries and special were only 101 thousand customer or about 11 percent of the total customers.

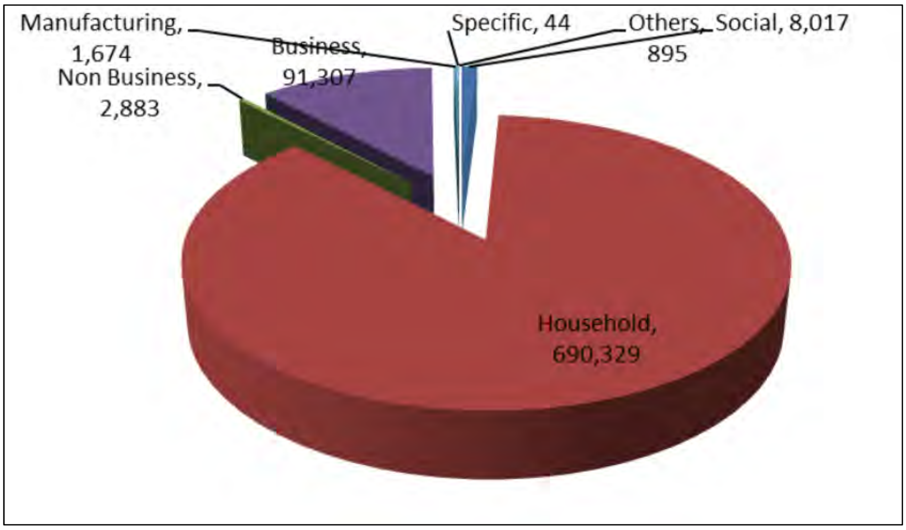


Figure- 2.8.5 Number of Customer by Type, 2009

Source: PAM Jaya

2.8.6 Solid Waste Management Facilities

As shown in Table- 2.8.6, people of DKI Jakarta produced around 28,286m^3 of garbage every day in 2009. About 55.4 percent of them were organic disposal which comes from organic material (i.e., leftover from meal, etc.) and the rest 44.6 percent comes from non-organic. The largest proportion of non-organic garbage was paper materials which shared about 20.6 percent and plastic about 13.3 percent. There were only 86.0 percent or 24,322m^3 of total garbage could be picked up daily (Jakarta in Figures 2010).

Table- 2.8.6 Daily Garbage Produced and Transported by Municipality, 2009

Municipality	Daily Production (m^3 per day)	Daily Transported (m^3 per day)	Residual (m^3 per day)
Jakarta Selatan	5,107	4,517	589
Jakarta Timur	6,331	5,427	904
Jakarta Pusat	5,338	5,194	144
Jakarta Barat	6,490	5,698	792
Jakarta Utara	5,020	3,487	1,533
Total	28,286	24,323	3,962
2008	29,217	24,756	1,774
2007	27,654	26,962	692
2006	26,444	25,904	540
2005	26,264	25,925	818

Source: Dinas Kebersihan Provinsi DKI

2.9 Provincial Spatial Plan of DKI Jakarta (RTRW DKI Jakarta 2030)

The current provincial spatial plan of DKI Jakarta to cover the period from 2011 to 2030 has been approved by the parliament in August 2011. The purposes of RTRW DKI Jakarta 2030 are as follows:

- Establish the area that provides the quality of productive and innovative urban life;
- Realize the optimum utilization of cultivation area in order to meet the needs of 12.5 million people, and to increase the productivity and value-added urban areas;
- Establish the urban infrastructure and service quality in viable numbers, sustainable, and can be accessed by all citizens of Jakarta;
- Establish the function of specific areas which is supporting the role of Jakarta as the capital optimally;
- Establish the integration of the use and the control of land space, sea and air space, including space below ground level and below the water surface, which consider the condition of the city of Jakarta as the delta city and the capacity of natural resources and environment in sustainable;
- Establish the integration of land use and adjacent areas;
- Establish the spatial planning of coastal areas and small islands in sustainable;
- Achieve the reduction of disaster risk;
- Establish the cultural Jakarta city which is equivalent to major cities in other countries; and
- Implement the State's defense to maintain and protect state sovereignty, territorial integrity, and safety from all of the threats.

To achieve the purposes as stated above, RTRW DKI Jakarta 2030 provides for a number of significant policies and strategies in detail for Space Structure and Space Pattern. These policies and strategies must be well-integrated into future urban, sectoral and infrastructure plans including flood control plan etc. in order to successfully achieve the goal as it is stipulated in this spatial plan.

CHAPTER 3 Inundation Area and Damage Level Estimation

3.1 Climate Change Scenarios and Simulation Conditions

3.1.1 Building Climate Change Scenarios

Climate change scenarios were built in order to estimate the increase in rainfall and sea level rise in 2050. Following climate change scenarios were settled based on social and economic changes described in IPCC 4th assessment report.

In the Joint Study by World Bank, ADB, and JICA, two scenarios of social and economic changes with different condition of greenhouse gas emission were adopted as presented in Table- 3.1.1; the one is with great impact of climate change by greenhouse gas, and the other is with small effect.

In this study, just as the examination cases in Manila and Bangkok, climate change condition in 2050 was simulated by two scenarios as follows:

・A1FI scenarios: high growth society scenario valuing on the fossil energy source
・B1 scenarios: sustainable development society scenario

Table- 3.1.1 Climate Change Scenarios

Scenario※		Application			
		Manila	Bangkok	Ho Chi Minh	**Jakarta**
A1	Growth-oriented Society Scenario				
A1FI	Value on Fossil Energy Resources	●	●	—	●
A1T	Value on Non-Fossil Energy Resources	—	—	—	—
A1B	Value on Balance of Energy Resources	—	—	—	—
A2	Pluralistic Society Scenario	—	—	●	—
B1	Sustainable Development Society Scenario	●	●	—	●
B2	Community Coexistence Scenario	—	—	●	—

※Social and economic changes in IPCC 4th assessment report

<Forecast Scenarios (Reference)>

○ A1 "Growth-oriented Society Scenario"

・World's economy will develop more and great innovation will be come up.

A1FI: Value on Fossil Energy Resources
A1T: Value on Non-Fossil Energy Resources
A1B: Value on Balance of Energy Resources

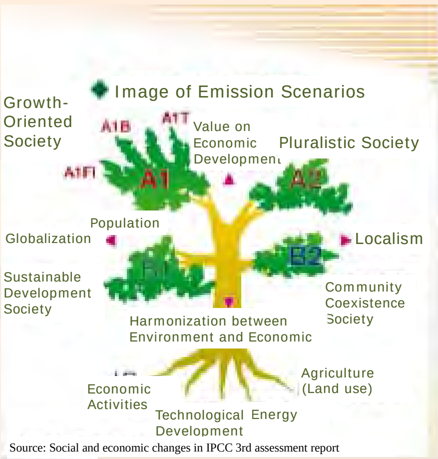
○ A2 " Pluralistic Society Scenario"

・World's economy and politics will be divided into blocks, and trading and movement of people/technologies will be restricted.

・World's economy will grow slower, and concerns for environment will be relatively scarce.

○ B1 "Sustainable Development Society Scenario"

・Environmental protection and economic development will be promoted at the same time.



Source: Ministry of Environment "Global Warming Panel"

○ B2 "Community Coexistence Scenario"

・Value on the problem solution in the communities and fairness of world, and economic development will be somewhat slow.

・Environmental issues will be resolved within each community.

These scenarios do not include the additional global warming measures

Figure- 3.1.1 Forecast Scenarios in IPCC 4th Assessment Report

Source: Summary on IPCC 4th Assessment Report (Official Edition)

Greenhouse Gas Emission Scenarios 2000-2100 (without Additional Climate Policies) and Forecast of Surface Temperature

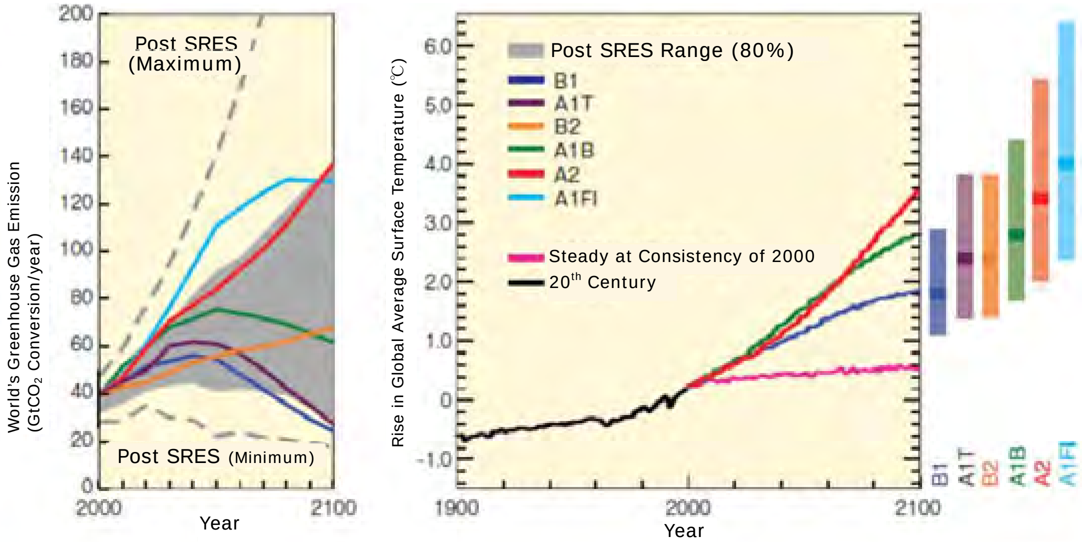


Figure SPM.5. ***Left Figure***: amount of greenhouse emission (CO2 conversion) without additional climate policies: six SRES marker scenarios (colored lines), 80% tile of recent scenarios (post SRES) publicized after SRES (range with grey colored). Dot lines are overall range of results of post SRES scenario. CO2, CH4, N2O and CFC are included in emission amount. ***Right Figure***: solid lines show rise in global average surface temperature continued from the condition of 20th century in models of A2, A1B, B1 scenarios. These forecasts are considered with the effects of short-lived greenhouse gas and aerosol. Pink line represents the simulation of air-sea coupling system model (AOGCM) which is sustained steadily at the atmospheric concentration of year 2000, but the scenario. Right belt of the figure indicates best estimation value (horizontal line of each belt) and forecast spread of high possibility from 2090-2099 of 6 SRES scenarios. All temperatures were comparison with 1980-1999.

Figure- 3.1.2 Forecast Scenarios in IPCC 4th Assessment Report

Source: Summary on IPCC 4th Assessment Report (Official Edition)

Table- 3.1.2 Forecast of Rise in Global Average Surface Temperature and Sea Level Rise at the End of 21st Century

Scenarios[a)]	Changes in Temperature (difference of year 2090-2099 based on the year 1980-1999 (℃))[C)]		Sea Level Rise (difference of year 2090-2099 based on the year 1980-1999 (℃)) Forecast range by models (exclusive of mechanical changes of rapid ice discharge)
	Best estimate value	Likely forecast range	
Steady at the consistence of 2000[b)]	0.6	0.3-0.9	No data
B1 scenario	1.8	1.1-2.9	0.18-0.38
A1T scenario	2.4	1.4-3.8	0.20-0.45
B2 scenario	2.4	1.4-3.8	0.20-0.43
A1B scenario	2.8	1.7-4.4	0.21-0.48
A2 scenario	3.4	2.0-5.4	0.23-0.51
A1FI scenario	4.0	2.4-6.4	0.26-0.59

Source: Summary on IPCC 4th Assessment Report (Official Edition)

Note: a) Scenarios are six SRES marker scenarios. CO2 conversion consistence (see p.823, 1st working group report of 3rd assessment report) corresponding to the radiative forcing by man-made greenhouse gas and aerosol are SRES marker scenarios of B1, A1T, B2, A1B, A2 and A1FI, and approximately 600, 700, 800, 850, 1250, 1550ppm respectively.

b) Composition of values of steady at the consistence of 2000 is obtained only by air-sea coupling system model (AOGCM).

c) Temperature is the best estimate value and forecast range of uncertainty obtained by models belonging to various hierarchies regarding constraints by observed values and composite degrees. Changes of temperature are presented as the differences between1980-1999. To present the changes between 1850-1899, 0.5℃ will be added.

3.1.2 Estimation of Climate Change in 2050

(1) Estimation of Rainfall Increment in 2050

Rainfall increment in 2050 is shown in Table- 3.1.3. It was estimated in accordance with downscaling procedure illustrated in Figure- 3.1.3. A statistical downscaling method was applied to implement the downscaling in this Study.

As a result, rainfall increment in 2050 was estimated at 17 percent in A1FI Scenario, and 8 percent in B1 scenario.

Table- 3.1.3 Rainfall Increment Volume

	A1FI	B1
Global mean temperature increase $\Delta T_{global}[K]$	2.0	0.9
$\Delta T_{\mathrm{local}}/\Delta T_{global}$	0.86	
Local mean temperature change $\Delta T_{local}[K]$	1.72	0.77
$\frac{1}{\Delta T_{local}} \frac{\Delta P_{local}^{extreme}}{P_{local}^{present,extreme}} [\%/K]$	10	
Change of precipitation $\Delta P_{\mathrm{local}}^{extreme} / P_{\mathrm{local}}^{present,extreme} [\%]$	17	8

$\Delta T_{global} \equiv T_{global}^{future} - T_{global}^{present}$

$\Delta P \equiv P^{future} - P^{Present}$

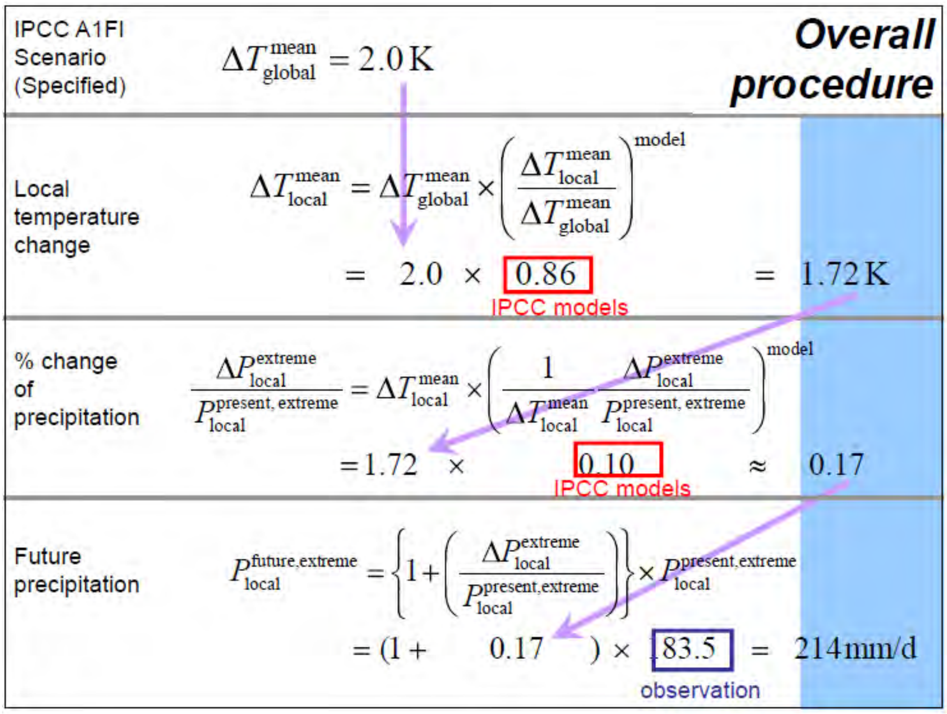


Figure- 3.1.3 Overall Downscaling Procedure

1) Climate Change Scenarios

Any climate impact assessment starts with specifying a global climate scenario that provides the boundary conditions for subsequent analysis. This study is based on global climate projections provided by the Fourth Assessment Report (AR4) of the IPCC, adopting the B1 and A1FI scenarios from the IPCC's Special Reports on Emissions Scenarios (SRES), and comparing them with the Present (P) scenario. B1 is the scenario projected by the IPCC to represent the least anticipated change, which makes it the most sustainable case. A1FI, on the other hand, represents a large change scenario due to high economic growth. The target year is set as 2050, the halfway mark of the IPCC SRES timeframe. The spatial spreads of flooding for the year 2050 under the SQ, B1, and A1FI scenarios are taken as the basis for impact analyses.

2) Uncertainties

It should be borne in mind that the present IPCC climate models cannot be directly applied to impact studies on local climate change because of various uncertainties: emission scenarios due to economic growth rates and energy efficiency improvements, carbon cycle response to changes in climate, global climate sensitivity, discrepancies in regional climate change scenarios, and changes in ecosystems, etc. Simulations of local climate change are fundamentally more uncertain than global mean values. Local climate is heavily influenced by atmospheric and oceanic circulation, such as prevailing weather situations and wind directions. For example, global mean precipitation changes do not necessarily determine the changes in local precipitation, so it is impossible to conclusively determine future precipitation rate extremes.

Although climate projections are based on global climate models or general circulation models (GCMs), their results contain various biases. If the raw GCM outputs were used for impact studies, the biases would surely contaminate the assessment outcome. Precipitation remains a stringent test for climate models. Many biases in precipitation statistics remain in both precipitation means and variability, especially in the tropics.2 Comparison between observations and simulations of 20th century conditions reveals that most models do not accurately simulate precipitation extremes.

3) Downscaling

Despite these various uncertainties, global climate scenarios can be translated to regional climate scenarios, a process called "downscaling", which is employed for this study (see Figure- 3.1.3). While there has been an increasing recognition of the explicit treatment of uncertainty in environmental assessments recently, this report deals with uncertainties qualitatively rather than quantitatively. Downscaling requires local-level, bias-corrected climate information. The analyses below discuss development of regional climatic changes in the period up to 2050. IPCC SRES scenarios B1 and A1FI provide a basis for discussing changes in local temperature and precipitation in Jakarta based on which hydrological conditions such as sea-level rise, high tide, and land subsidence are projected.

4) Temperature

IPCC provides projections for global mean temperature changes for various IPCC SRES scenarios up to 2100. Projected global temperature rise can be set using projected values as illustrated in Figure- 3.1.2.

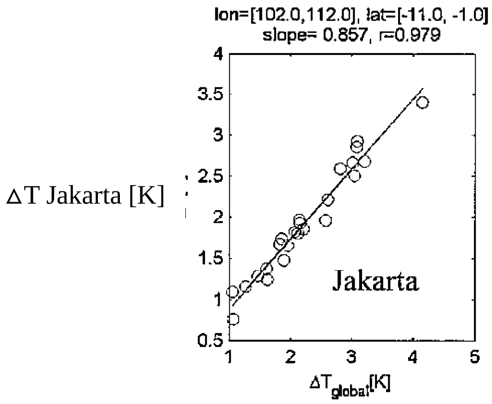
Global average temperature increase is shown in Table- 3.1.4

Table- 3.1.4 ΔT_{global} for 2050 from IPCC AR4

Scenario	ΔT_{global} for 2050
A1FI	2.0K
B1	0.9K

$\Delta T_{global} \equiv T_{global}^{future} - T_{global}^{present}$

Plotting local temperature changes in the Jakarta versus average global temperature changes predicted by the B1 and A1FI scenarios and fitting a regression line to them as presented in Figure- 3.1.4 shows a high correlation between the global mean temperature rise and the local temperature rise in the Philippines. In fact, the local temperature increase in Jakarta is about 90 percent of the global average temperature increase.

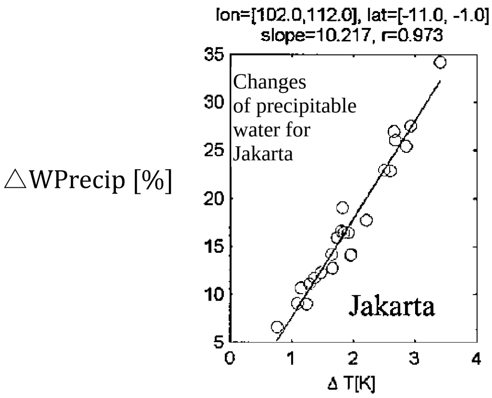


Circles represent different models, with red ones denoting the SRES A1B scenario and blue ones corresponding to SRES B1.

Figure- 3.1.4 Relationship between Local and Global Temperature Changes

5) Precipitation

Local precipitable water, the source of the intense rainfall that is a main cause of storm events, increases in the Philippines in the modeled scenarios. The increase could be as much as 10 percent of the local temperature rise in degrees Kelvin. This ratio was determined by plotting changes in local precipitable water increases versus local temperature increases in Jakarta. The results of a regression analysis relating them are presented in Figure- 3.1.5.



Circles represent different models, with red ones denoting the SRES A1B scenario and blue ones corresponding to SRES B1.

Figure- 3.1.5 Relationship between Changes in Precipitable Water and Temperature Increase in the Jakarta

Increases in (peak) precipitable water are then translated into increased (peak) water discharge rates for river flood simulation. This means that in the simulations, water discharge at given return periods increases. In this report, 10-year, 30-year, and 100-year recurrence periods are set as target flood levels. To explain the shift caused by climate change, one way is to decrease the number of years in the return periods and the other way is to increase the peak precipitation, but for this report we increase the level of peak precipitation.

(2) Estimation of Sea Level Rise in 2050

Sea level rise in 2050 was estimated as shown in Table- 3.1.5 considering observation data and estimation inferred from global model.

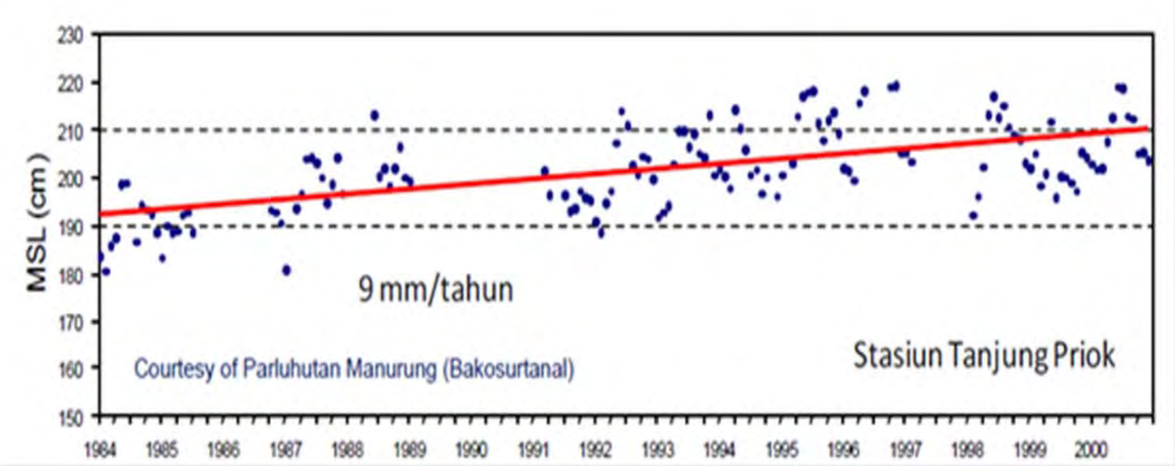
Table- 3.1.5 Sea Level Rise in 2050 (cm)

Scenario	Observation data	Global model	Adopted value
P	-	0 cm	0 cm
B1	-	19 cm	20 cm
A1FI	39cm	29 cm	39 cm

1) Estimation of Sea Level Rise in 2050 by Observation data

Figure- 3.1.6 shows yearly changes of monthly average tide level (MSL) at the Tanjung Priok Port from 1984 to 2000. According to this, annual average of sea level rise was estimated at approximately 9mm.

Sea Level Rise in 2050＝9 mm/ year x 43 year= 387 mm ≒ 39 cm



Source: Land Subsidence Characteristics of the Jakarta Basin (Indonesia) as estimated from Leveling, GPS and InSAR and its Environmental Impacts HASANUDDIN Z. ABIDIN

Figure- 3.1.6 Yearly Changes of Monthly Average Tide Level at the Tanjung Priok Port (1984-2000)

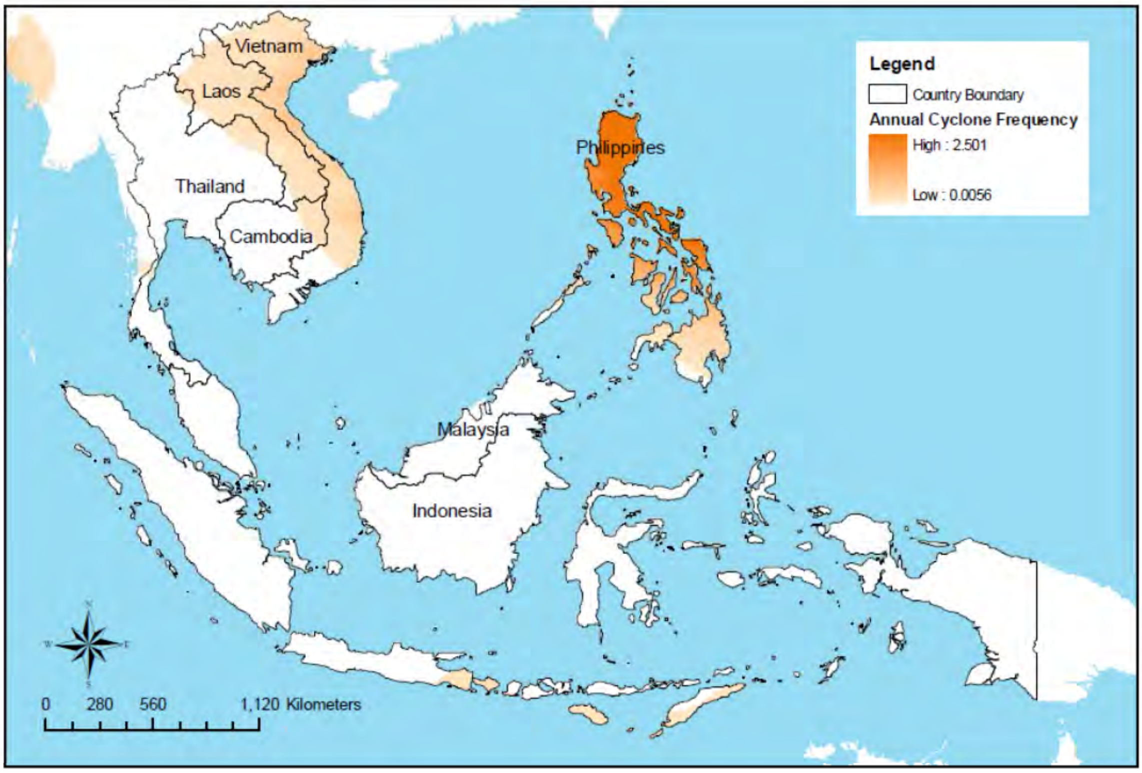
2) Estimation of Sea Level Rise in 2050 by Global model

50 percent of the sea level rise for the year 2100 as projected in IPCC AR4 is assumed for the year 2050. Sea level, as a boundary condition for flood simulation, can be estimated by adding tidal factors. High tidal level is a critical determiner of flooding. In consideration of future global climate change, sea level rise must be added to the high tide level. Therefore, the Spring tide (High High Water: HHW) level in Java Sea is set as the baseline level for flood simulation, and sea level rise predicted from the global warming scenarios are placed above that level.

Global sea level is estimated to increase by an average of 29cm in 2050 considering global average temperature rise of 2 degrees.

3) Estimation of High Tide Level in 2050

Since the annual cyclone frequency in Jakarta is extremely low as shown in Figure- 3.1.7, it can be said that the impact of high tide derived from cyclone can be negligible. Thus, synodic average high tide level is employed as the condition of high tide in Jakarta.



Source: Climate Change Vulnerability Mapping for Southeast Asia Arief Anshory Yusuf & Herminia Francisco

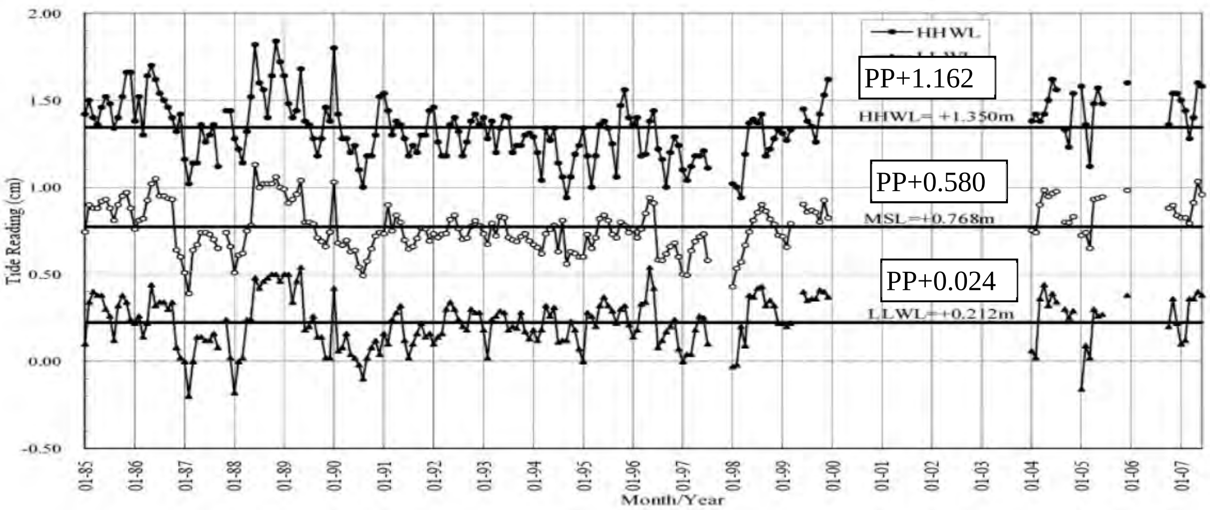
Figure- 3.1.7 Tropical Cyclone Frequency (event per year from 1980-2003)

Synodic average low tide level is defined as the standard tidal level based on the observed value in 1925, and values of standard tide level are presented in Table- 3.1.6. Compared the standard tidal level with organized data on monthly tide level at the Tanjung Priok Port from 1985 to 2007 of which average was approximately Priok Peil (P.P.) +0.580m as shown in Figure- 3.1.8, no significant difference can be found between them. Thus, high tide level in the Study is set at the sum up of P.P. +1.15m (High High Water Level: H.H.W.L.) as synodic average high tide level and sea level rise.

Table- 3.1.6 Tidal Level in Java in 1925

Tide	Elevation above P.P.
Spring tide (High High Water Level: H.H.W.L)	P.P. + 1.15
Average high water (H.W.)	P.P. + 0.90
Mean Sea Level (M.S.L)	P.P. + 0.60
Average low water (L.W.)	P.P. + 0.25
Spring tide (Low Low Water Level: L.L.W.L)	P.P. = 0.00

Note: PP (Priok Peil) is standard tide level based on the 1925 observation



Source: The Institutional Revitalization Project for Flood Management in JABODETABEK

Figure- 3.1.8 Annual Tide Level at Tanjung Priok Station

3.1.3 Estimation of Land Use in 2050

Land use in 2050 was estimated based on the Spatial Plan of related municipalities in 2030 considering the uncertainty over the prediction of land development in 2050 (see Figure- 3.1.9). Urbanization rate[1] in 2050 is estimated to be 84.3 percent, 22 percent higher than that in 2008. Runoff rate (f) in 2050 is estimated to be f = 0.79, 0.05 higher than that in 2008.

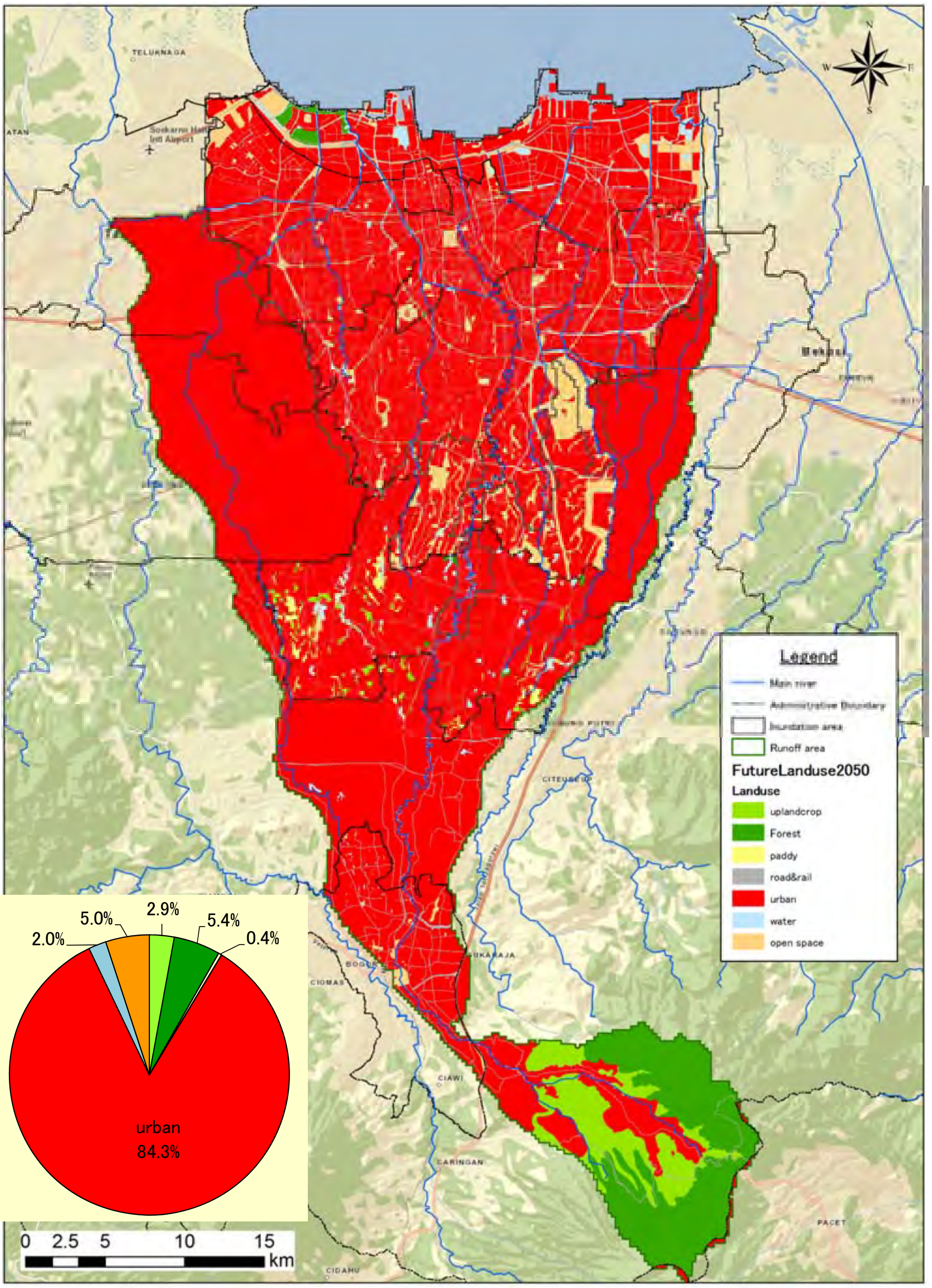


Figure- 3.1.9 Land Use in 2050

3.1.4 Estimation of Land Subsidence in 2050

Aerial distribution of the amount of land subsidence in 2050 was estimated based on the current amount

[1] Percentage of urban areas accounted for river basin areas

of land subsidence and ground water pumping. Since the correlation between the amount of land subsidence and ground water pumping is high as described in (1)3)(a) below, it can be said that land subsidence derives from the excess extraction of underground water. In addition, the amount of land subsidence tends to be moderate in recent years as described in (2) below. Thus, the following two scenarios were employed to estimate the amount of land subsidence.

①Estimation of land subsidence based on the trend of previous survey data (in the case that previous demand of underground water is expected to continue.)

②Estimation of land subsidence by recent trend of subsidence (in the case that the demand of underground water in recent years is expected to continue.)

(1) Estimation of Land Subsidence by Existing Survey Data*1（Version 2）

The amount of land subsidence up to 2050 as the assumed maximum amount was estimated based on the data at 26 GPS survey points from 1997 to 2005.

1) GPS Survey Data

From 1997 to 2005, GPS survey was implemented 8 times at the survey points illustrated in Figure-3.1.10 by ITB in DKI Jakarta in December 1997, June 1999, June 2000, June 2001, October 2001, July 2002, December 2002, and September 2005. The amount of land subsidence is shown in Table- 3.1.7.

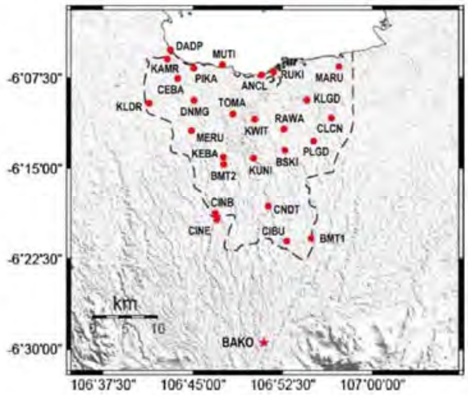


Figure- 3.1.10 GPS Survey Points for Monitoring Land Subsidence in Jakarta

Source: Land subsidence characteristics of Jakarta between 1997and 2005, as estimated using GPS surveys (Hasanuddin Z. Abidin)

Table- 3.1.7 The Result of GPS Survey at Each Survey Point

No	Station	Ddh12	Ddh23	Ddh34	Ddh45	Ddh56	Ddh67	Ddh78
		S-1: Dec-1997	S-2: Jun-1999	S-3: Jun-2000	S-4: Jun-2001	S-5: Oct-2001	S-6: Jul-2002	S-7: Dec-2002
		S-2: Jun-1999	S-3: Jun-2000	S-4: Jun-2001	S-5: Oct-2001	S-6: Jul-2002	S-7: Dec-2002	S-8: Sep-2005
1	CIBU	-2.4 ± 0.3	-4.6 ± 0.4	-2.3 ± 0.4	-2.9 ± 0.9	-1.3 ± 1.0	-0.2 ± 0.7	-9.6 ± 0.7
2	CINE	-3.5 ± 0.2	-0.6 ± 0.2					
3	KEBA	-6.9 ± 0.3	-2.2 ± 0.3	-4.4 ± 1.0	-1.5 ± 1.1	u.r.	-10.7 ± 1.3	-19.1 ± 1.5
4	KUNI	-4.7 ± 0.2	-4.0 ± 0.6	-7.9 ± 0.6	-1.6 ± 0.3	0.0 ± 0.3	-0.1 ± 0.3	-10.6 ± 0.7
5	KWIT	-5.7 ± 0.5	-1.0 ± 0.5	-0.9 ± 0.2	-0.6 ± 0.6	-3.0 ± 0.9	-7.6 ± 1.0	-29.9 ± 1.5
6	MARU	-6.4 ± 0.2	-0.4 ± 0.3	-4.3 ± 1.4	-0.1 ± 1.5	-0.8 ± 0.6	-0.2 ± 0.7	-13.2 ± 0.7
7	MERU	-5.8 ± 0.3	-5.9 ± 0.4	-0.3 ± 0.6	-4.6 ± 0.8	-1.4 ± 0.7	-1.1 ± 0.6	-17.2 ± 0.7
8	MUTI	-1.2 ± 0.4	-0.5 ± 0.4	-5.5 ± 0.5	-0.5 ± 0.7	-6.1 ± 0.7	-2.4 ± 0.8	-34.4 ± 0.7
9	PIKA	-6.1 ± 0.2	-17.6 ± 0.2	-0.4 ± 0.2	u.r.	-6.9 ± 0.9	-2.1 ± 0.9	-28.0 ± 0.9
10	RAWA	-3.8 ± 0.3	-4.2 ± 0.9					
11	RUKI	-16.1 ± 0.4	-0.4 ± 0.4	-8.5 ± 0.2	-1.4 ± 0.6	0.0 ± 0.8	0.3 ± 0.8	-13.4 ± 0.9
12	TOMA	-1.2 ± 0.1	-1.1 ± 0.2	-2.9 ± 0.6	-0.5 ± 0.7	-4.4 ± 0.5	-3.4 ± 0.5	-29.6 ± 0.9
13	ANCL			-3.4 ± 0.6	-0.3 ± 0.7	-2.3 ± 0.7	-3.2 ± 0.7	-17.8 ± 0.6
14	BSKI			-1.5 ± 0.2	-3.6 ± 0.6	-3.9 ± 0.7	0.0 ± 0.8	-15.1 ± 0.9
15	CLCN			-8.1 ± 0.2	-0.2 ± 0.6	0.2 ± 0.6	-4.7 ± 0.6	
16	CNDT			u.r.	-0.3 ± 0.2			
17	DNMG			-25.8 ± 0.4	-8.5 ± 1.0	-1.8 ± 1.3	-1.0 ± 1.4	-28.7 ± 1.3
18	KAMR			-9.4 ± 0.3	-1.6 ± 0.8	-2.9 ± 1.4	0.0 ± 1.6	
19	KLDR			-13.0 ± 0.4	-2.8 ± 0.7	-0.4 ± 0.8	-2.6 ± 1.0	-14.6 ± 1.0
20	KLGD			-1.4 ± 0.3	-3.3 ± 0.6	-6.7 ± 0.8	-0.1 ± 0.9	-16.4 ± 1.1
21	BMT1				-9.2 ± 2.8	-1.4 ± 3.5	0.3 ± 3.2	4.2 ± 3.7
22	BMT2				-2.3 ± 0.9	-9.8 ± 1.3	u.r	u.r.
23	CEBA				-1.1 ± 0.5	-8.3 ± 0.6	-2.8 ± 0.6	-36.6 ± 0.8
24	DADP				-5.4 ± 0.8	-0.7 ± 0.6	-0.4 ± 0.8	-21.3 ± 1.2
25	PLGD				-5.8 ± 1.3	-6.1 ± 1.4	-34.9 ± 2.1	2.9 ± 2.3
26	CINB				-1.2 ± 0.6	-0.5 ± 0.6	-4.3 ± 0.7	-16.6 ± 1.1

The unit is (cm)

u.r. Indicates unreliable result caused by severe signal obstruction and too many cycle slips in the data

Source: Land subsidence characteristics of Jakarta between 1997and 2005, as estimated using GPS surveys (Hasanuddin Z. Abidin)

2) Amount of Groundwater Pumping

Figure- 3.1.11 shows the number of pumping well under the control of Mineral and Coal, Ministry of Energy and Mineral Resources (MEMR) and the amount of pump discharge from 1879 to 2008.

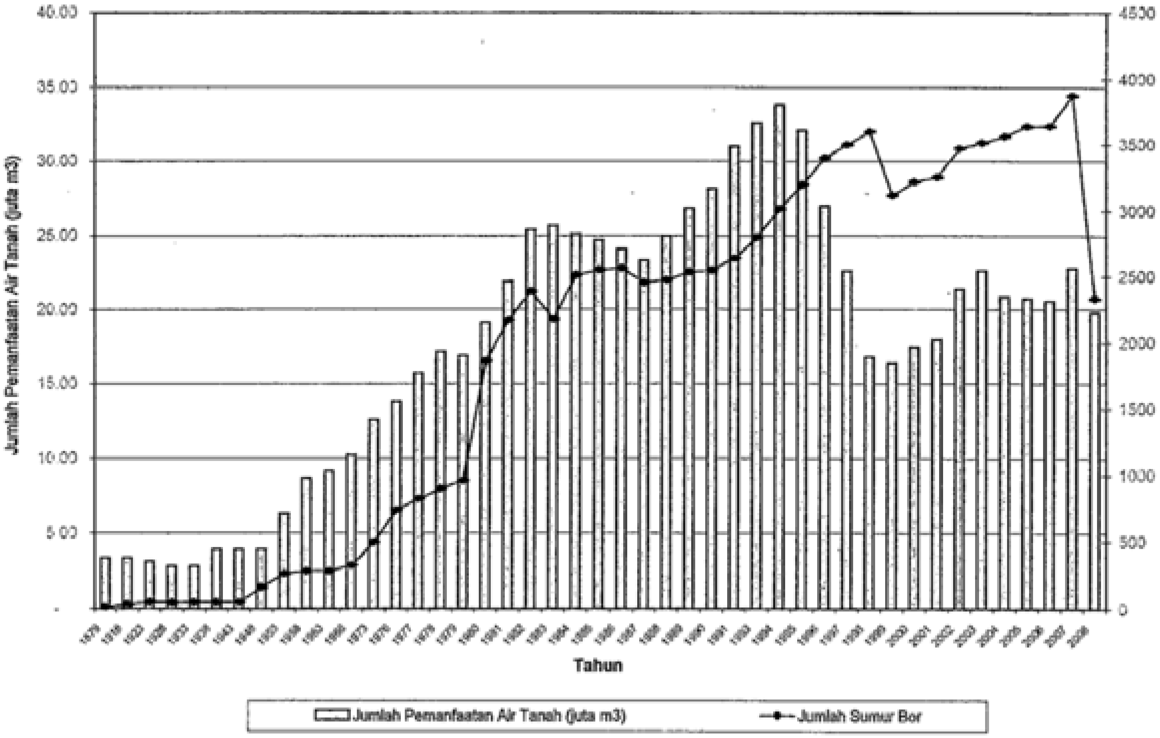


Figure- 3.1.11 Number of Pumping Well and the Amount of Pump Discharge from 1879 to 2008

Source: KEMENTERIAN ENERGI DAN SUMBER DAYA MINERAL

As shown in Figure- 3.1.12, the volume of cumulative abstraction constantly increases; underground water has been discharged in constant proportion every year.

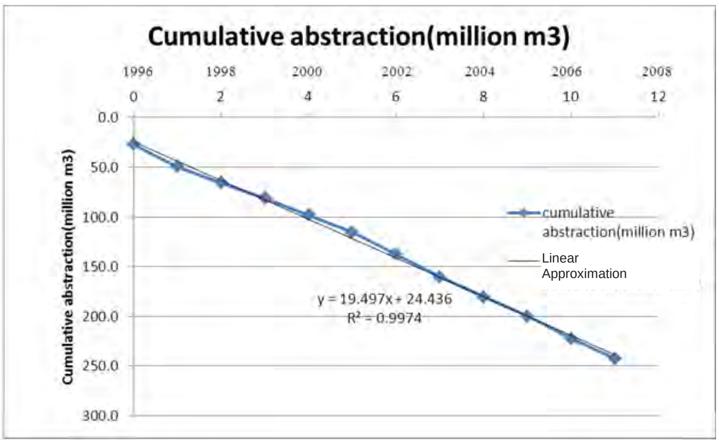


Figure- 3.1.12 Yearly Cumulative Abstraction

3) Estimation of the Amount of Land Subsidence

(a) Correlation between land subsidence and underground water discharge

In order to grasp a relation between land subsidence and underground water discharge, the data of cumulative amount of land subsidence and cumulative amount of underground water discharge at each survey point were collected as shown in Figure- 3.1.13, Figure- 3.1.14, and Figure- 3.1.15. These figures show a highly correlation between the cumulative amount of land subsidence and the cumulative amount of underground water discharge.

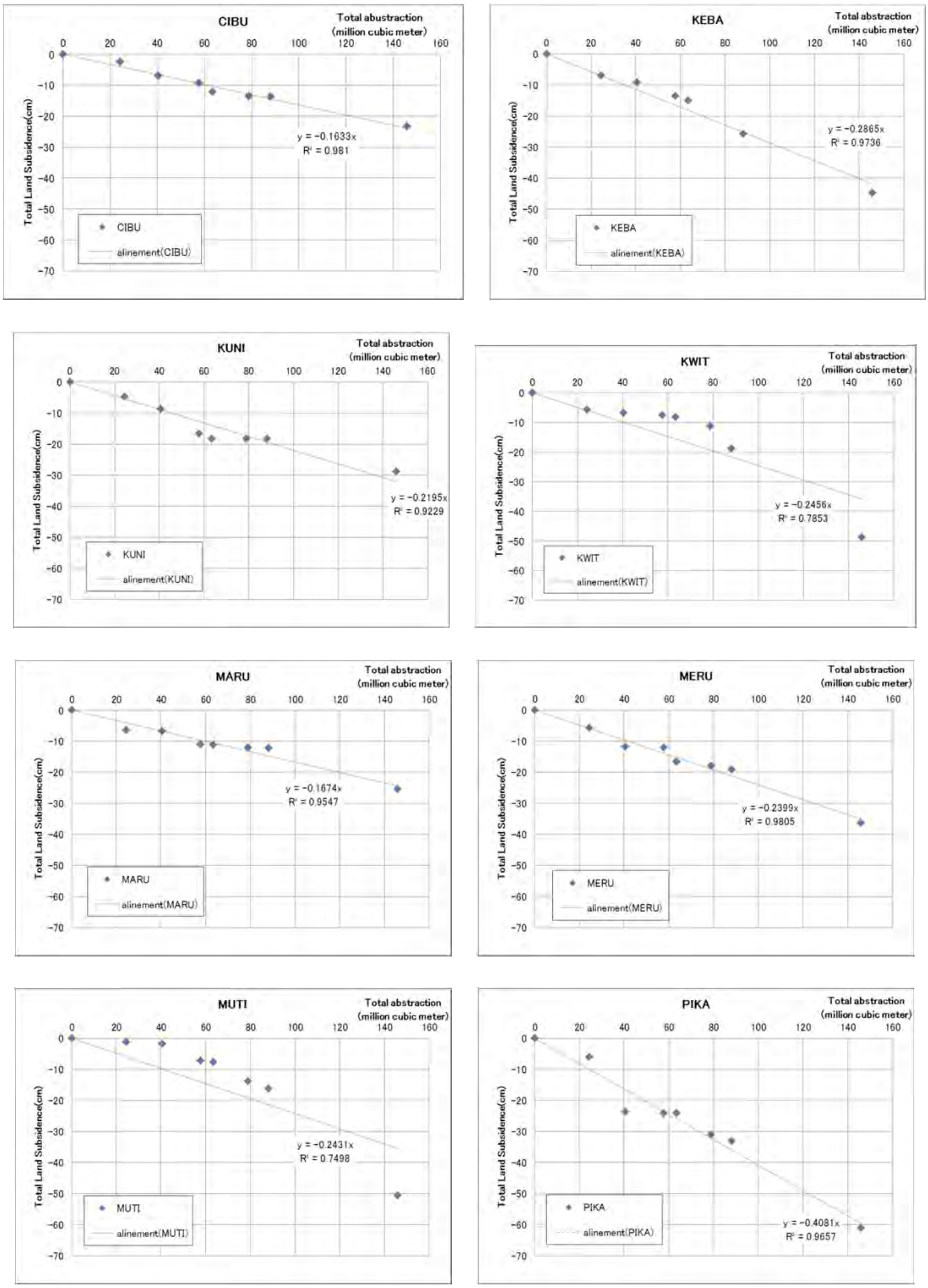


Figure- 3.1.13 Correlation between the Cumulative Amount of Land Subsidence and Underground Water Discharge at GPS Survey Points (1)

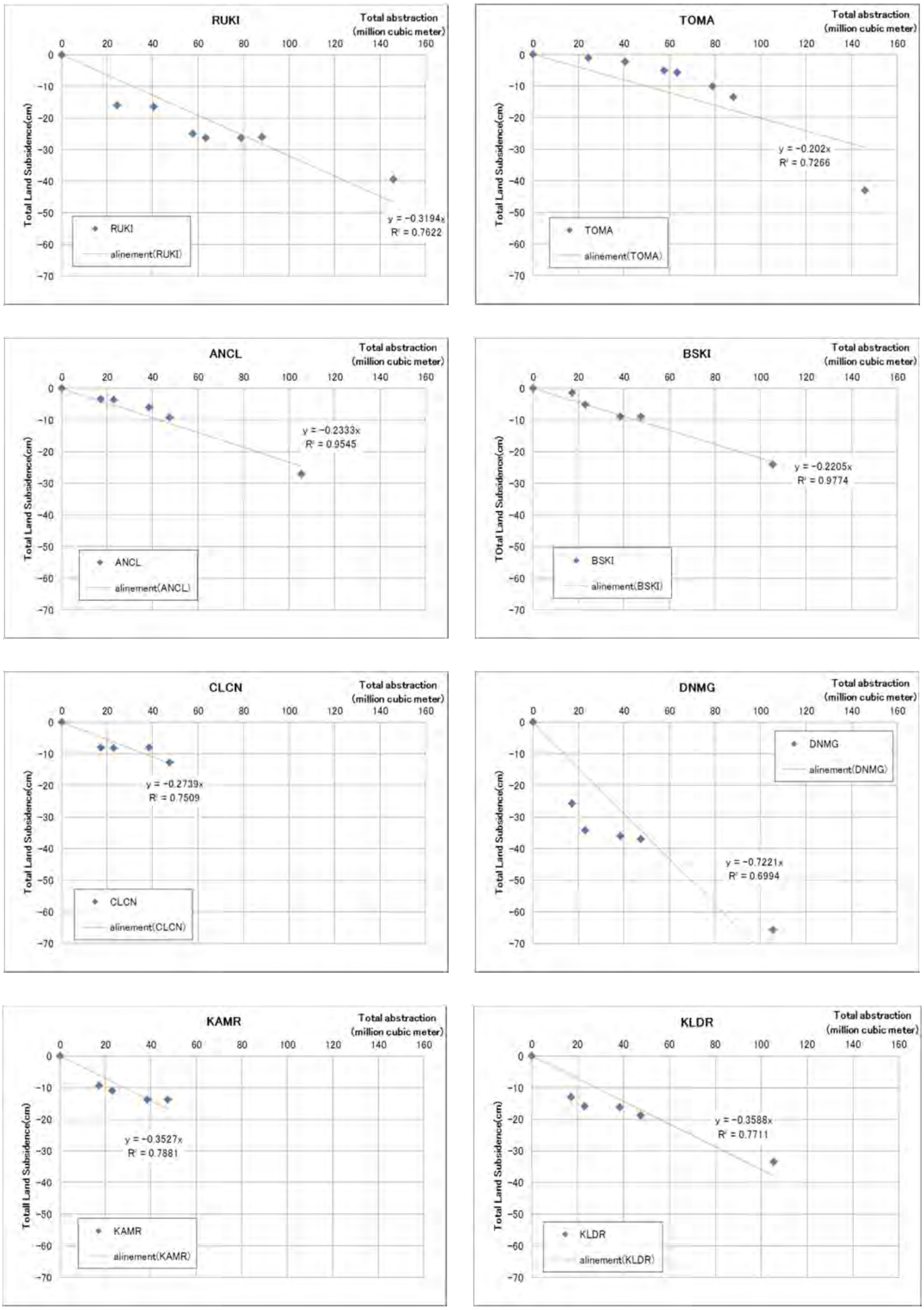


Figure- 3.1.14 Correlation between the Cumulative Amount of Land Subsidence and Underground Water Discharge at GPS Survey Points (2)

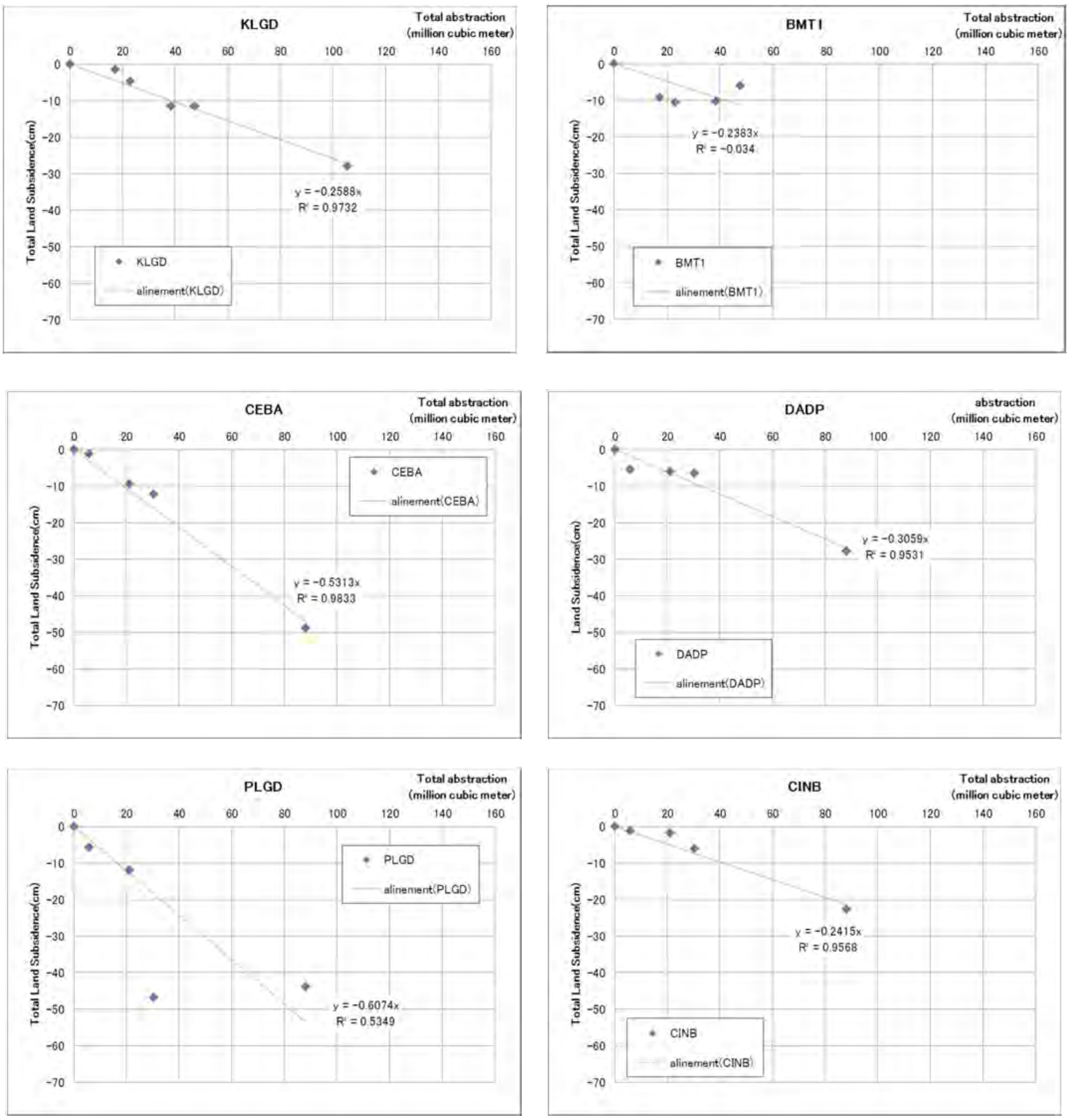


Figure- 3.1.15 Correlation between the Cumulative Amount of Land Subsidence and Underground Water Discharge at GPS Survey Points (3)

(b) Estimation of the Amount of Land Subsidence at Each Station

Since the collected data were not enough to estimate the amount of underground water extraction in 2050, the amount of land subsidence in 2050 was estimated based on the yearly change of land subsidence on the assumption that the demand for underground water so far would remain the same up to 2050.

As described in (a) above, the amount of land subsidence is highly correlated with the amount of underground water extraction. Thus, land subsidence was assumed to remain the same trend on the assumption that the demand for underground water would remain the same in 2050.

Concretely, linear approximation of curves from 1997 to 2005 was made at each station at first. Then, the amount of land subsidence was estimated based on the curves.

The result of estimation of land subsidence at each survey station in 2050 is shown in Figure- 3.1.16, and the trend of the estimation is shown in Figure- 3.1.17～Figure- 3.1.20

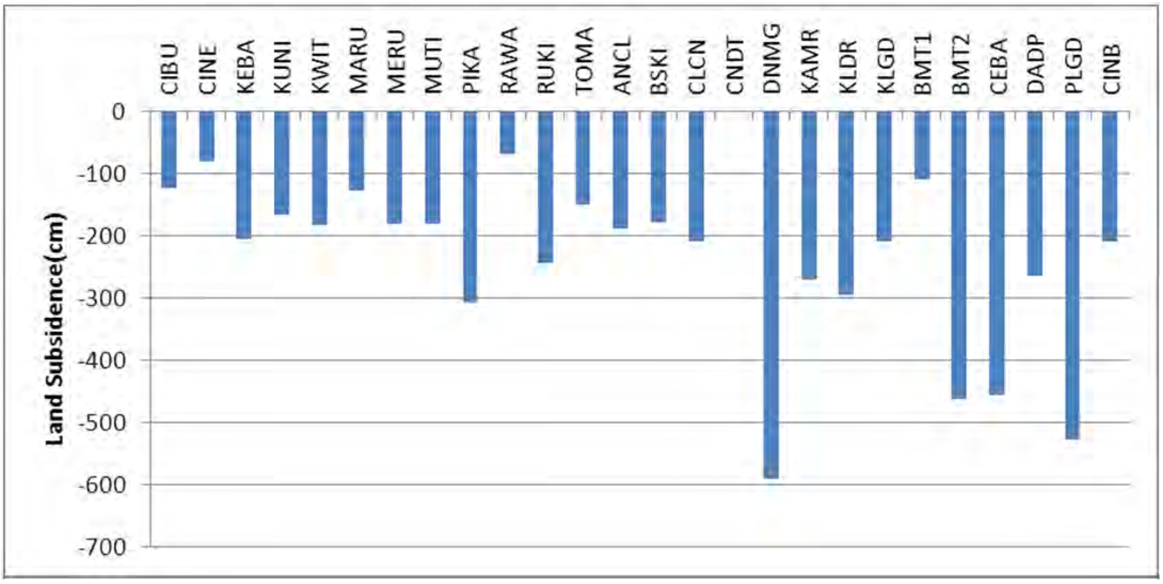


Figure- 3.1.16 Estimation of Land Subsidence at Station

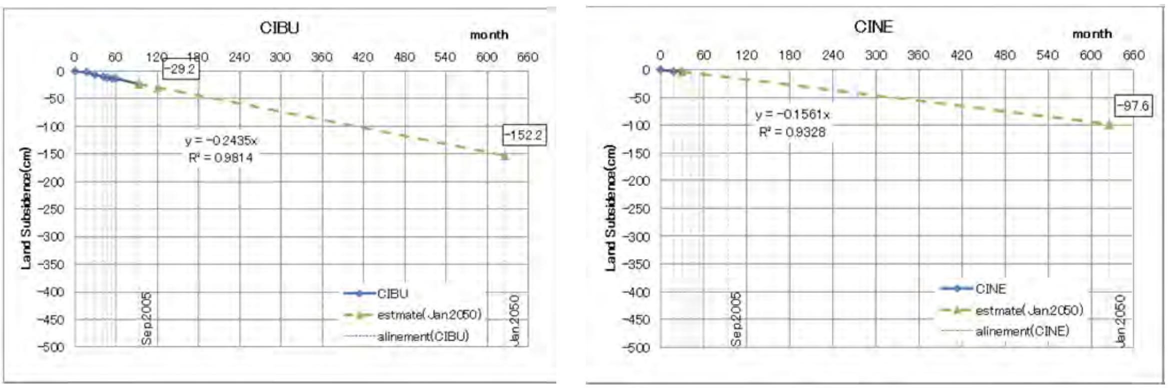


Figure- 3.1.17 Trend of the Estimation of Land Subsidence at GPS Survey Point in 2050 (1)

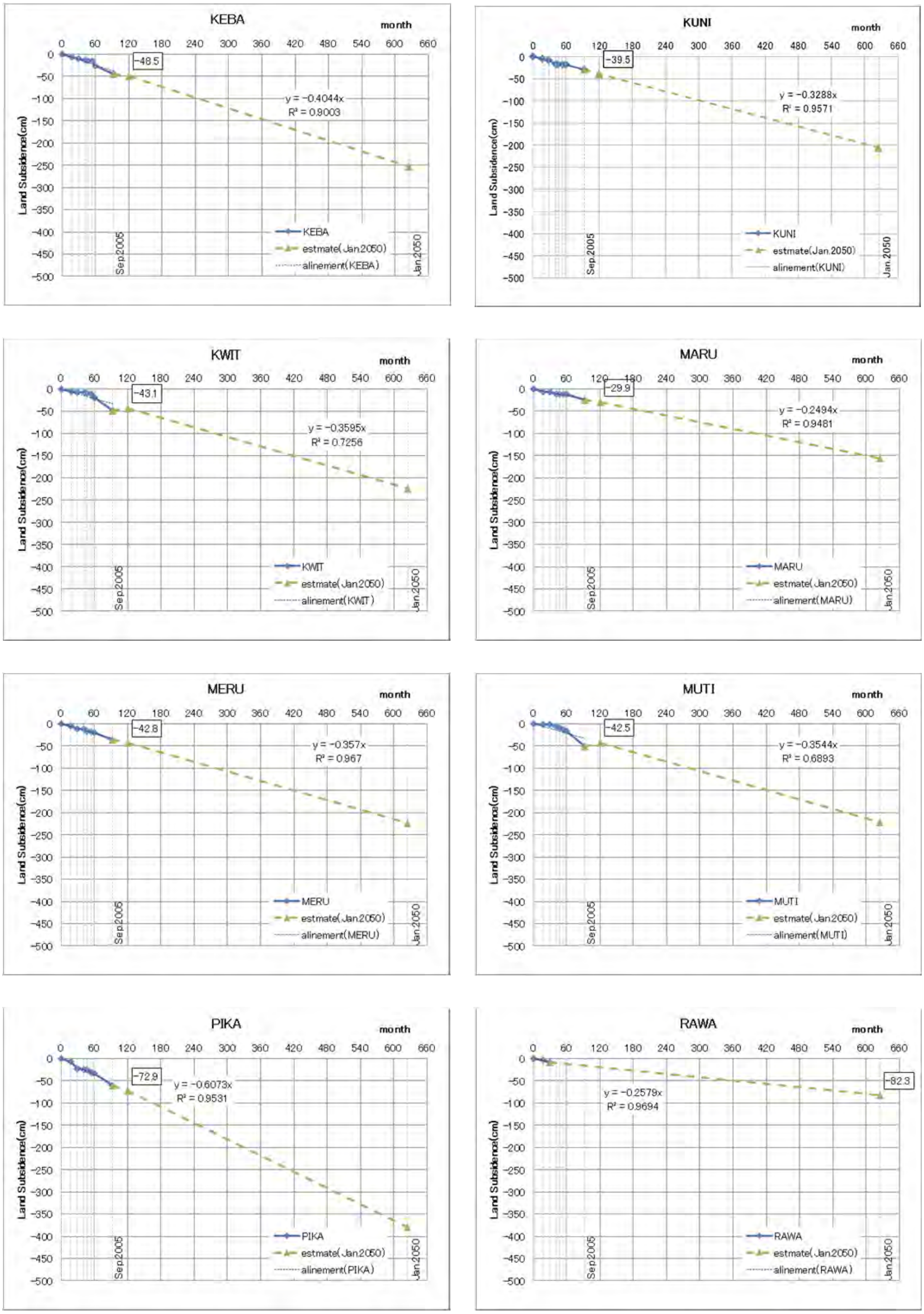


Figure- 3.1.18 Trend of the Estimation of Land Subsidence at GPS Survey Point in 2050 (2)

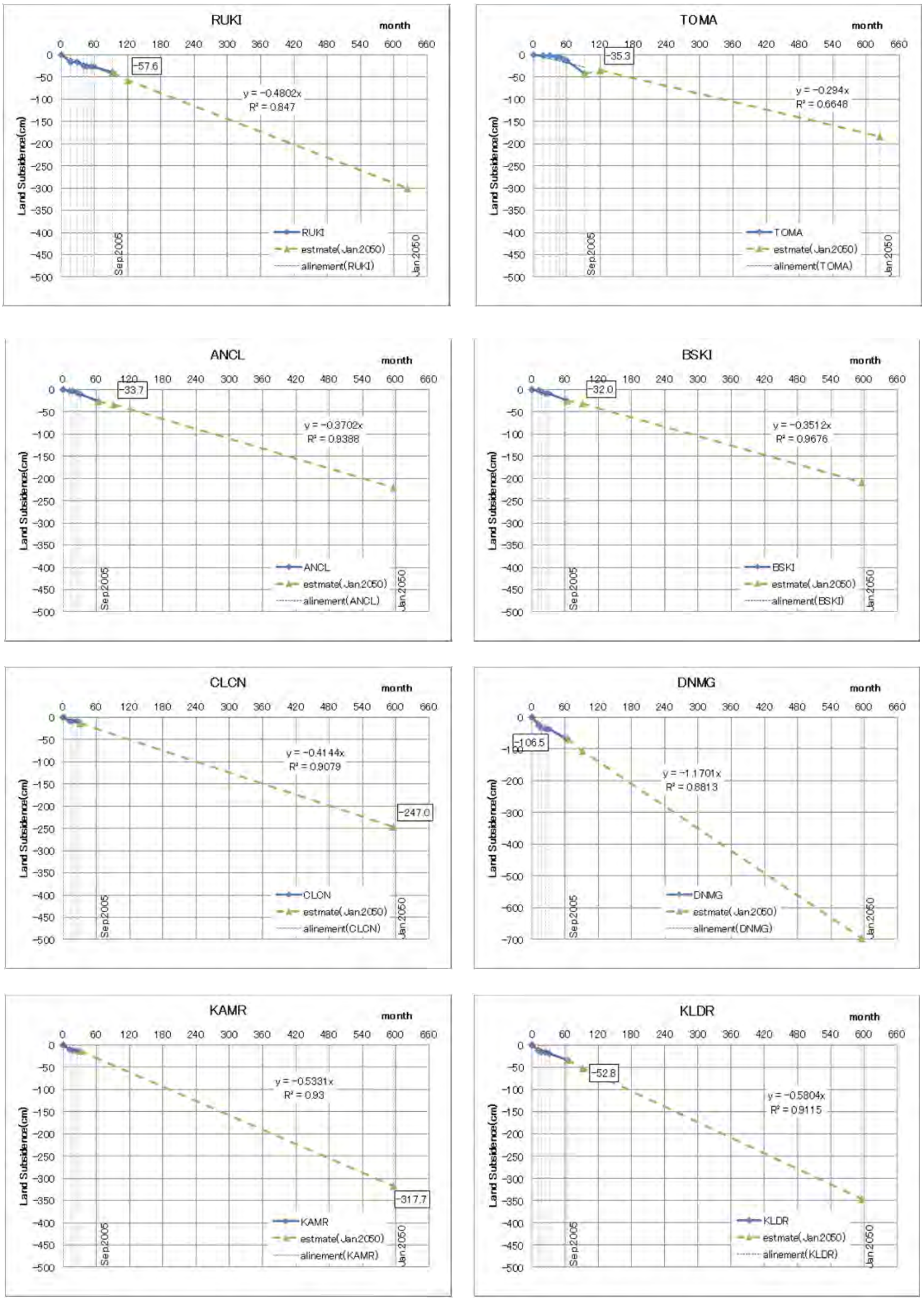
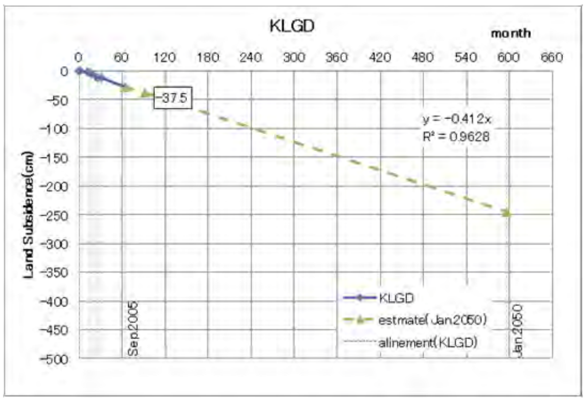
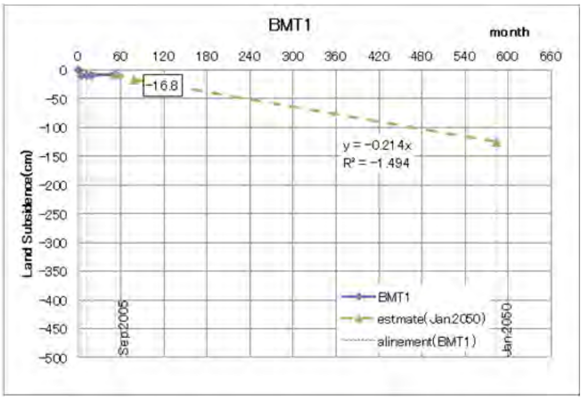
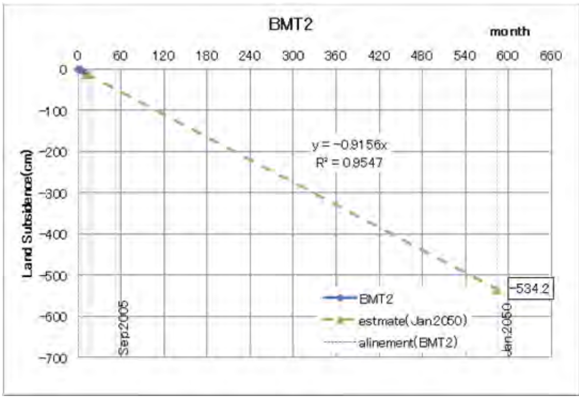
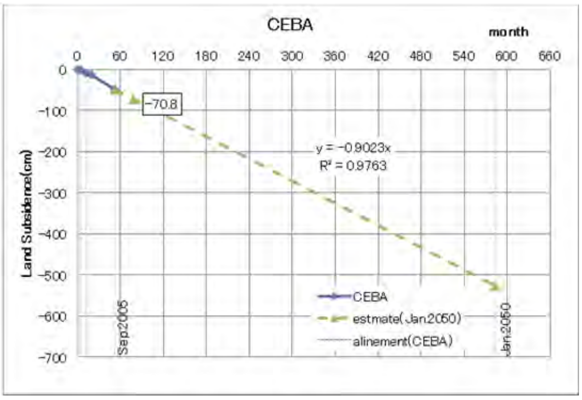


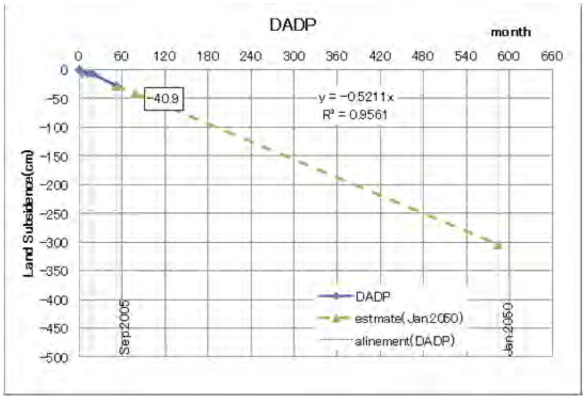
Figure- 3.1.19 Trend of the Estimation of Land Subsidence at GPS Survey Point in 2050 (3)

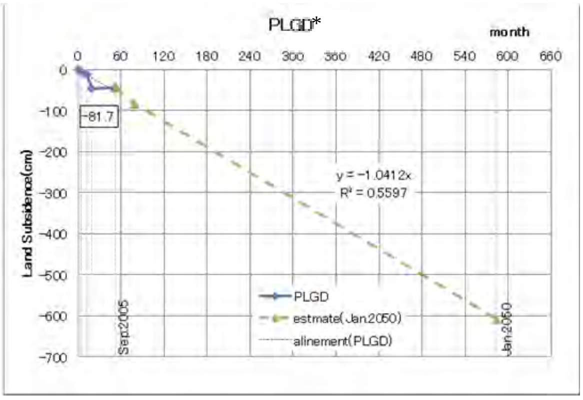


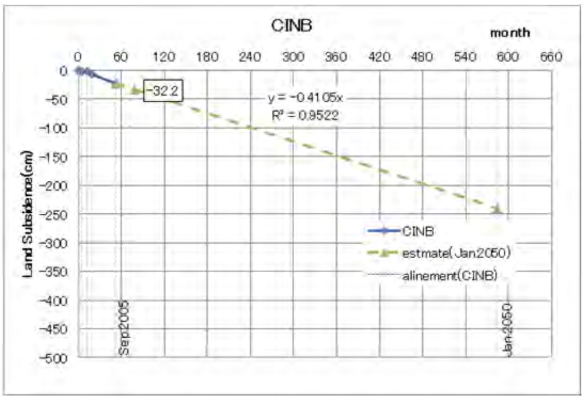












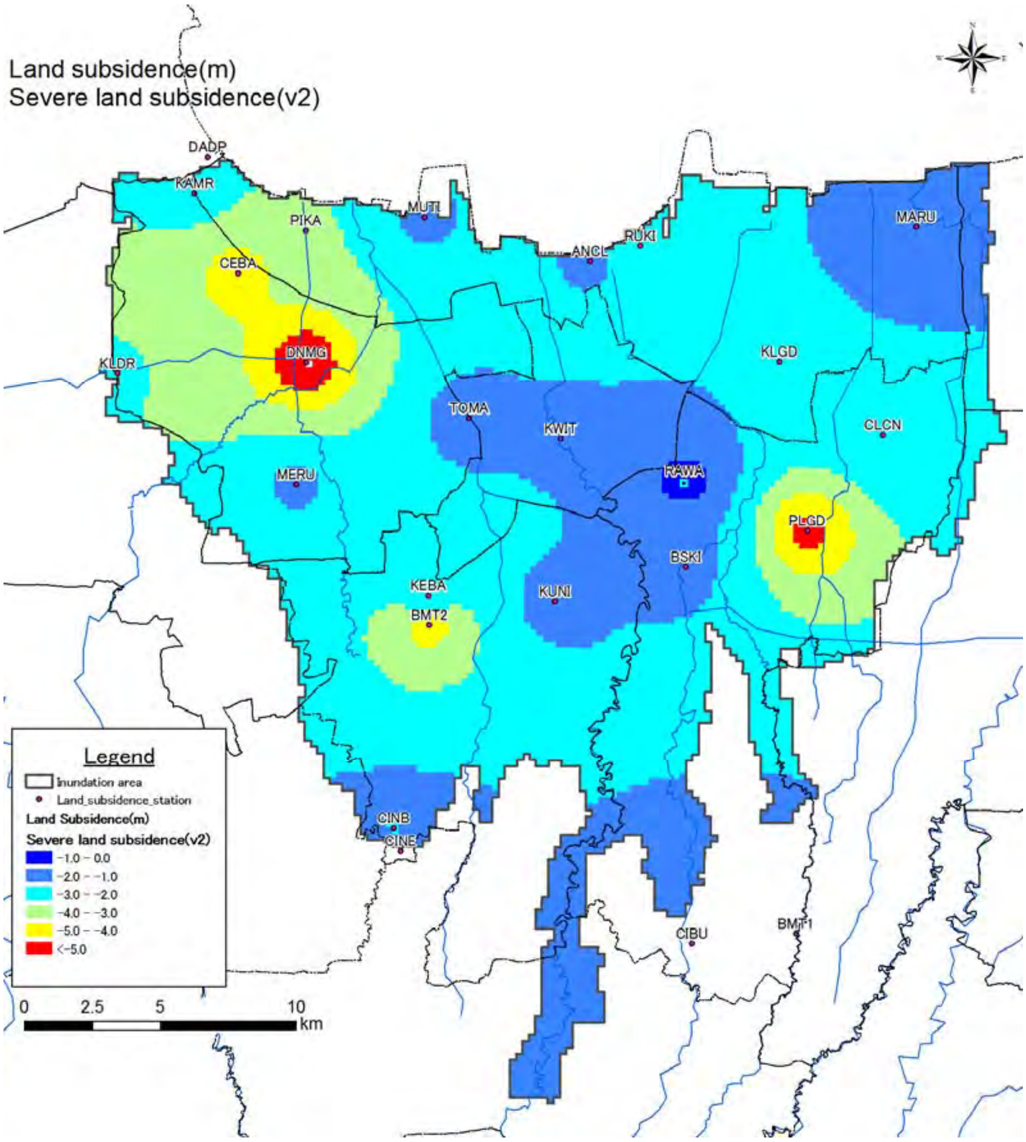
*Straight-line approximation was employed considering the tendency observed at stations around PLGD.

Figure- 3.1.20 Trend of the Estimation of Land Subsidence at GPS Survey Point in 2050 (4)

(c) Distribution of Land Subsidence

Figure- 3.1.21 shows the estimation of planar distribution of subsidence based on the amount of land subsidence at each survey point. On the basis of this, average ground level in 2050 was established by subtracting the amount of land subsidence at each survey point from ground level at present (see Figure- 3.1.22).

- The amount of land subsidence was from 0.7m up to 5.9m. Severe land subsidence can be seen mainly in Cengkareng Floodway located in the northern area of West Jakarta, and in the junction area of Angke and Mookervaart Canal.
- Large amount of subsidence can also be seen in the area around the upstream of Cakung Drain located in the northeast area of East Jakarta.
- In 2008, the area of which ground level is lower than the sea level accounts for 22 percent of whole inundation area (612 km^2). On the other hand, the proportion of lower area is assumed to increase up to about 43 percent in 2050.



Maximum Land Subsidence by 2050: around 5.9 m
*1：GPS survey(1997 to 2005)

Figure- 3.1.21 Distribution of Land Subsidence（230m mesh, LS:V2）

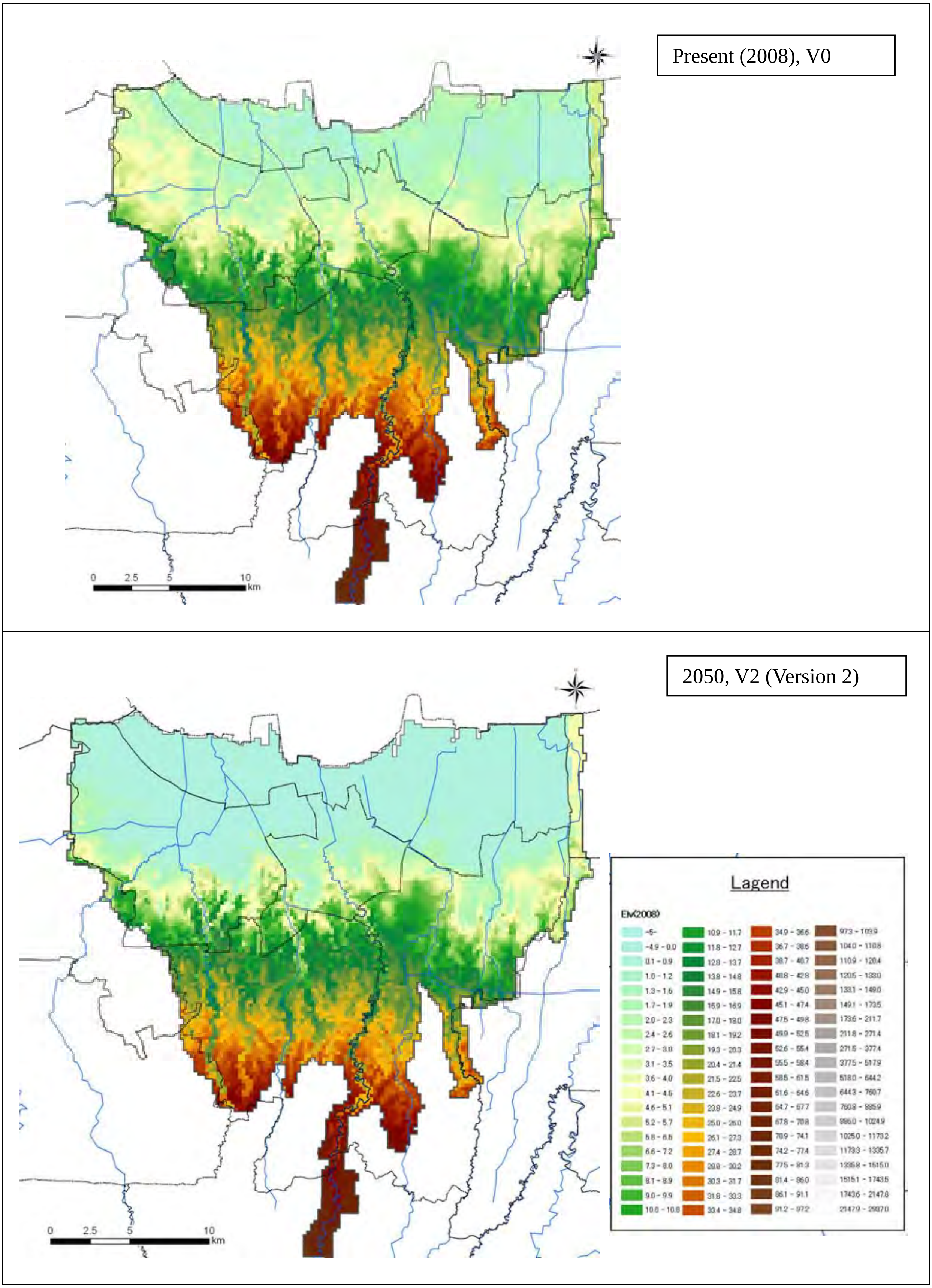


Figure- 3.1.22 Average Ground Level（230m mesh size, upper:V0, lower:V2）

(2) Estimation by Using Satellite Data (Version 1)

The amount of land subsidence in 2050 was estimated by the yearly average amount of subsidence calculated by an analysis of satellite image from 2007 to 2011. As shown in Table- 3.1.8, the amount of land subsidence is assumed to be maximum depth at 2.5m up to 2050.
Figure- 3.1.23 shows the planar distribution of subsidence based on the result shown in Figure- 3.1.21 above and adjusted maximum depth to be 2.5m. Average Ground Level shown in Figure- 3.1.24 was established based on the adjusted planar distribution of land subsidence.

- In 2008, the area of which ground level is lower than the sea level accounts for 22 percent of whole inundation area (612 km^2) as described above. On the other hand, the proportion of lower area is assumed to increase up to about 34 percent in 2050 in this case.

Table- 3.1.8 The amount of land subsidence in 2050 calculated by an analysis of satellite image from 2007 to 2011

Estimated average Land Subsidence Rate (cm/year)	Estimated Total Amount of Land Subsidence by 2050 (m)
4～6	1.5~2.5

Satellite Data: 2007-2011
Source: The Project for Capacity Development of Jakarta Comprehensive Flood Management in Indonesia

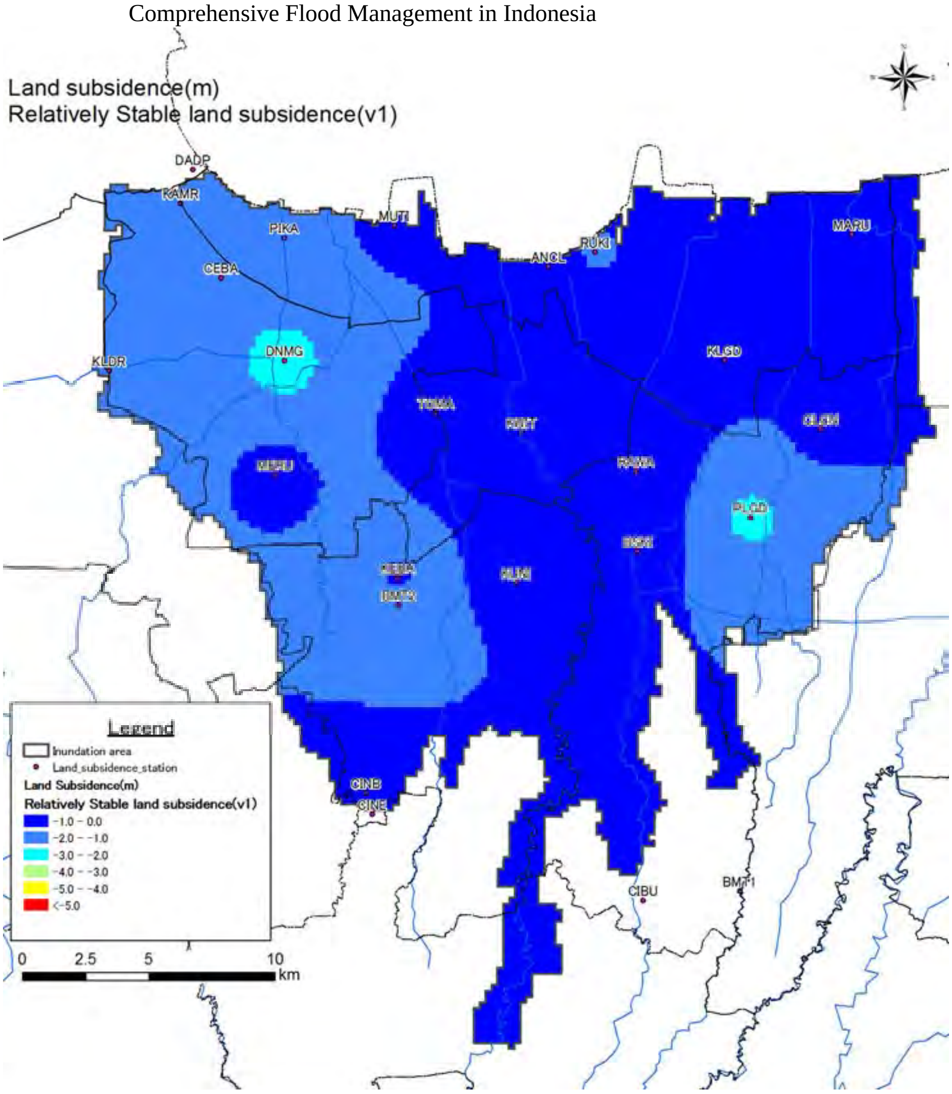


Figure- 3.1.23 Planar Distribution of Land Subsidence (230m mesh size, LS:V1)

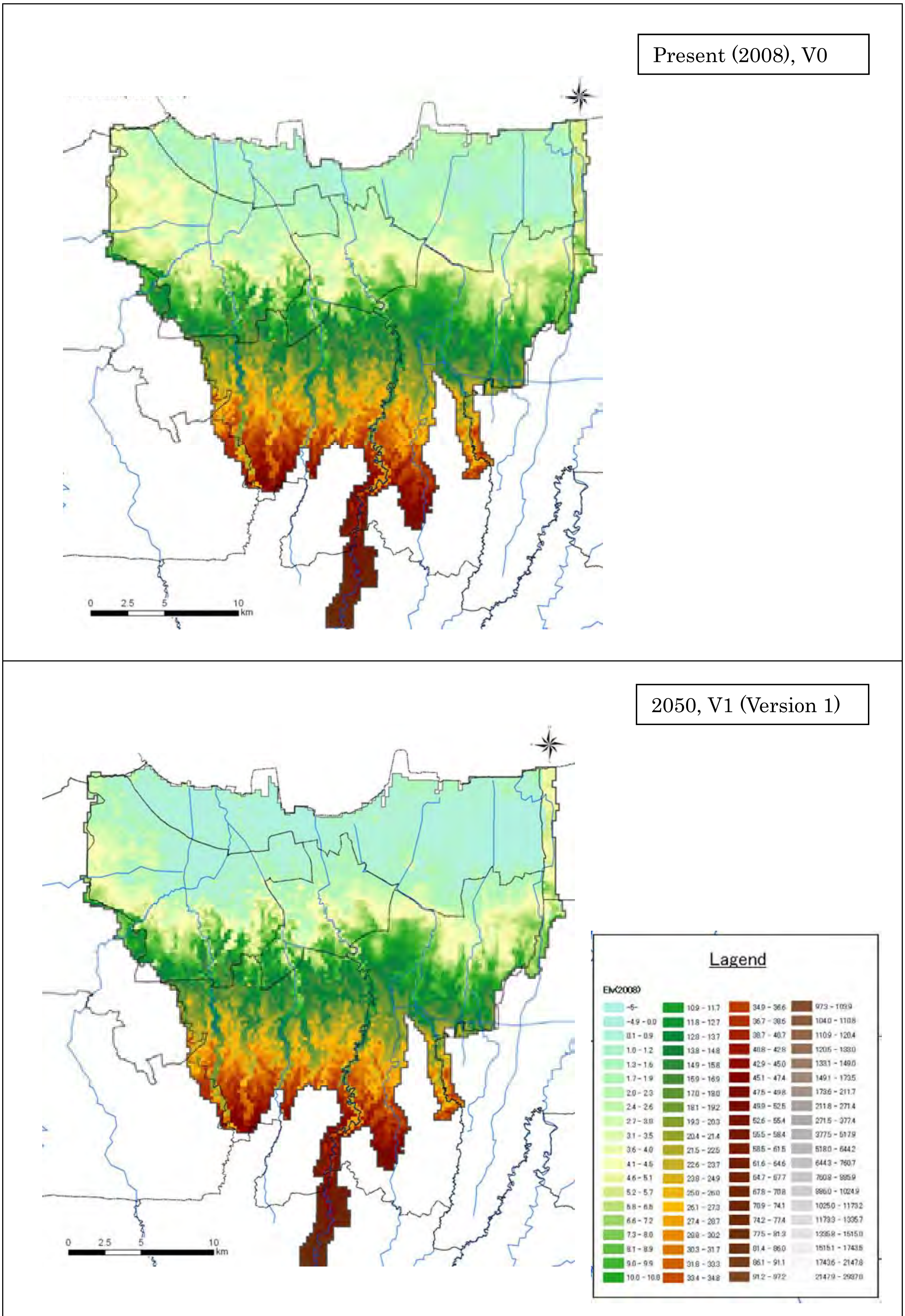


Figure- 3.1.24 Average Ground Level（230m mesh size, upper:V0, lower:V1）

<Notes for the estimation of the amount of land subsidence>

The amount of land subsidence in the future is estimated referring to that of the past in this Study, but esssentially it is important to be estimated based on the consideration of the decrease of ground water level in detail as it appeares to be primary factor behind land subsidence in DKI Jakarta.

It is preferable that the estimation of the amount of land subsidence is implemented considering the forecast of the change of groundwater volume based on the comprehension of the detail of ground condition and the status of groundwater extraction.

Therefore, the amount of land subsidence was estimated basically based on the data of GPS survey from 1997 to 2005, considering the result of an analysis of satellite image from 2007 to 2011.

3.1.5 Building the Infrastructure Scenarios

The extent of flood damage in river basin and coastal area in 2050 would depend not only on the impact of climate change but also on the capacity of flood infrastructure in DKI Jakarta. Given the above, three types of flood infrastructure scenarios described in Table- 3.1.9 were established in this Study.

Table- 3.1.9 Flood Infrastructure Scenarios

Scenario		Contents
SQ	Status Quo Scenario	The existing flood control infrastructure would be maintained by 2050; the existing flood control facilities are as of 2011.
MP	Master Plan Scenario	The flood control infrastructure in 2050 would be based on the implementation of existing Master Plan. The Ciliwung Floodway of which construction has been suspended at present was not considered in this scenario. On the other hand, Ciliwung River improvement plan prospected to implement after the completion of Master Plan by the Government of Indonesia was taken into account.
MP＋PS	Master Plan + Strengthening of Pumping Station Scenario	The existing Master Plan would be strengthened with Pumping Station by 2050.

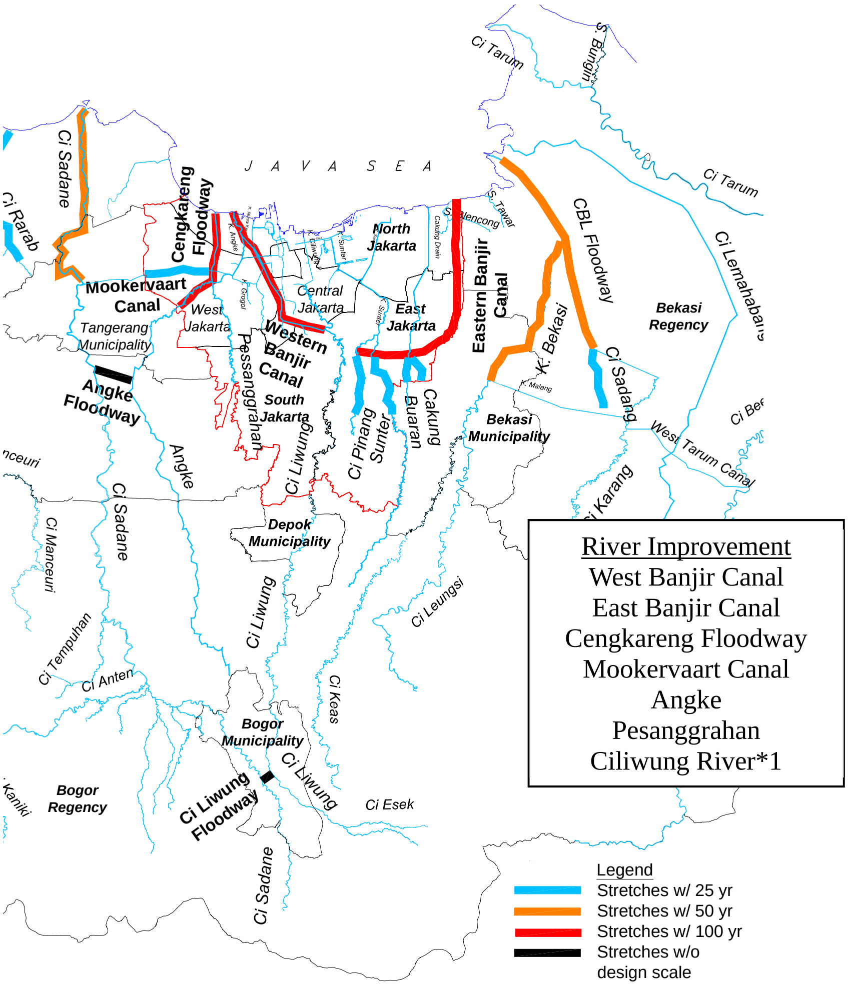
(1) Status Quo Scenario

In this scenario, the existing flood control infrastructure would be maintained by 2050; the existing flood control facilities are as of 2011. It is established as a basic scenario in order to grasp and evaluate the extent of flood damage under the existing flood control facilities.

- West Flood Canal of which reclamation has been completed in 2011 and East Flood Canal which has been constructed and operated are taken into consideration in this scenario.

(2) Master Plan Scenario

In this scenario, the flood control infrastructure in 2050 would be based on the implementation of existing Master Plan as of 1997. The Ciliwung Floodway of which construction has been suspended at present was not considered. On the other hand, Ciliwung River improvement plan prospected to implement after the completion of Master Plan by the Government of Indonesia was taken into account. Figure- 3.1.25 shows the outline of river improvement plan considered in this scenario.



*1: Ciliwung River improvement would be implemented by BBWS-CilCis
Note: without Ciliwung Floodway

Figure- 3.1.25 Master Plan Scenario

(3) Master Plan + Strengthening of Pumping Station Scenario

In this scenario, the existing Master Plan would be strengthened with pumping station by 2050. In the case that the amount of land subsidence increased in DKI Jakarta, an area of which ground level is lower than the sea level would suffer from flood due to the insufficiency of discharge of inland water. In this Study, strengthening of pumping stations was employed as the most effective method for mitigation of damages of inundation.

The areas in which pumping station is supposed to be strengthened are shown in Figure- 3.1.26. Note that the reinforcement of pumping stations does not diminish the current flood damage since the pumping stations are planned to cancel out the increment of flood damage from present to 2050 due to land subsidence in the low and flat area.

As shown in Table- 3.1.10, pump capacity needed in this scenario was total 760m^3/s among 12 drainage districts. The pump capacity was settled to adjust the extent of flood damage in the most severe scenario (a 100-year flood, A1FI and V2 in 2050) to that in the scenario with no land subsidence (a 100-year flood, A1FI and V0 in 2050) in order to diminish the increment of flood damage due to land subsidence.

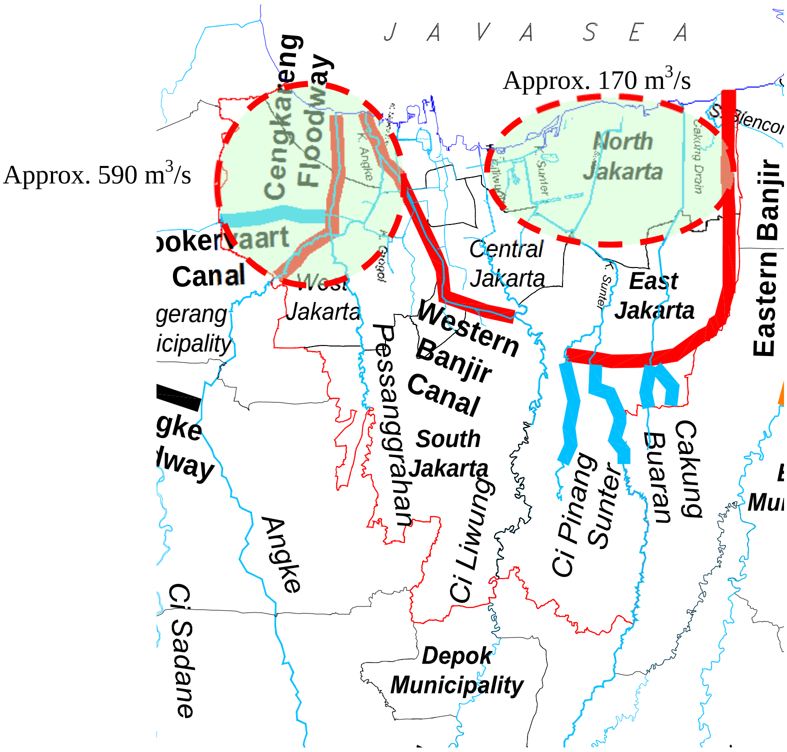


Figure- 3.1.26 Area of Strengthening Pumping Stations

Table- 3.1.10 Pump Capacity

Type of Land Subsidence	Pump Capacity (m^3/s)	Specific Pump Capacity ($m^3/s/km^2$)
V2	760	4.5

Drainage area: around 170km^2

3.1.6 Climate Change Scenarios

Climate change scenarios and simulation conditions considering urbanization, increased rate of rainfall, sea level rise, high tide, and land subsidence are shown in Table- 3.1.11.

Table- 3.1.11 Climate Change Scenario and Simulation Conditions

Climate Change Scenario	Temperature rise(℃) (downscaled)	Urbanization	Increased Rate of Rainfall	Sea-Level-Rise (cm)	High Tide Level (m)	Land Subsidence (m)
P	-	62.8% (2008)	0%	0	1.15	V0 = 0m V1 = 0.3m - 2.5m V2 = 0.9m – 5.9m
B1	0.8	84.3% (2050)	8%	20	1.15	V0 = 0m V1 = 0.3m - 2.5m V2 = 0.9m – 5.9m
A1FI	1.7	84.3% (2050)	17%	39	1.15	V0 = 0m V1 = 0.3m - 2.5m V2 = 0.9m – 5.9m

P: No Climate Change, B1: Sustainable Development Society Scenario, A1FI: Growth-oriented Society Scenario
V0: No Land Subsidence, Relatively Stable Subsidence, V2: Severe Land Subsidence

3.2 Flood Inundation Analysis Model

3.2.1 Selection of Flood Inundation Analysis Model

(1) Selection of Flood Inundation Model

Flood inundation model will be selected to comprehend following functions:

① Reflecting the features of the basin (topography, land use, etc.) and flooding of both inland water and external water are able to be simulated

② Effectiveness of various flood control measures in the basin is able to be evaluated.

Previously, concentration models such as rational formula, tank model, storage function model have been applied to analyze the discharge from the basin. Parameters required in these models were the average value or representative value of the basin, and outcomes derived from these models were limited to the information of the exit points of the basin.

In recent years, however, the information on the consecutive water level and flow velocity of the random points in the basin is required. Since the concentration models cannot meet such requirements thoroughly, distribution models have been proposed as the alternative model.

In the distribution model, whole basin area will be split into micro meshes and the information on geographical features, geological condition, land use, etc. will be reflected in each mesh. And rainfall can be provided to each mesh directly in order to track the flow between meshes (see Figure- 3.2.1).

Distribution model will be applied in this analysis due to the following reasons:

① The rainfall discharge and the process of the flooding at random location in the basin are required to be analyzed.

② The effectiveness of the various flood control measures are to be inspected.

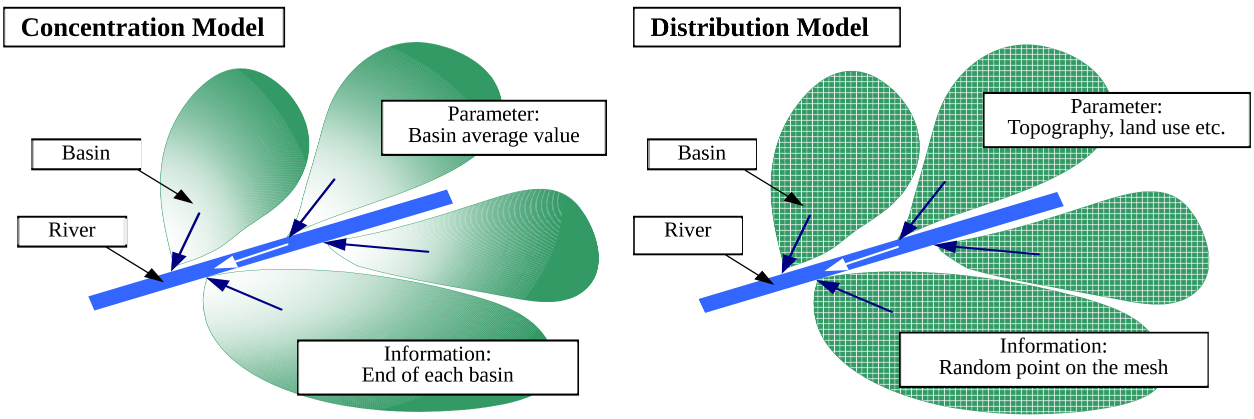


Figure- 3.2.1 Image of Concentration Model and Distribution Model

Flood inundation model of the target area shall be separated into 2 areas, “run-off area” and “inundation area” by the physical features of the area.

In this analysis, ①mountain areas and hilly areas are regarded as run-off area, ②low-lying areas are regarded as inundation area, and adequate hydraulic model will be applied according to each type of flow (see Figure- 3.2.2). Brief overviews of hydraulic models for run-off area and inundation area are shown as follows:

① Model for Run-off Area

Kinematic Wave Method will be applied because it is able to present the flow of the slope regardless of water level in the downstream. Adopted form of the model is **Distributed Runoff Model**, which has the same mesh structure with the inundation area and is able to track flow of each mesh along with the land features and slopes, in order to provide the flow volume according to the minute meshes of inundation area.

② Model for Inundation Area

Dynamic Wave Method, which is able to present the change of flows affected by the land features and structures such as drains, will be applied and trace the inundation flows. And adopted form of the model is **Two Dimensional Un-Steady Flow Model** which is able to recreate the propagation phenomena of flooding flow in greatest detail.

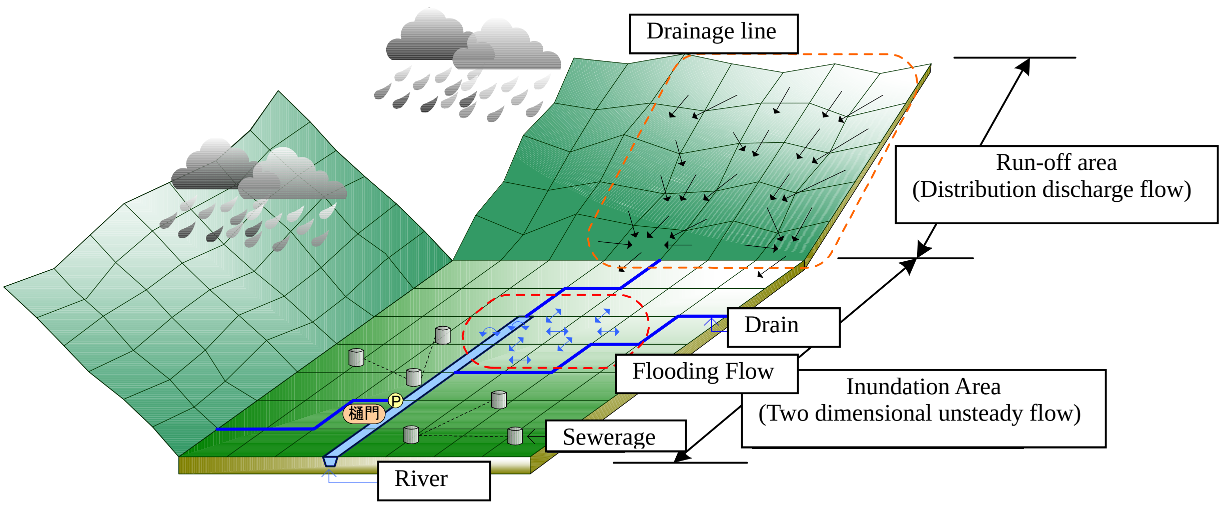


Figure- 3.2.2 Image of Flood Inundation Analysis Model

Land Features	①Upstream areas are mountainous and moderate slope descending to the lowland areas. ②Downstream areas are low-lying areas.
At Rainfall	①Rainfall flows down through the slopes in mountainous areas and mid-stream areas to the lowland area. ②In lowland area, drainage is damaged by affection of sea water level and external water and flooding occurs.
Possible Flooding Situation	①Flooding disaster will not be occurred in the uphill areas. ②In the lowland area, flooding is spread under the influence of water level of downstream.

Figure- 3.2.3 Discharge Pattern Expected by Land Features

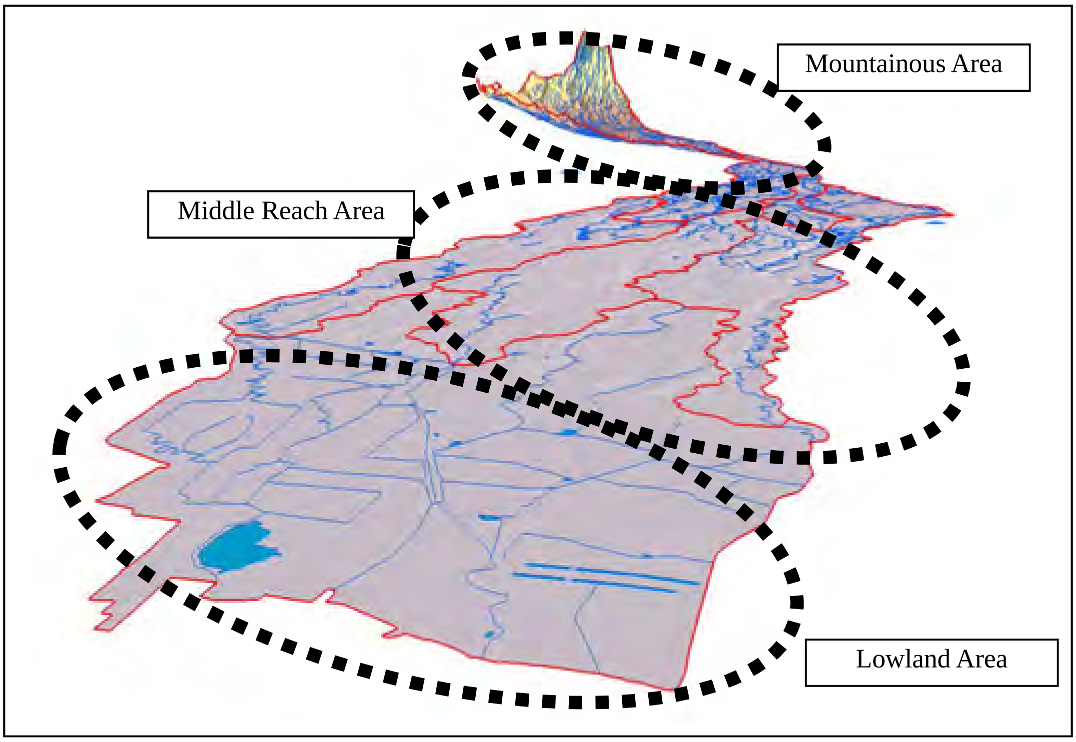


Figure- 3.2.4 Land Features of the Basin

(2) Mesh Tessellation over the Whole Basin

To analyze the discharge of whole basin, the whole basin will be segmented into orthogonal meshes and track the flow of individual mesh. Mesh segmentation of whole basin will be 230m square (7.5") in order to represent the inundation condition which is easily affected by the humble land features.

The number of meshes for this survey is approximately 28,300 in total; 11,600 for run-off area and 16,700 for inundation area respectively as shown in Table- 3.2.1.

Meshes are settled to cover the basin and segmented both latitude and longitude by 7.5", resulting in 230m east to west and 230m north to south.

Table- 3.2.1 Number of Meshes for the Model

Item	Number of Meshes
Inundation area	11,569
Run-off area	16,676
Total	28,245

(3) Settings of Run-off Area and Inundation Area

Flood inundation model of target basin is generally divided into "run-off area" and "inundation area" by the features of land. Target inundation area is the range enveloping the inundation record map (flooding in February, 2007, see Figure- 3.2.5).

Segmentation map of run-off area and inundation area is shown in Figure- 3.2.6.

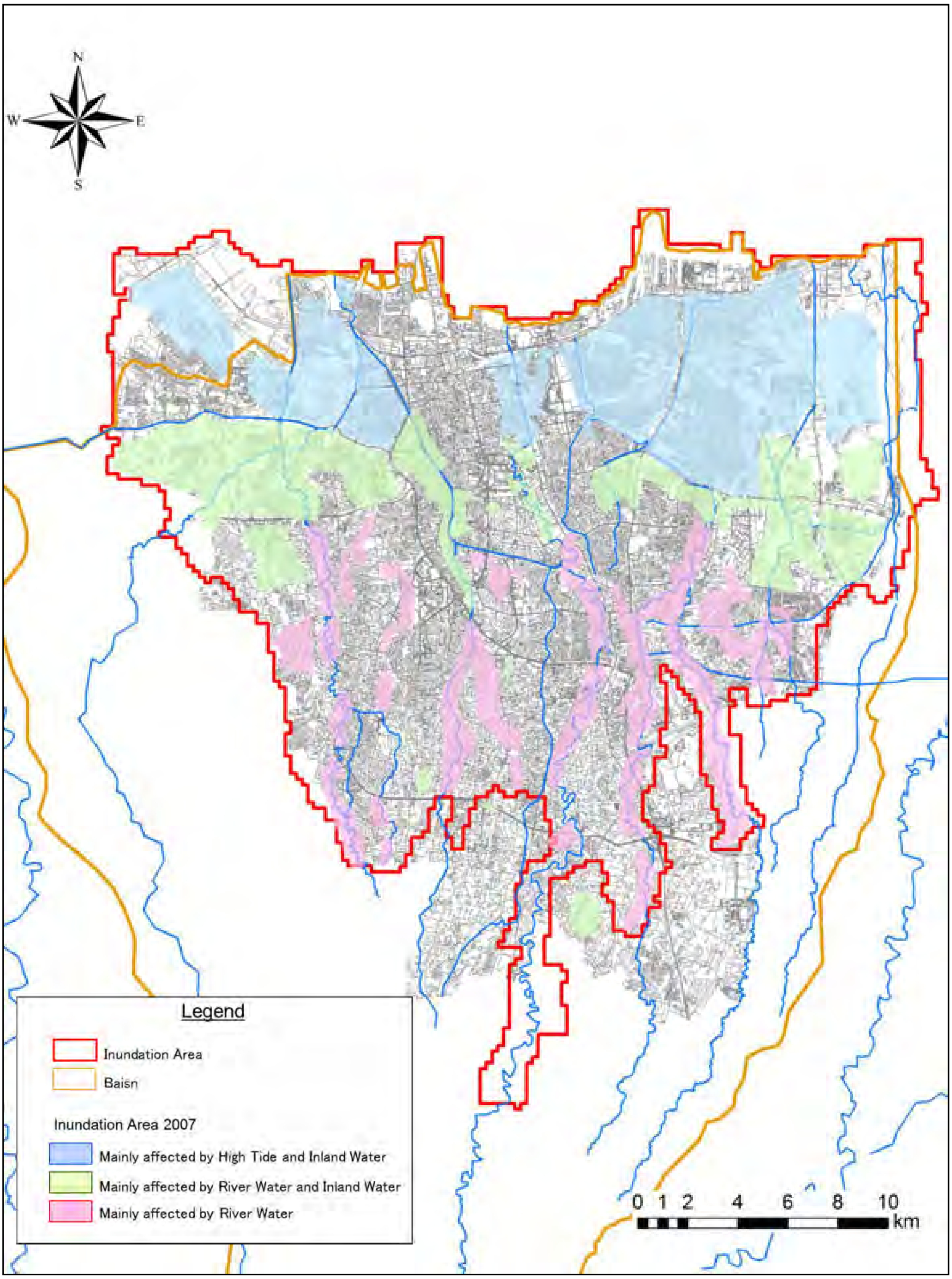
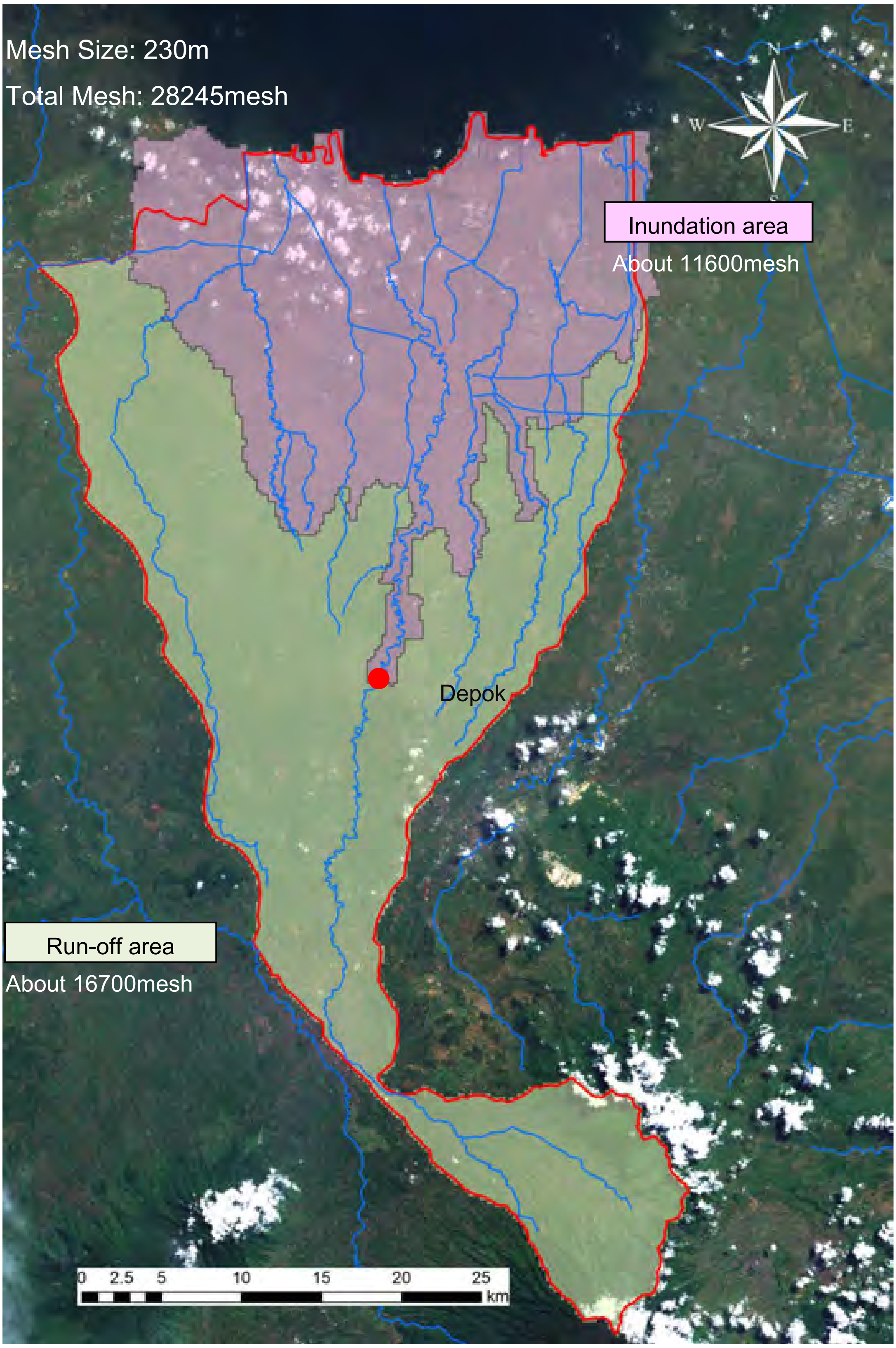


Figure- 3.2.5 Established Run-off Area and Inundation Area

(Inundation Record Map of 2007)



Aerial photograph: Google Earth

Figure- 3.2.6 Run-off Area and Inundation Area

3.2.2 Basic Structure of Flood Inundation Model

To settle the basic structure of flood inundation model, the features of target basin shown below needs to be reflected.

・Target basin is divided into "run-off area" and "inundation area".

・Target basin has been urbanized significantly, therefore surface drainage facilities such as rainwater drainage system are developed within the basin.

・High frequency of flooding

Required functions for structuring model are described as follows:

・Duplicate the combined flooding of inland flooding and external flooding.

・Analyze discharge and inundation in the basin as consistent phenomena.

・Duplicate time-series fluctuation considering the downstream water level, runoff volume from run-off area and effect of bridges.

・As for dimensional expansion of flood steam and propagation velocity, duplicate the flow-down resistance, etc. considering the land use and density of houses.

・Secure high accuracy with consideration for the effect of drainage, earth fill and subtle land features.

・Reflect the sluice way and discharge by pumping under the effect of inland and external water level.

・Settle the culvert for sewage rainwater discharge separately from surface flow, and describe the urban discharge system.

・Settle the retention facilities and reflect the initial flood adjustment functions.

Then following model is required to satisfy the functions described above.

<u>Rainfall model</u>
Time series distribution of rainfall is given to overall basin with consideration of loss phenomenon.
<u>River model</u>
Forced discharge to the river and tide level at the mouth of the river is reflected in the river level and hourly fluctuation is duplicated by One Dimensional Un-Steady Flow Model which can describe the overflow and the dike break.
<u>Run-off area model</u>
Runoff volume to the run-off area fixed based on land features is duplicated by Distributed Runoff Model (Kinematic Wave) which can trace the runoff volume in accordance with actual flow channels.
<u>Inundation area model</u>
Flood propagation is traced by Distributed Runoff Model considering water channels, sewerages, drainage system from pump stations, earth fill, as well as the land features of inundation area.

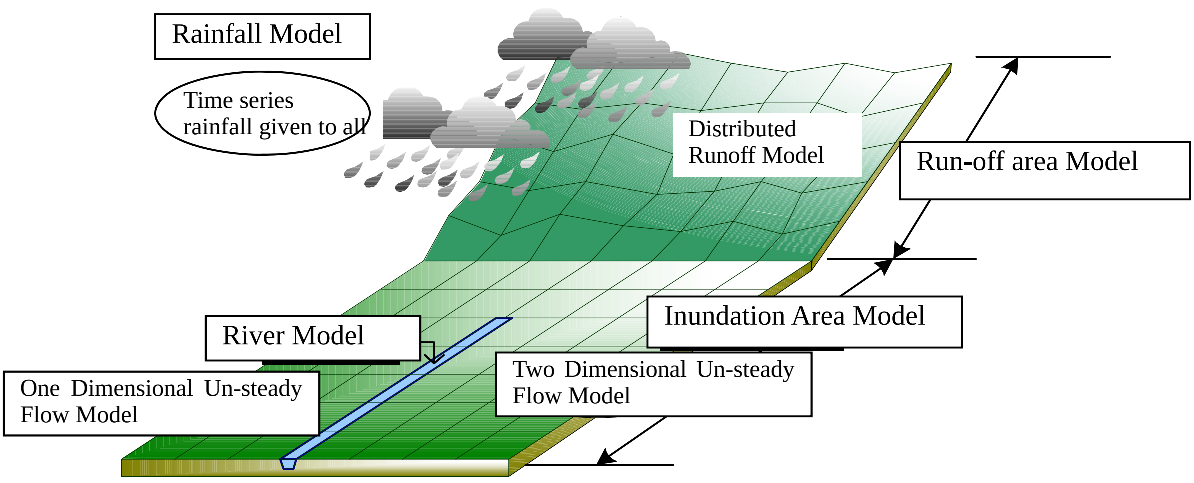


Figure- 3.2.7 Basic Structure of Discharge and Flooding Analysis Model

3.2.3 Formulation of Flood Inundation Model

(1) Brief Summary of Flood Inundation Model

Brief summary of flood inundation model is shown in Table- 3.2.2.

Table- 3.2.2 List of Flood Inundation Analysis Model

Items		Conditions	Remarks
Land Feature	Basic mesh	Run-off area 230m(7.5”), inundation area 230m(7.5”)	
	Inundation area land feature	Formulated based on 1/5000 Topographic map(2008) and GPS data	
	Run-off area land feature	Formulated based on 1/25000 Topographic map(2008)	
	Land use (inundation area)	Formulated based on DKI land use map(2008)	
	Land use (run-off area)	Formulated based on Jabodetabekpunjur land use map(2009)	
Analysis Model	River	One dimensional un-steady flow model(Dynamic Wave)	
	Inundation area	Two dimensional un-steady flow model(Dynamic Wave)	
	Run-off area	Distributed runoff model (Kinematic Wave)	
Built-in Model	Condition on the river	Bridges, gates, pumps	
	Inundation land feature mesh	Drainage canals, banks, culvert	
	Intervals of river and floodplain land feature mesh	Overflows, gates, pumps	
River	Cross sectional surface	Current river in 2011, identify 100m and 200m pitch in 2008	
	Water level of downstream end	Junction point with Java Sea: Tide level data of Tanjung Priok	
	Upstream end/inflow volume	Runoff volume of distributed runoff model (Kinematic Wave)	
Facilities	Banks	Main local roads and railways over 50cm	
	Drainage canals	Secondary affluent	
	Others		
Overflow	Coefficient of overflow	Settled considering the side overflow by formula	
	Overflow height	Current dike height	
	Overflow point	All intervals are targeted	
Pump operating condition		Follow the operation rules of each pump station	
Rainfall distribution		Waveform of flood in Feb. 2007(provided dimensionally by Thiessen method)	

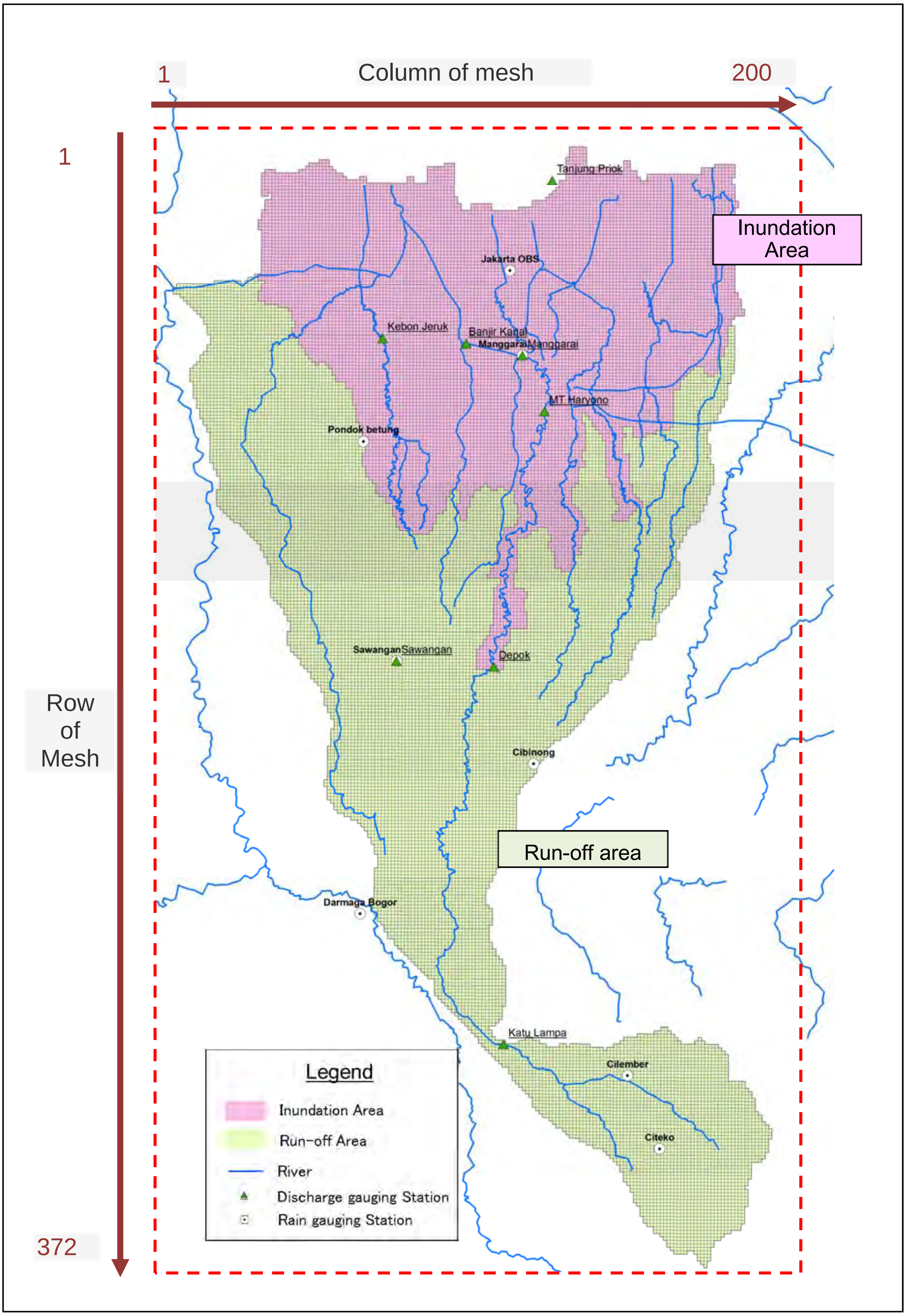


Figure- 3.2.8 Overall Area Segmented into 230m Meshes

(2) Reproducibility of the Model

Reproduction of recent most severe flood in February 2007 will be implemented in the model. Model validity is verified by actual flow volume (HQ adjusted value) at Depok point for run-off area model and by actual water level and actual inundation area at Manggarai for inundation area model.

1) River Flow Volume

The result of reproductive calculation for river flow volume at Depok is shown in Figure- 3.2.9.

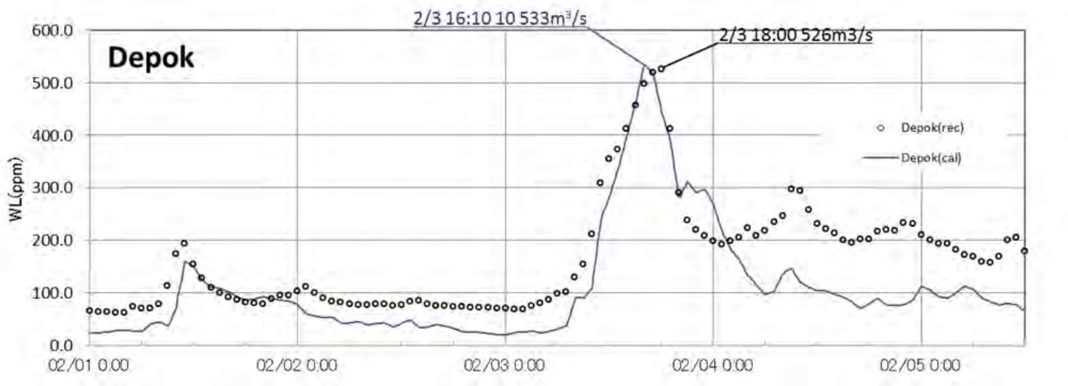


Figure- 3.2.9 Discharge Hydro (Depok)

2) River Water Level

The result of reproductive calculation for river flow volume at Manggarai is shown in Figure- 3.2.10.

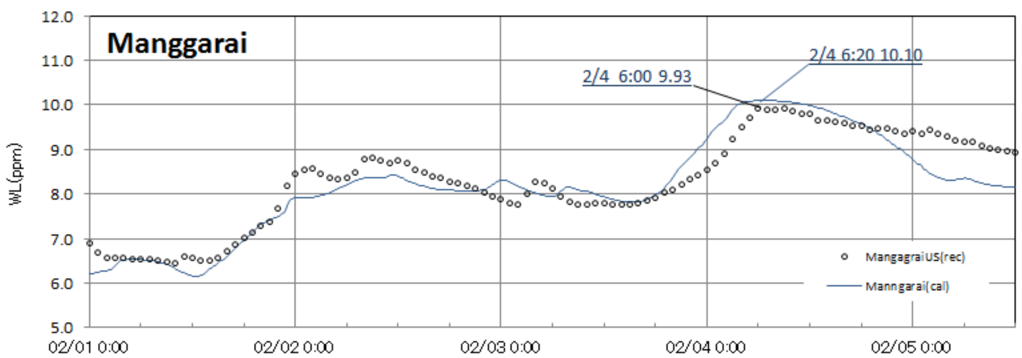


Figure- 3.2.10 Water Level Hydro (Manggarai)

3) Inundation Area

The results of reproductive calculation for inundation area based on the results above are shown in Figure- 3.2.11.

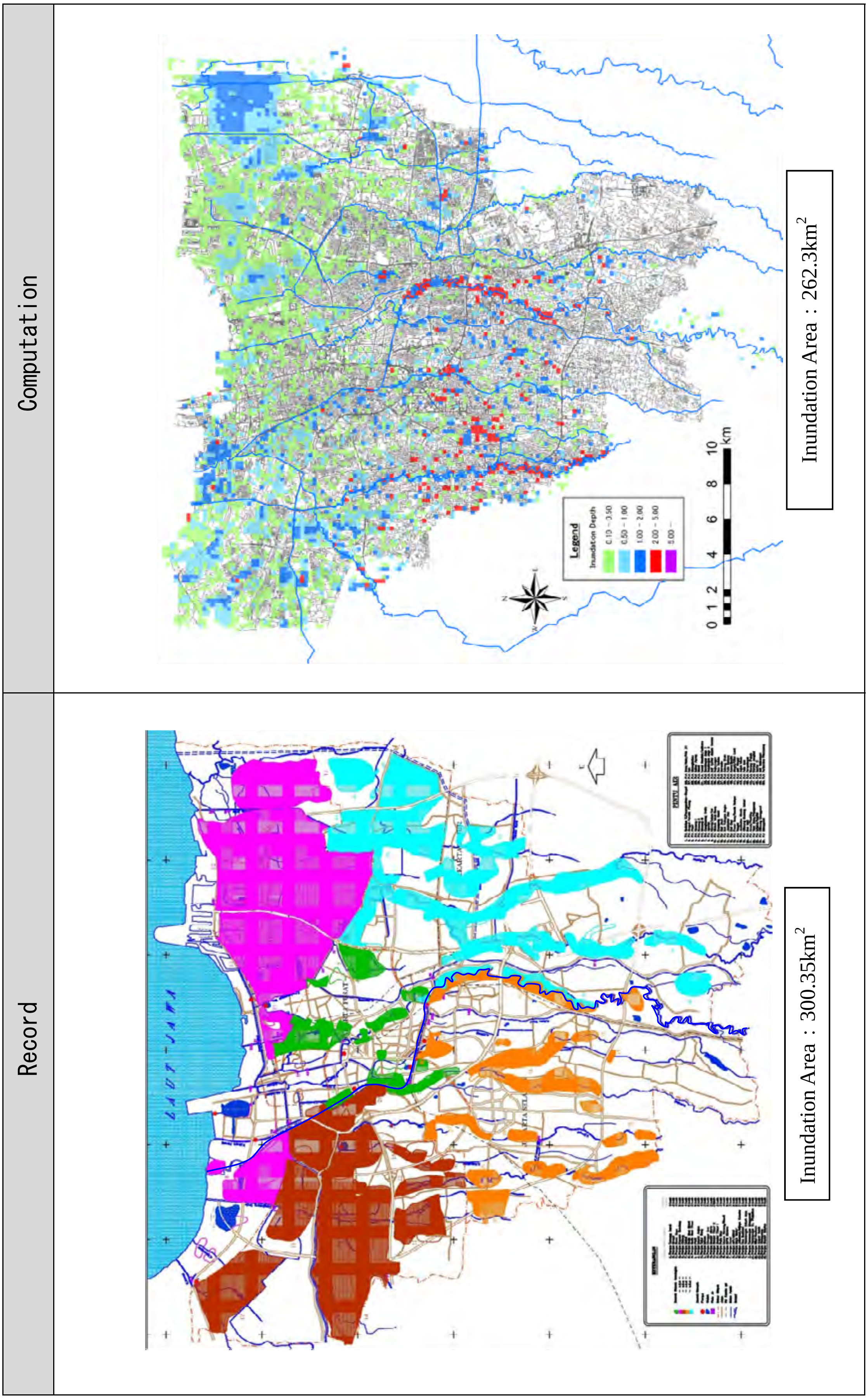


Figure- 3.2.11 Maximum Inundation Depth

3.3 Inundation Areas and Damage Level Estimation

3.3.1 Climate Change Scenarios and Flood Infrastructure Scenarios

(1) Planning Climate Change Scenario in 2050

Climate Change Scenarios in 2050, based on the scenarios considered in the Fourth Assessment Report of IPCC, are set as the following two scenarios as same as Manila and Bangkok of Joint Study.

- B1：Sustainable Development Society Scenario
- A1FI：Growth-oriented Society Scenario/Set Importance on Fossil Energy Resources

(2) Climate Change Scenario and Simulation Conditions

Climate Change Scenario and Simulation Conditions are shown in Table- 3.1.11 above.

(3) Climate Change Scenarios and Flood Infrastructure Scenarios

Table- 3.3.1 shows simulation cases in which climate change scenarios and flood infrastructure scenarios were combined. 45 cases of simulation were established in all.

- Return period: 1/10, 1/30, 1/100
- Land use: P(present condition in 2008), F(future condition in 2050)
- Flood Infrastructure: SQ(status quo scenario), MP(Master Plan scenario), MP+PS(MP + Strengthening of Pumping Station)
- Climate Change: P(no climate change), B1(sustainable development society scenario), A1FI(growth-oriented society scenario/set importance on fossil energy resources)
- Land Subsidence: V0(no land subsidence relative to 2008), V1(relatively stable land subsidence), V2(severe land subsidence)

Table- 3.3.1 Simulation Cases (Climate Change Scenarios and Flood Infrastructure Scenarios)

NO	Return Period	Year	Land Use	Infrastructure	Climate Change	Land Subsidence	Land Subsidence
1	10	2008	P	SQ	P	V0	2008_P_SQ_P_v0_10
2	10	2050	P	MP	P	V0	2050_P_MP_P_v0_10
3	10	2050	F	MP	P	V0	2050_F_MP_P_v0_10
4	10	2050	F	MP	B1	V0	2050_F_MP_B1_v0_10
5	10	2050	F	MP	B1	V1	2050_F_MP_B1_v1_10
6	10	2050	F	MP	B1	V2	2050_F_MP_B1_v2_10
7	10	2050	F	MP	A1FI	V0	2050_F_MP_A1FI_v0_10
8	10	2050	F	MP	A1FI	V1	2050_F_MP_ A1FI _v1_10
9	10	2050	F	MP	A1FI	V2	2050_F_MP_ A1FI _v2_10
10	10	2050	F	MP+PS	B1	V0	2050_F_MP+PS_B1_v0_10
11	10	2050	F	MP+PS	B1	V1	2050_F_MP+PS _B1_v1_10
12	10	2050	F	MP+PS	B1	V2	2050_F_MP+PS _B1_v2_10
13	10	2050	F	MP+PS	A1FI	V0	2050_F_MP+PS _A1FI_v0_10
14	10	2050	F	MP+PS	A1FI	V1	2050_F_MP+PS _ A1FI _v1_10
15	10	2050	F	MP+PS	A1FI	V2	2050_F_MP+PS _ A1FI _v2_10
16	30	2008	P	SQ	P	V0	2008_P_SQ_P_v0_30
17	30	2050	P	MP	P	V0	2050_P_MP_P_v0_30
18	30	2050	F	MP	P	V0	2050_F_MP_P_v0_30
19	30	2050	F	MP	B1	V0	2050_F_MP_B1_v0_30
20	30	2050	F	MP	B1	V1	2050_F_MP_B1_v1_30
21	30	2050	F	MP	B1	V2	2050_F_MP_B1_v2_30
22	30	2050	F	MP	A1FI	V0	2050_F_MP_A1FI_v0_30
23	30	2050	F	MP	A1FI	V1	2050_F_MP_ A1FI _v1_30
24	30	2050	F	MP	A1FI	V2	2050_F_MP_ A1FI _v2_30
25	30	2050	F	MP+PS	B1	V0	2050_F_MP+PS_B1_v0_30
26	30	2050	F	MP+PS	B1	V1	2050_F_MP+PS _B1_v1_30
27	30	2050	F	MP+PS	B1	V2	2050_F_MP+PS _B1_v2_30
28	30	2050	F	MP+PS	A1FI	V0	2050_F_MP+PS _A1FI_v0_30
29	30	2050	F	MP+PS	A1FI	V1	2050_F_MP+PS _ A1FI _v1_30
30	30	2050	F	MP+PS	A1FI	V2	2050_F_MP+PS _ A1FI _v2_30
31	100	2008	P	SQ	P	V0	2008_P_SQ_P_v0_100
32	100	2050	P	MP	P	V0	2050_P_MP_P_v0_100
33	100	2050	F	MP	P	V0	2050_F_MP_P_v0_100
34	100	2050	F	MP	B1	V0	2050_F_MP_B1_v0_100
35	100	2050	F	MP	B1	V1	2050_F_MP_B1_v1_100
36	100	2050	F	MP	B1	V2	2050_F_MP_B1_v2_100
37	100	2050	F	MP	A1FI	V0	2050_F_MP_A1FI_v0_100
38	100	2050	F	MP	A1FI	V1	2050_F_MP_ A1FI _v1_100
39	100	2050	F	MP	A1FI	V2	2050_F_MP_ A1FI _v2_100
40	100	2050	F	MP+PS	B1	V0	2050_F_MP+PS_B1_v0_100
41	100	2050	F	MP+PS	B1	V1	2050_F_MP+PS _B1_v1_100
42	100	2050	F	MP+PS	B1	V2	2050_F_MP+PS _B1_v2_100
43	100	2050	F	MP+PS	A1FI	V0	2050_F_MP+PS _A1FI_v0_100
44	100	2050	F	MP+PS	A1FI	V1	2050_F_MP+PS _ A1FI _v1_100
45	100	2050	F	MP+PS	A1FI	V2	2050_F_MP+PS _ A1FI _v2_100

Land Use
P: present condition in 2008, **F**: future condition in 2050

Flood Infrastructure Scenario
SQ: Status Quo Scenario, **MP**: Master Plan Scenario, **MP+PS**: Master Plan + Strengthening of Pumping Station

Climate Change Scenario
P: present condition, **B1**: Sustainable Development Society Scenario, **A1FI**: Growth-oriented Society Scenario / Set Importance on Fossil Energy Resources

Land Subsidence
V0: no land subsidence compared to 2008, **V1**: relatively stable land subsidence, **V2**: severe land subsidence

(4) Rainfall Waveform under Climate Change

Figure- 3.3.1 shows basin average rainfall volume at Manggarai in the flood in February 2007 which was the most severe flood in recent years and was adopted as the object of climate change simulation in this Study. In the climate change scenarios, rainfall waveform at present was extended in accordance with the extension rate of rainfall shown in Table- 3.3.2.

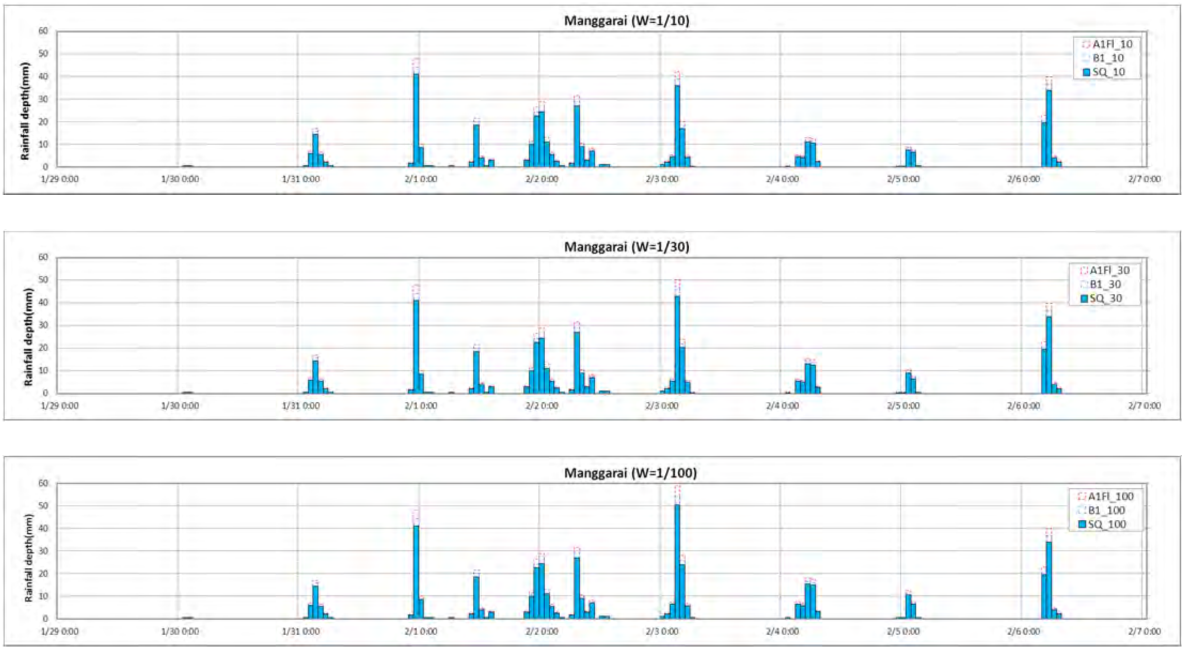


Figure- 3.3.1 Basin Average Rainfall Volume at Manggarai (Flood in February 2007)

Table- 3.3.2 Extension Rate of Rainfall

Scenario	P	B1	A1FI
Extension Rate of Rainfall	1.00	1.08	1.17

(5) Hydrograph under Climate Change

Figure- 3.3.2 shows hydrograph at Depok under the climate change scenarios described above. This discharge waveform is applied to the edge of the upstream of Ciliwung River as a boundary condition in the simulation of climate change. As shown in Table- 3.3.3, peak discharge increases by approximately 20~30 percent in accordance with the change of land use, and also increases by approximately 20~30 percent in accordance with climate change.

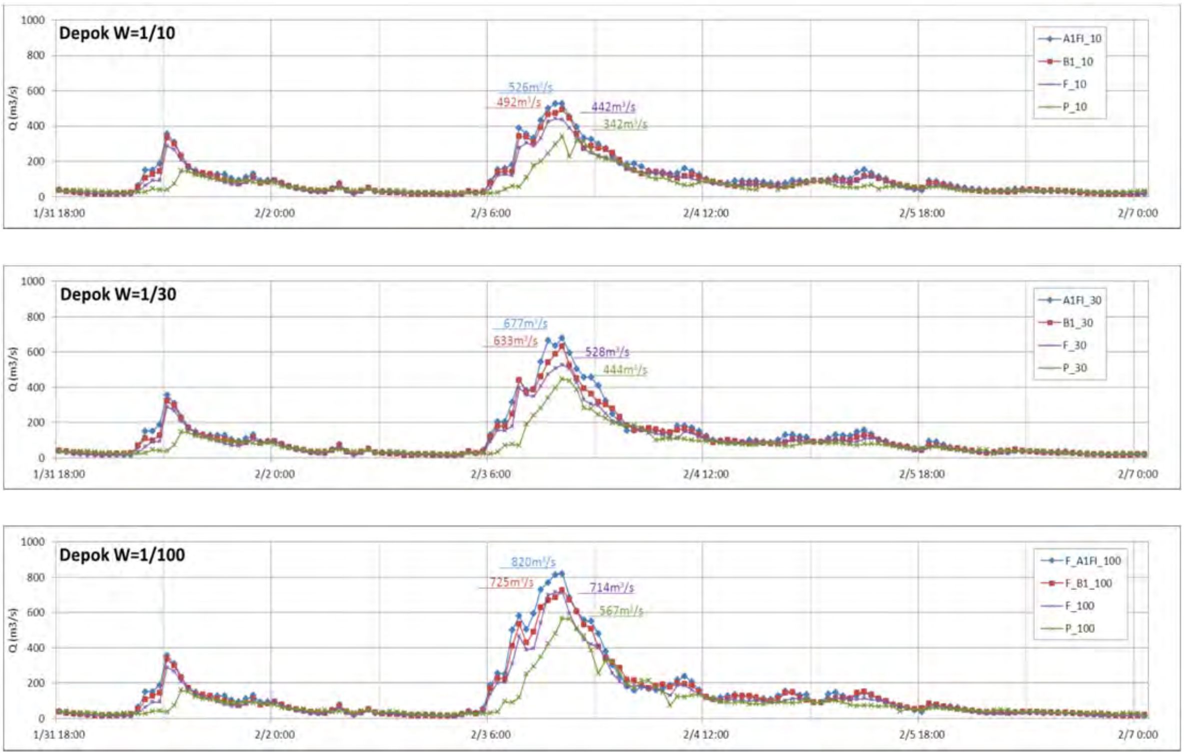


Figure- 3.3.2 Hydrograph at Depok (Flood in February 2007)

Table- 3.3.3 Peak Discharge

Return period		1/10	1/30	1/100
Peak Discharge (m3/s)	Present	342	444	567
	Future	442	528	714
	B1	492	633	725
	A1FI	526	677	820
Ratio	Future/Present	1.29	1.19	1.26
	B1/Present	1.44	1.43	1.28
	A1FI/Present	1.54	1.52	1.45

3.3.2 Flood Inundation Damage Area/Volume/Average Depth

The results of simulation are shown in Table- 3.3.4.

Table- 3.3.4 Results of Inundation Simulation

NO	Return Period	Year	Land Use	Infra-structure	Climate Change	Land Subsidence	Inundation Area (km2)	Ratio for Inundation Area	Area Ratio for No.1	Inundation Volume (millionm^3)	Volume ratio for No.1	Average Inundation Depth (m)
1	10	2008	P	SQ	P	V0	237.9	39%	100%	154.9	100%	0.65
2	10	2050	P	MP	P	V0	231.6	38%	97%	142.0	92%	0.61
3	10	2050	F	MP	P	V0	233.9	38%	98%	150.7	97%	0.64
4	10	2050	F	MP	B1	V0	253.3	41%	106%	180.4	116%	0.71
5	10	2050	F	MP	B1	V1	300.4	49%	126%	276.4	178%	0.92
6	10	2050	F	MP	B1	V2	310.9	51%	131%	355.0	229%	1.14
7	10	2050	F	MP	A1FI	V0	264.2	43%	111%	197.2	127%	0.75
8	10	2050	F	MP	A1FI	V1	308.1	50%	130%	295.8	191%	0.96
9	10	2050	F	MP	A1FI	V2	320.6	52%	135%	382.5	247%	1.19
10	10	2050	F	MP+PS	B1	V0	248.0	41%	104%	165.4	107%	0.67
11	10	2050	F	MP+PS	B1	V1	279.0	46%	117%	212.8	137%	0.76
12	10	2050	F	MP+PS	B1	V2	283.7	46%	119%	224.9	145%	0.79
13	10	2050	F	MP+PS	A1FI	V0	258.0	42%	108%	179.9	116%	0.70
14	10	2050	F	MP+PS	A1FI	V1	288.5	47%	121%	230.7	149%	0.80
15	10	2050	F	MP+PS	A1FI	V2	294.2	48%	124%	246.7	159%	0.84
16	30	2008	P	SQ	P	V0	241.9	40%	102%	161.3	104%	0.67
17	30	2050	P	MP	P	V0	235.0	38%	99%	144.7	93%	0.62
18	30	2050	F	MP	P	V0	237.4	39%	100%	154.0	99%	0.65
19	30	2050	F	MP	B1	V0	257.4	42%	108%	183.9	119%	0.71
20	30	2050	F	MP	B1	V1	303.8	50%	128%	283.2	183%	0.93
21	30	2050	F	MP	B1	V2	315.3	52%	133%	365.3	236%	1.16
22	30	2050	F	MP	A1FI	V0	268.9	44%	113%	201.5	130%	0.75
23	30	2050	F	MP	A1FI	V1	312.1	51%	131%	303.9	196%	0.97
24	30	2050	F	MP	A1FI	V2	324.3	53%	136%	394.2	254%	1.22
25	30	2050	F	MP+PS	B1	V0	252.5	41%	106%	169.3	109%	0.67
26	30	2050	F	MP+PS	B1	V1	282.4	46%	119%	218.6	141%	0.77
27	30	2050	F	MP+PS	B1	V2	287.6	47%	121%	232.1	150%	0.81
28	30	2050	F	MP+PS	A1FI	V0	263.1	43%	111%	185.3	120%	0.70
29	30	2050	F	MP+PS	A1FI	V1	292.5	48%	123%	238.1	154%	0.81
30	30	2050	F	MP+PS	A1FI	V2	298.1	49%	125%	255.7	165%	0.86
31	100	2008	P	SQ	P	V0	247.2	40%	104%	169.8	110%	0.69
32	100	2050	P	MP	P	V0	239.8	39%	101%	148.8	96%	0.62
33	100	2050	F	MP	P	V0	243.4	40%	102%	159.7	103%	0.66
34	100	2050	F	MP	B1	V0	264.0	43%	111%	190.0	123%	0.72
35	100	2050	F	MP	B1	V1	309.2	51%	130%	292.7	189%	0.95
36	100	2050	F	MP	B1	V2	321.6	53%	135%	378.3	244%	1.18
37	100	2050	F	MP	A1FI	V0	277.1	45%	116%	210.0	136%	0.76
38	100	2050	F	MP	A1FI	V1	317.3	52%	133%	314.3	203%	0.99
39	100	2050	F	MP	A1FI	V2	331.2	54%	139%	410.5	265%	1.24
40	100	2050	F	MP+PS	B1	V0	258.8	42%	109%	175.9	114%	0.68
41	100	2050	F	MP+PS	B1	V1	287.9	47%	121%	227.2	147%	0.79
42	100	2050	F	MP+PS	B1	V2	293.4	48%	123%	243.2	157%	0.83
43	100	2050	F	MP+PS	A1FI	V0	269.7	44%	113%	194.1	125%	0.72
44	100	2050	F	MP+PS	A1FI	V1	299.0	49%	126%	248.0	160%	0.83
45	100	2050	F	MP+PS	A1FI	V2	304.4	50%	128%	268.5	173%	0.88

Table- 3.3.5～Table- 3.3.19, Figure- 3.3.3～Figure- 3.3.17 show the result of the analysis on inundation area, inundation volume, and average depth by such types as the condition of land use, climate change, and land subsidence. Three figures illustrate flood damages in the case of 1-in-10 year flood, 1-in-30 year flood, and 1-in-100 year flood respectively. It is illustrated that flood damages in view of inundation area and average inundation depth increase in accordance with the increase of rainfall volume.

Given the above, it can be said that even if the rainfall volume is relatively low, DKI Jakarta is likely to suffer from flood (due to inner water) in consideration of the characteristics of rainfall, inundation, topography, and the state of flood infrastructure (e.g. improvement of river and storm drains). Regardless of the progress of river improvement based on the Master Plan, flood damage due to inner water still occurs since the improvement of storm drains and streams in DKI Jakarta has not been sufficiently implemented. Thus, it is conceivable that flood damage due to inner water increases in accordance with the increase of rainfall volume.

In addition, it can be said that flood damage concentrates on along the rivers because drainage channels are located on an area around the rivers which is comparatively low and flat and water is likely to accumulate. In the case that land subsidence is in progress in DKI Jakarta, it causes further flood due to inner water because inundation water accumulated in inundation area is not properly discharged to the sea. Therefore, the possibility that floods cause not only economic but also social damages in large scale would become extremely high. Considering the increase of rainfall volume and sea level rise due to climate change, flood damage due to inner water increases for the same reason described above.

Consequently, serious flood damage can occur in DKI Jakarta due to the progress of urbanization of land use, the effect of climate change, and further progress of land subsidence. The occurrence of flood is mainly derived from the delay of river improvement, and the improvement of storm drains and streams which flow into the rivers. Therefore, it needs to establish comprehensive flood management in DKI Jakarta including countermeasures against climate change and land subsidence, land use regulations, and improvement of river and storm drains, etc. considering the whole river basin.

Table- 3.3.5 Result of Inundation Analysis by Return Period (1/15)

Case	(1) 2008_P_SQ_P_v0_10	(16) 2008_P_SQ_P_v0_30	(31) 2008_P_SQ_P_v0_100
Flood Area	237.9km^2	241.9 km^2	247.2 km^2
Flood Volume	154.9×10^{6}m^3	161.3×10^{6}m^3	169.8×10^{6}m^3
Flood Depth	0.65m	0.67m	0.69m

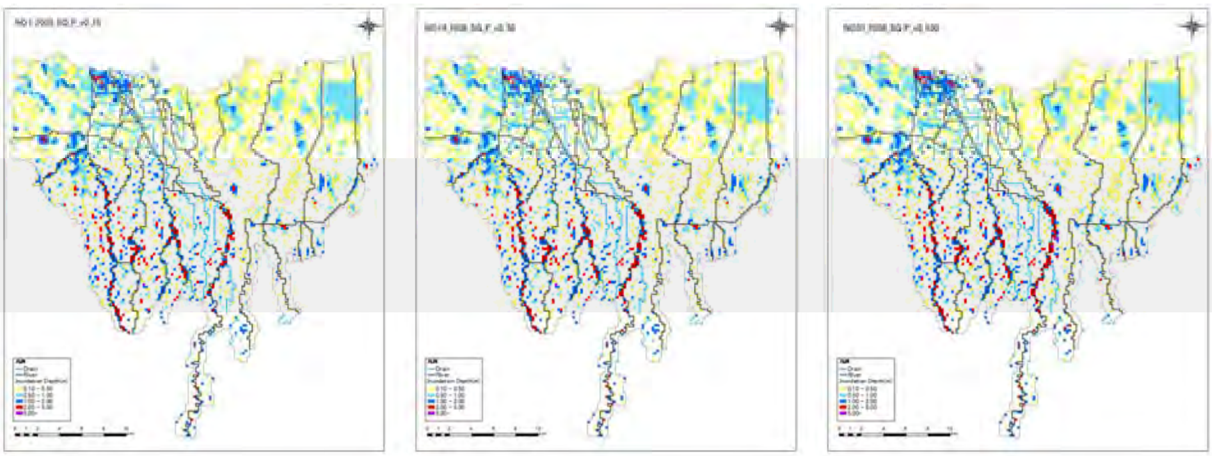


Figure- 3.3.3 Map of the Result of Inundation Analysis (1/15)

Table- 3.3.6 Result of Inundation Analysis by Return Period (2/15)

Case	(2) 2050_P_MP_P_v0_10	(17) 2050_P_MP_P_v0_30	(32) 2050_P_MP_P_v0_100
Flood Area	231.6 km^2	235.0 km^2	239.8km^2
Flood Volume	$142.0 \times 10^6 m^3$	$144.7 \times 10^6 m^3$	$148.8 \times 10^6 m^3$
Flood Depth	0.61m	0.62m	0.62m

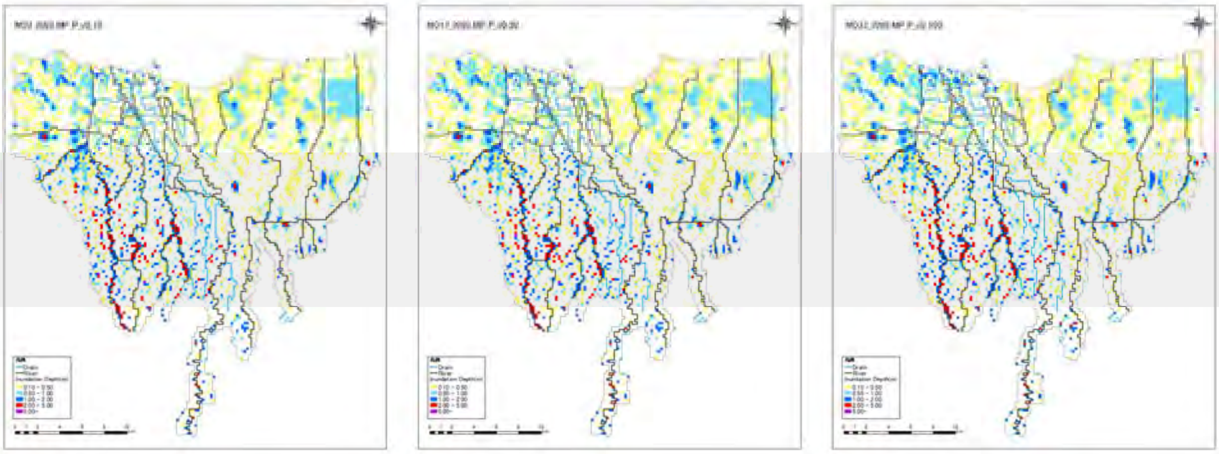


Figure- 3.3.4 Map of the Result of Inundation Analysis (2/15)

Table- 3.3.7 Result of Inundation Analysis by Return Period (3/15)

Case	(3) 2050_F_MP_P_v0_10	(18) 2050_F_MP_P_v0_30	(33) 2050_F_MP_P_v0_100
Flood Area	233.9 km^2	237.4 km^2	243.4km^2
Flood Volume	$150.7 \times 10^6 m^3$	$154.0 \times 10^6 m^3$	$159.7 \times 10^6 m^3$
Flood Depth	0.64m	0.65m	0.66m

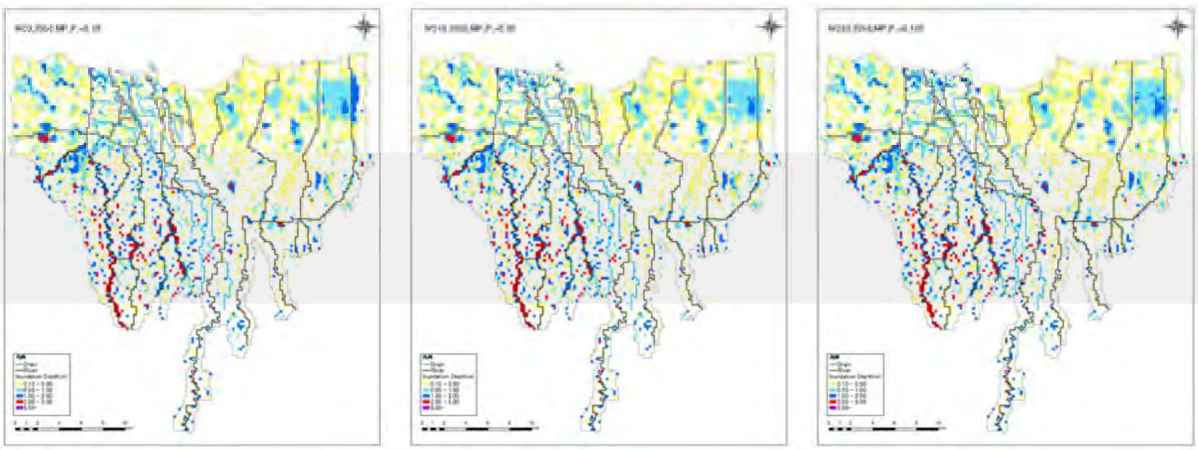


Figure- 3.3.5 Map of the Result of Inundation Analysis (3/15)

Table- 3.3.8 Result of Inundation Analysis by Return Period (4/15)

Case	(4) 2050_F_MP_B1_v0_10	(19) 2050_F_MP_B1_v0_30	(34) 2050_F_MP_B1_v0_100
Flood Area	253.3 km^2	257.4 km^2	264.0km^2
Flood Volume	$180.4 \times 10^6 m^3$	$183.9 \times 10^6 m^3$	$190.0 \times 10^6 m^3$
Flood Depth	0.71m	0.71m	0.72m

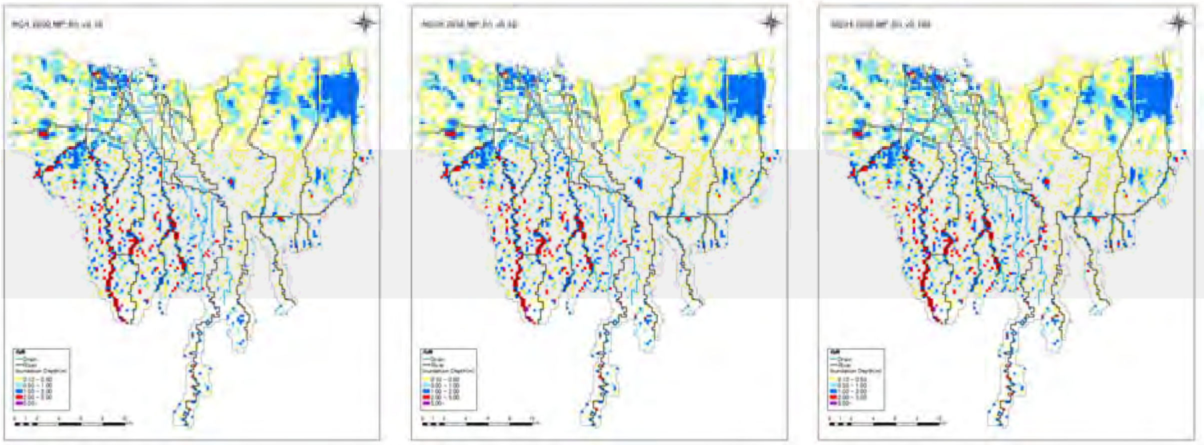


Figure- 3.3.6 Map of the Result of Inundation Analysis (4/15)

Table- 3.3.9 Result of Inundation Analysis by Return Period (5/15)

Case	(5) 2050_F_MP_B1_v1_10	(20) 2050_F_MP_B1_v1_30	(35) 2050_F_MP_B1_v1_100
Flood Area	300.4 km^2	303.8 km^2	309.2 km^2
Flood Volume	$276.4 \times 10^6 m^3$	$283.2 \times 10^6 m^3$	$292.7 \times 10^6 m^3$
Flood Depth	0.92m	0.93m	0.95m

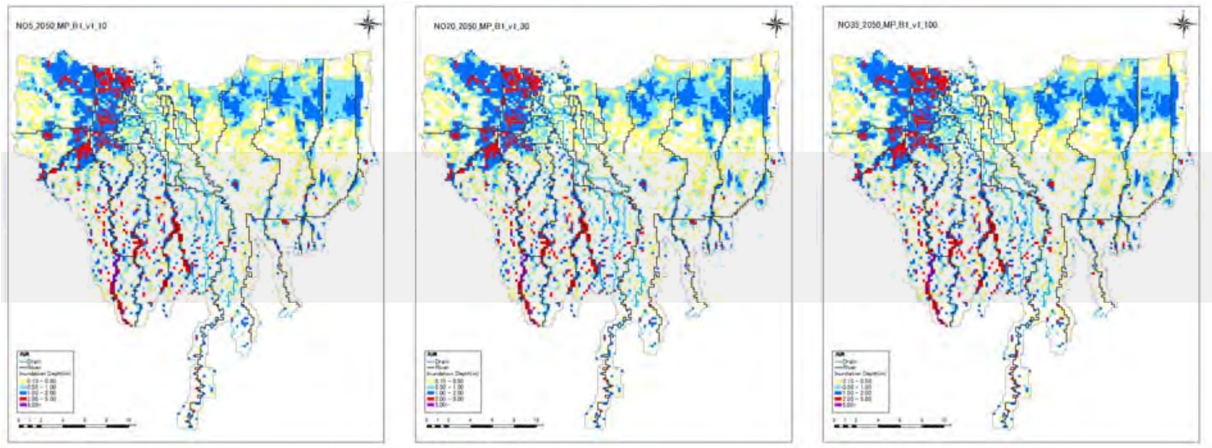


Figure- 3.3.7 Map of the Result of Inundation Analysis (5/15)

Table- 3.3.10 Result of Inundation Analysis by Return Period (6/15)

Case	(6) 2050_F_MP_B1_v2_10	(21) 2050_F_MP_B1_v2_30	(36) 2050_F_MP_B1_v2_100
Flood Area	310.9 km^2	315.3 km^2	321.6 km^2
Flood Volume	$355.0\times10^6 m^3$	$365.3\times10^6 m^3$	$378.3\times10^6 m^3$
Flood Depth	1.14m	1.16m	1.18m

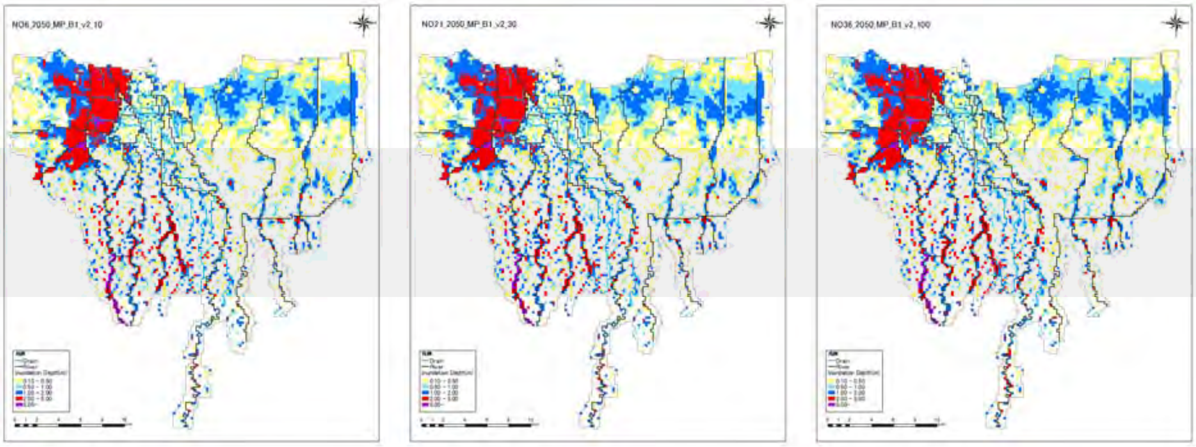


Figure- 3.3.8 Map of the Result of Inundation Analysis (6/15)

Table- 3.3.11 Result of Inundation Analysis by Return Period (7/15)

Case	(7) 2050_F_MP_A1FI_v0_10	(22) 2050_F_MP_A1FI_v0_30	(37) 2050_F_MP_A1FI_v0_100
Flood Area	264.2 km^2	268.9 km^2	277.1km^2
Flood Volume	$197.2\times10^6 m^3$	$201.5\times10^6 m^3$	$210.0\times10^6 m^3$
Flood Depth	0.75m	0.75m	0.76m

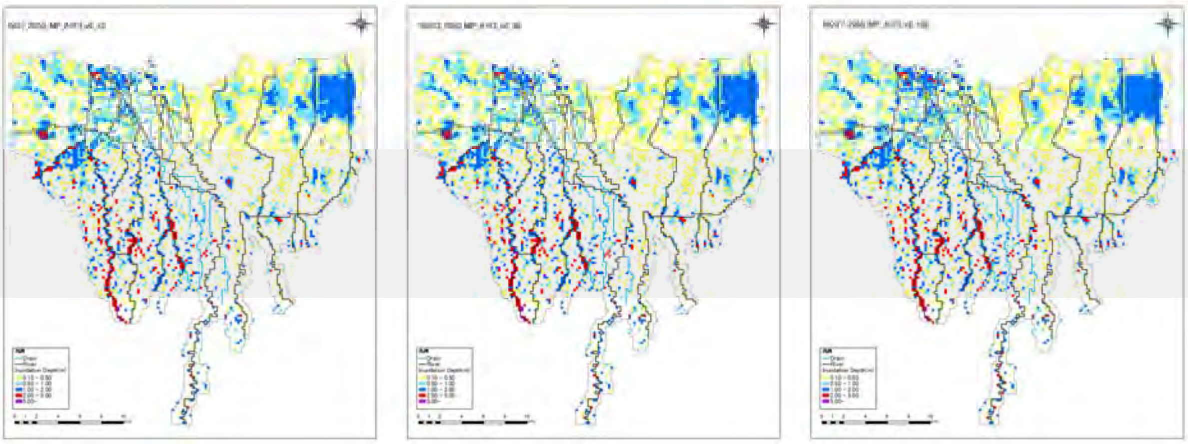


Figure- 3.3.9 Map of the Result of Inundation Analysis (7/15)

Table- 3.3.12 Result of Inundation Analysis by Return Period (8/15)

Case	(8) 2050_F_MP_A1FI_v1_10	(23) 2050_F_MP_A1FI_v1_30	(38) 2050_F_MP_A1FI_v1_100
Flood Area	308.1 km^2	312.1 km^2	317.3 km^2
Flood Volume	$295.8\times10^6 m^3$	$303.9\times10^6 m^3$	$314.3\times10^6 m^3$
Flood Depth	0.96m	0.97m	0.99m

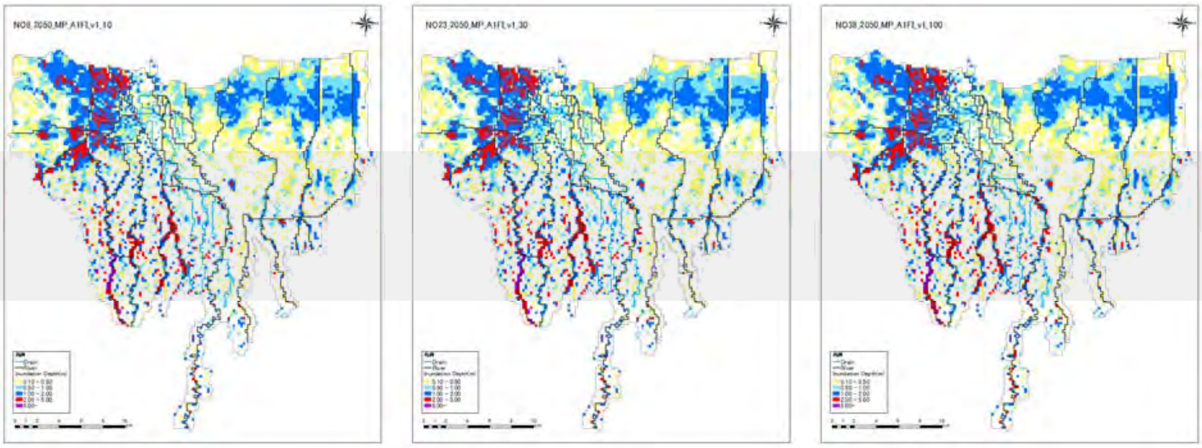


Figure- 3.3.10 Map of the Result of Inundation Analysis (8/15)

Table- 3.3.13 Result of Inundation Analysis by Return Period (9/15)

Case	(9) 2050_F_MP_A1FI_v2_10	(24) 2050_F_MP_A1FI_v2_30	(39) 2050_F_MP_A1FI_v2_100
Flood Area	320.6 km^2	324.3 km^2	331.2 km^2
Flood Volume	$382.5\times10^6 m^3$	$394.2\times10^6 m^3$	$410.5\times10^6 m^3$
Flood Depth	1.19m	1.22m	1.24m

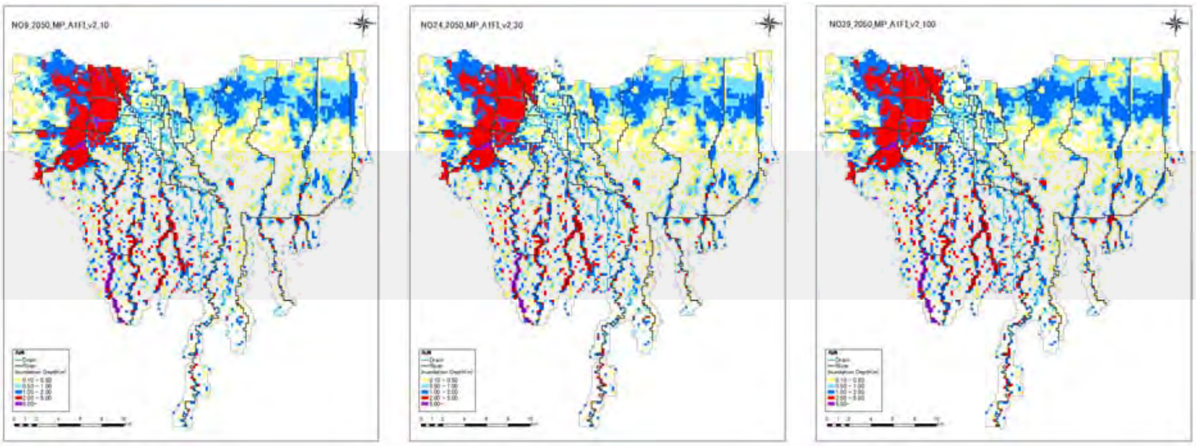


Figure- 3.3.11 Map of the Result of Inundation Analysis (9/15)

Table- 3.3.14 Result of Inundation Analysis by Return Period (10/15)

Case	(10) 2050_F_MP+PS_B1_ v0_10	(25) 2050_F_MP+PS_B1_ v0_30	(40) 2050_F_MP+PS_B1_ v0_100
Flood Area	248.0 km^2	252.5 km^2	258.8 km^2
Flood Volume	$165.4\times10^6 m^3$	$169.3\times10^6 m^3$	$175.9\times10^6 m^3$
Flood Depth	0.67m	0.67m	0.68m

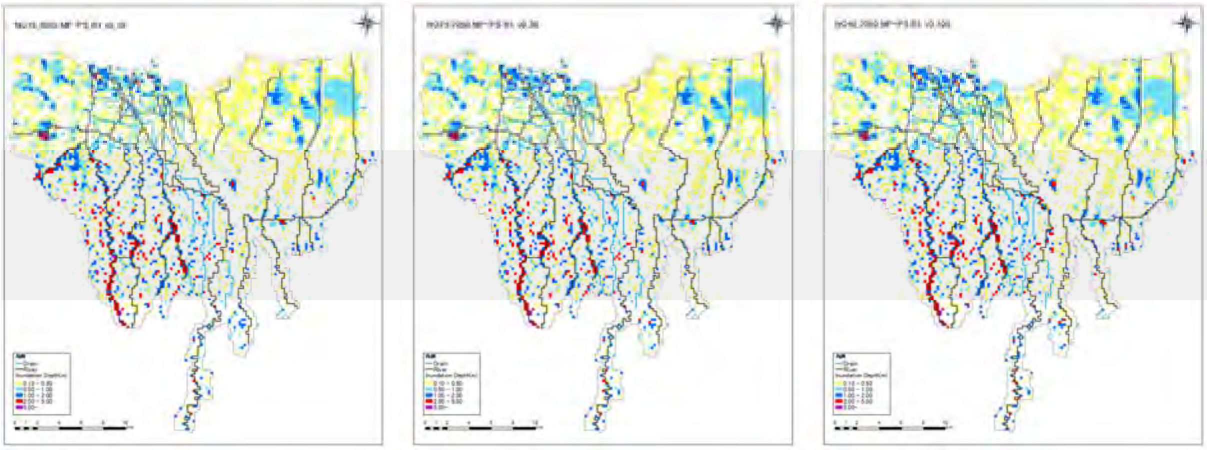


Figure- 3.3.12 Map of the Result of Inundation Analysis (10/15)

Table- 3.3.15 Result of Inundation Analysis by Return Period (11/15)

Case	(11) 2050_F_MP+PS_B1_ v1_10	(26) 2050_F_MP+PS_B1_ v1_30	(41) 2050_F_MP+PS_B1_ v1_100
Flood Area	279.0 km^2	282.4 km^2	287.9km^2
Flood Volume	$212.8\times10^6 m^3$	$218.6\times10^6 m^3$	$227.2\times10^6 m^3$
Flood Depth	0.76m	0.77m	0.79m

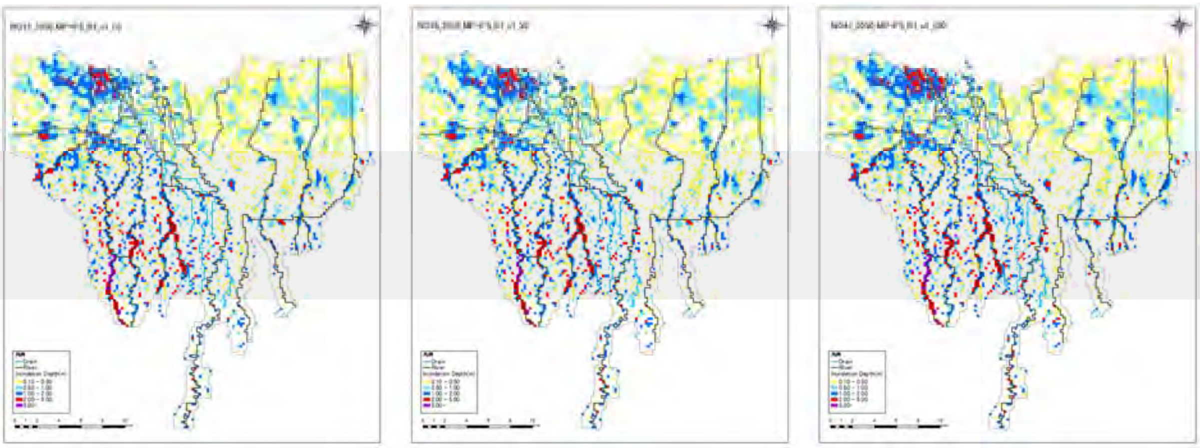


Figure- 3.3.13 Map of the Result of Inundation Analysis (11/15)

Table- 3.3.16 Result of Inundation Analysis by Return Period (12/15)

Case	(12) 2050_F_MP+PS_B1_ v2_10	(27) 2050_F_MP+PS_B1_ v2_30	(42) 2050_F_MP+PS_B1_ v2_100
Flood Area	283.7 km^2	287.6 km^2	293.4 km^2
Flood Volume	$224.9 \times 10^6 m^3$	$232.1 \times 10^6 m^3$	$243.2 \times 10^6 m^3$
Flood Depth	0.79m	0.81m	0.83m

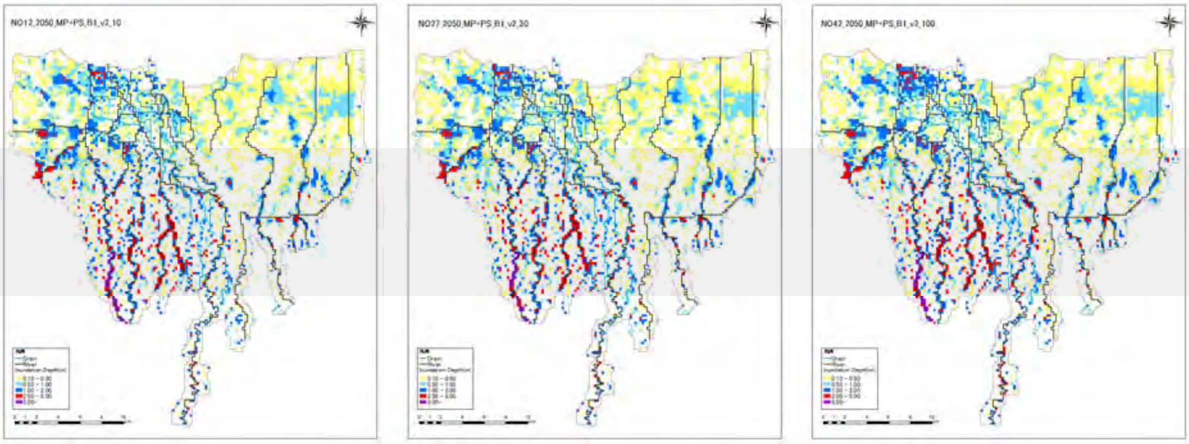


Figure- 3.3.14 Map of the Result of Inundation Analysis (12/15)

Table- 3.3.17 Result of Inundation Analysis by Return Period (13/15)

Case	(13) 2050_F_MP+PS_A1FI_ v0_10	(28) 2050_F_MP+PS_A1FI_ v0_30	(43) 2050_F_MP+PS_A1FI_ v0_100
Flood Area	258.0 km^2	263.1 km^2	269.7 km^2
Flood Volume	$179.9 \times 10^6 m^3$	$185.3 \times 10^6 m^3$	$194.1 \times 10^6 m^3$
Flood Depth	0.70m	0.70m	0.72m

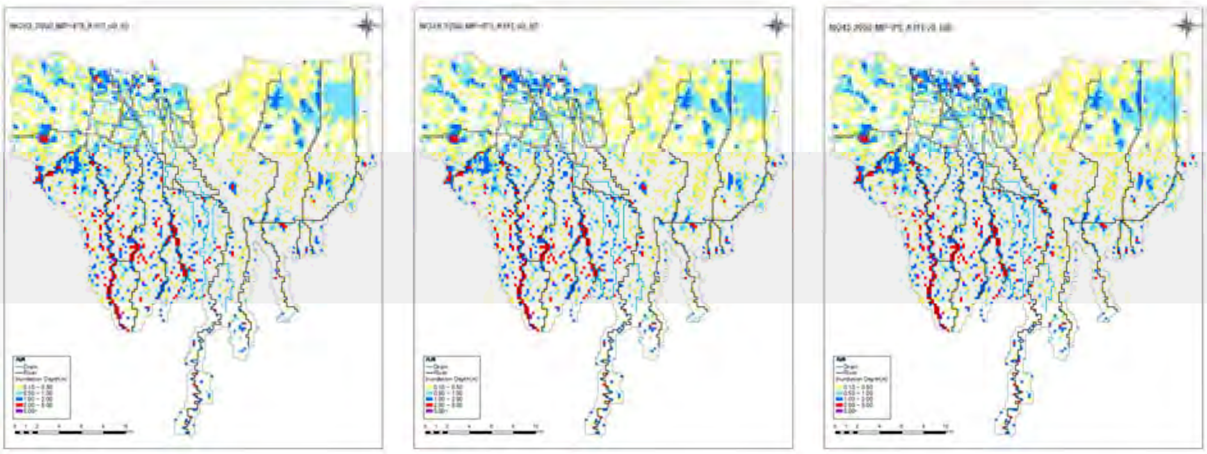


Figure- 3.3.15 Map of the Result of Inundation Analysis (13/15)

Table- 3.3.18 Result of Inundation Analysis by Return Period (14/15)

Case	(14) 2050_F_MP+PS_A1FI_ v1_10	(29) 2050_F_MP+PS_A1FI_ v1_30	(44) 2050_F_MP+PS_A1FI_ v1_100
Flood Area	288.5 km^2	292.5 km^2	299.0km^2
Flood Volume	$230.7 \times 10^6 m^3$	$238.1 \times 10^6 m^3$	$248.0 \times 10^6 m^3$
Flood Depth	0.80m	0.81m	0.83m

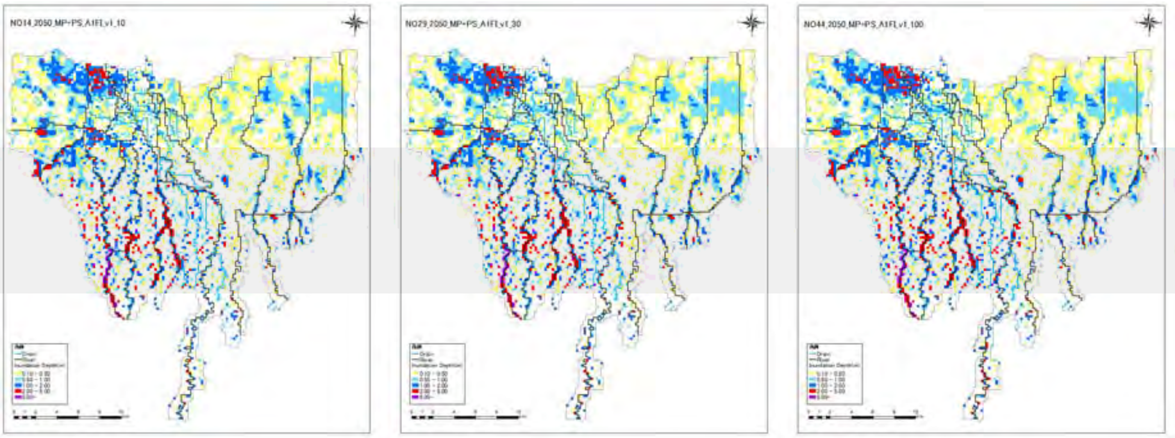


Figure- 3.3.16 Map of the Result of Inundation Analysis (14/15)

Table- 3.3.19 Result of Inundation Analysis by Return Period (15/15)

Case	(15) 2050_F_MP+PS_A1FI_ v2_10	(30) 2050_F_MP+PS_A1FI_ v2_30	(45) 2050_F_MP+PS_A1FI_ v2_100
Flood Area	294.2 km^2	298.1 km^2	304.4 km^2
Flood Volume	$246.7 \times 10^6 m^3$	$255.7 \times 10^6 m^3$	$268.5 \times 10^6 m^3$
Flood Depth	0.84m	0.86m	0.88m

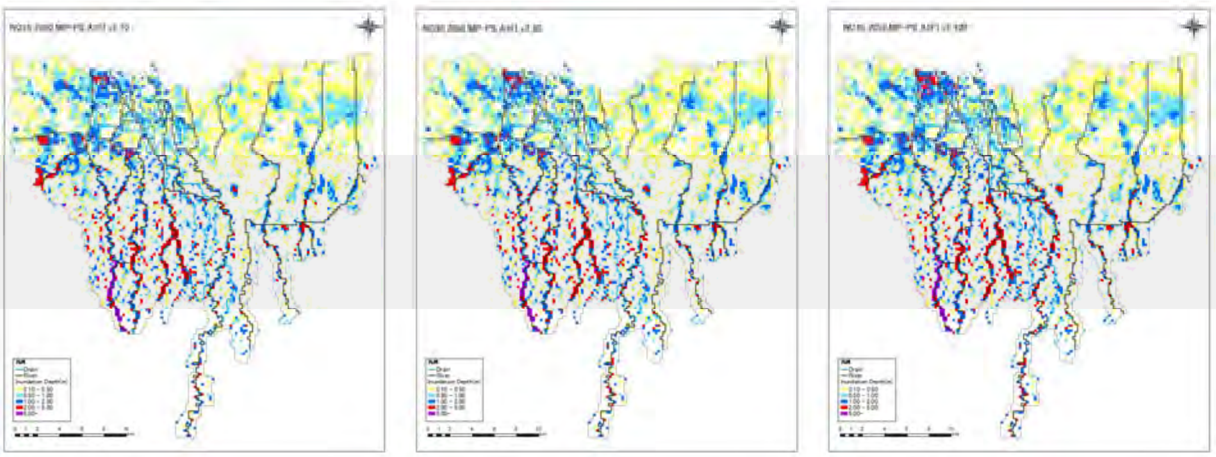


Figure- 3.3.17 Map of the Result of Inundation Analysis (15/15)

3.3.3 Findings from Inundation Analysis

(1) Impact of Urbanization

Due to urbanization, inundation area increases about 1 percent, inundation volume increases about 7 percent, and average inundation depth increases about 6 percent (see Table- 3.3.20 and Figure- 3.3.18).

Table- 3.3.20 Impact of Urbanization

Case	(A) 2050_P_MP_P_v0_100	(B) 2050_F_MP_P_v0_100
Flood Area	239.8 km^2 (100%)	243.4 km^2 (101%)
Flood Volume	$148.8\times10^6 m^3$ (100%)	$159.7\times10^6 m^3$ (107%)
Flood Depth	0.62m (100%)	0.66m (106%)

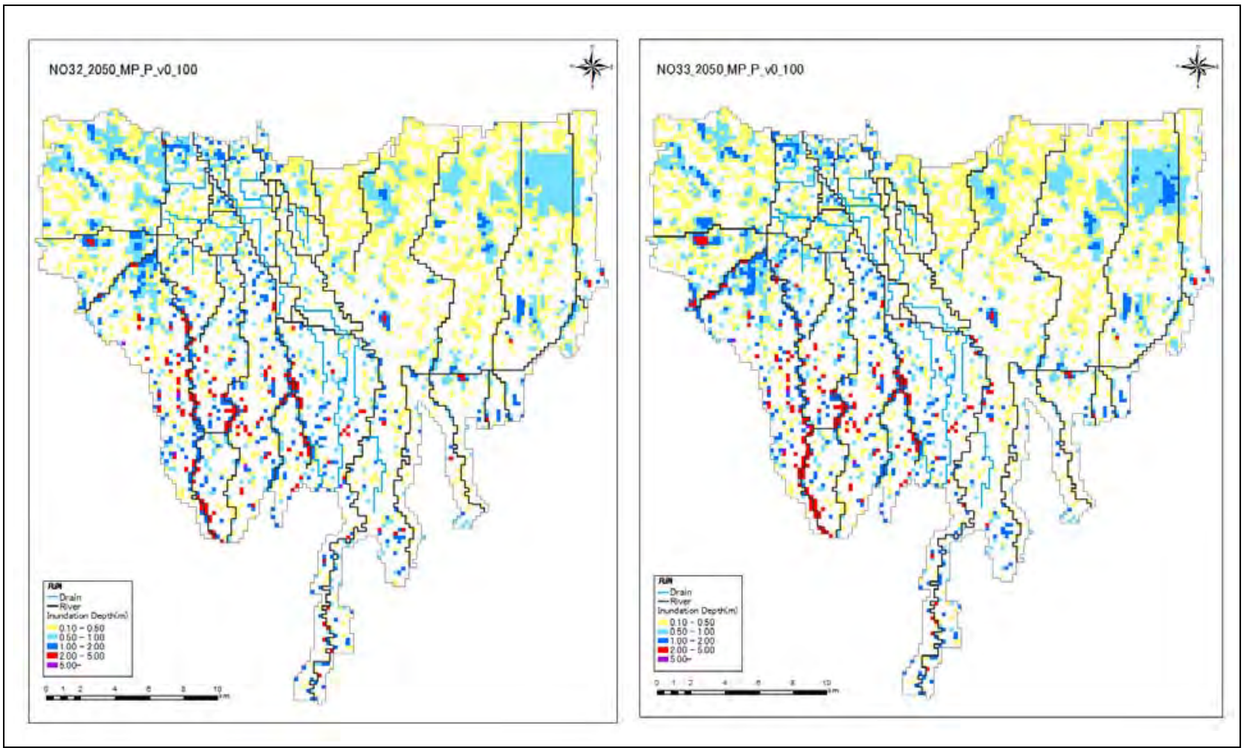


Figure- 3.3.18 Map of the Impact of Urbanization

The effect of urbanization on flood damage is lowly evaluated compared to the other factors (climate change and land subsidence) in this Study. Since rapidly urbanizing areas concentrate on upstream area, the increase of flood damage due to urbanization influences largely on an urbanized area located in the upstream area, and an area which the river directly flows into.

Generally, in accordance with urbanization, runoff volume which flows out from an urbanized area increases, and the water overflows the urbanized area, rivers and canals in which the water directly flows into, and it results in the increase of flood damage.

(2) Impact of Climate Change

Due to climate change, inundation area increases about 8-14 percent, inundation volume increases about 19-31 percent, and average inundation depth increases about 10-15 percent (see Table- 3.3.21 and Figure- 3.3.19).

Table- 3.3.21 Impact of Climate Change

Case	(A) 2050_F_MP_P_v0_100	(B) 2050_F_MP_B1_v0_100	(C) 2050_F_MP_A1FI_v0_100
Flood Area	243.4 km^2 (100%)	264.0 km^2 (108%)	277.1 km^2 (114%)
Flood Volume	$159.7 \times 10^6 m^3$ (100%)	$190.0 \times 10^6 m^3$ (119%)	$210.0 \times 10^6 m^3$ (131%)
Flood Depth	0.66m (100%)	0.72m (110%)	0.76m (115%)

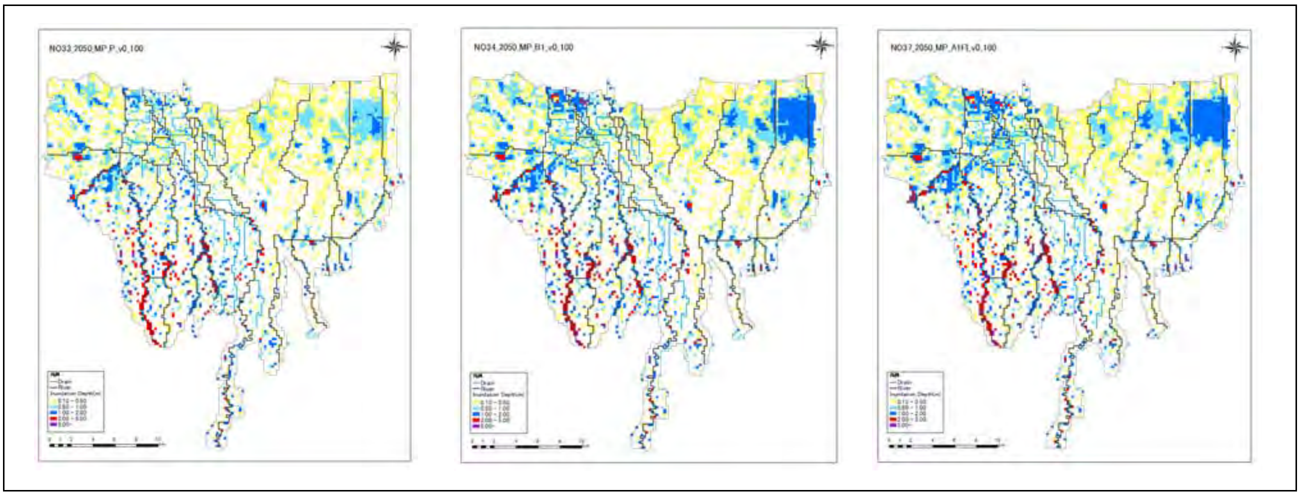


Figure- 3.3.19 Map of the Impact of Climate Change

In view of the impact of climate change, the increase of rainfall volume largely influences on flood damage. The influenced area extends along the rivers, and the flood is much deeper. In consideration of the characteristics of topography and the state of flood infrastructure in DKI Jakarta, it can be said that flood damage concentrates on the area which is comparatively low and flat and water is likely to accumulate, and the improvement of drainage facility comparatively delays. If climate change rapidly progresses, the influence of climate change on flood damage will increase further in the future.

(3) Impact of Land Subsidence

Due to land subsidence, inundation area increases about 15-20 percent, inundation volume increases about 50-95 percent, and average inundation depth increases about 31-64 percent (see Table- 3.3.22 and Figure- 3.3.20).

Table- 3.3.22 Impact of Land Subsidence

Case	(A) 2050_F_MP_A1FI_v0_100	(B) 2050_F_MP_A1FI_v1_100	(C) 2050_F_MP_A1FI_v2_100
Flood Area	277.1 km^2 (100%)	317.3 km^2 (115%)	331.2 km^2 (120%)
Flood Volume	$210.0 \times 10^6 m^3$ (100%)	$314.3 \times 10^6 m^3$ (150%)	$410.5 \times 10^6 m^3$ (195%)
Flood Depth	0.76m (100%)	0.99m (131%)	1.24m (164%)

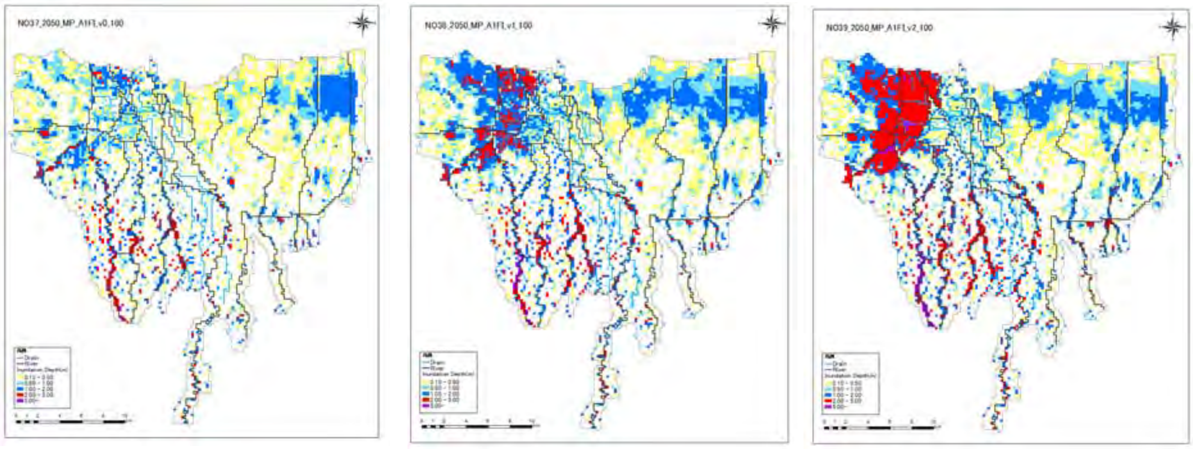


Figure- 3.3.20 Map of the Impact of Land Subsidence

As shown in Figure- 3.3.21, the impact of land subsidence is greater than the impact of climate change.

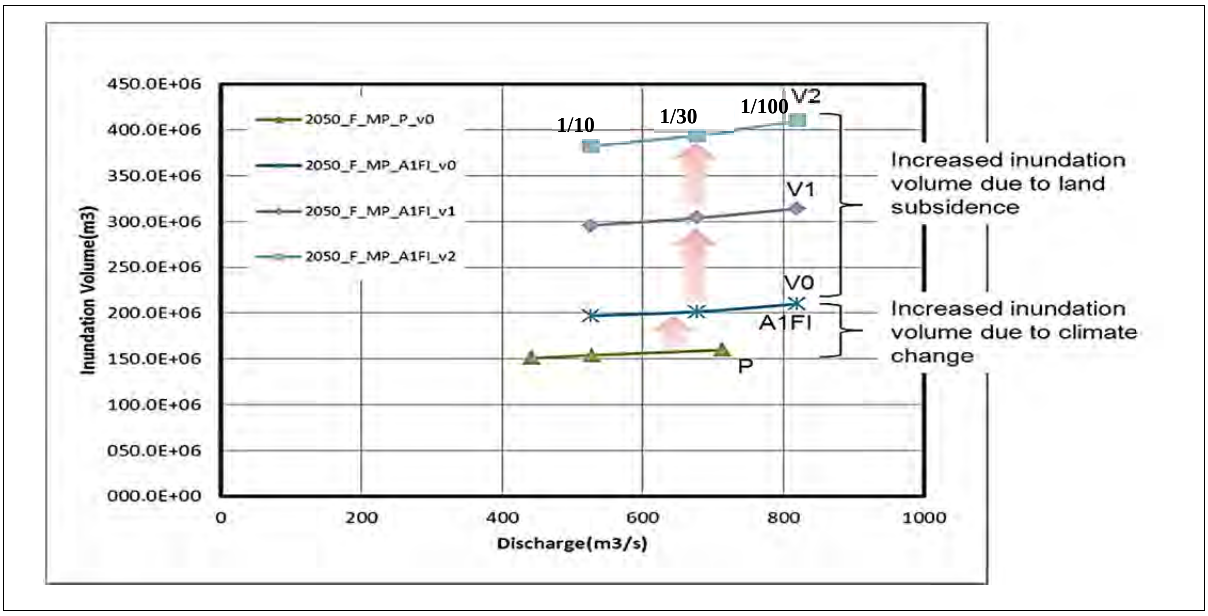


Figure- 3.3.21 Change of Inundation Volume by the Amount of Land Subsidence

In DKI Jakarta, land subsidence has a huge impact on flood. The area which suffers from flood extends in northern coastal area of DKI Jakarta. Especially in the northwest Jakarta in which the amount of land subsidence is estimated to be relatively large, flood depth would reach at more than 2m and the flood would cause not only economic but also social damages in large scale.

(4) Effect of Pump Stations

By increasing the capacity of pump stations, inundation area decreases about 8 percent, inundation volume decreases about 35 percent, and the average inundation depth decreases about 29 percent (see Table- 3.3.23, Figure- 3.3.22 and Figure- 3.3.23).

Table- 3.3.23 Effect of Pump Stations

Case	(A) 2050_F_MP_A1FI_v2_100	(B) 2050_F_MP+PS_A1FI_v2_100
Flood Area	331.2 km^2 (100%)	304.4 km^2 (92%)
Flood Volume	$410.5\times10^6 m^3$ (100%)	$268.5\times10^6 m^3$ (65%)
Flood Depth	1.24m (100%)	0.88m (71%)

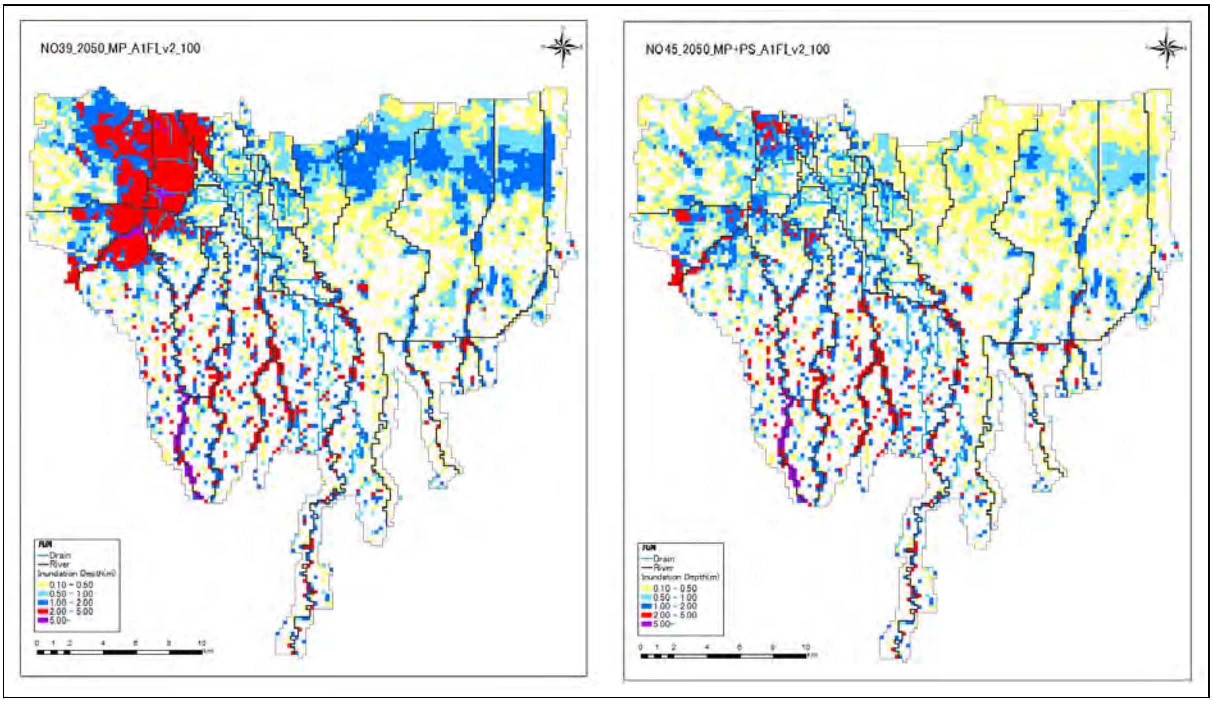


Figure- 3.3.22 Map of the Effect of Pump Stations

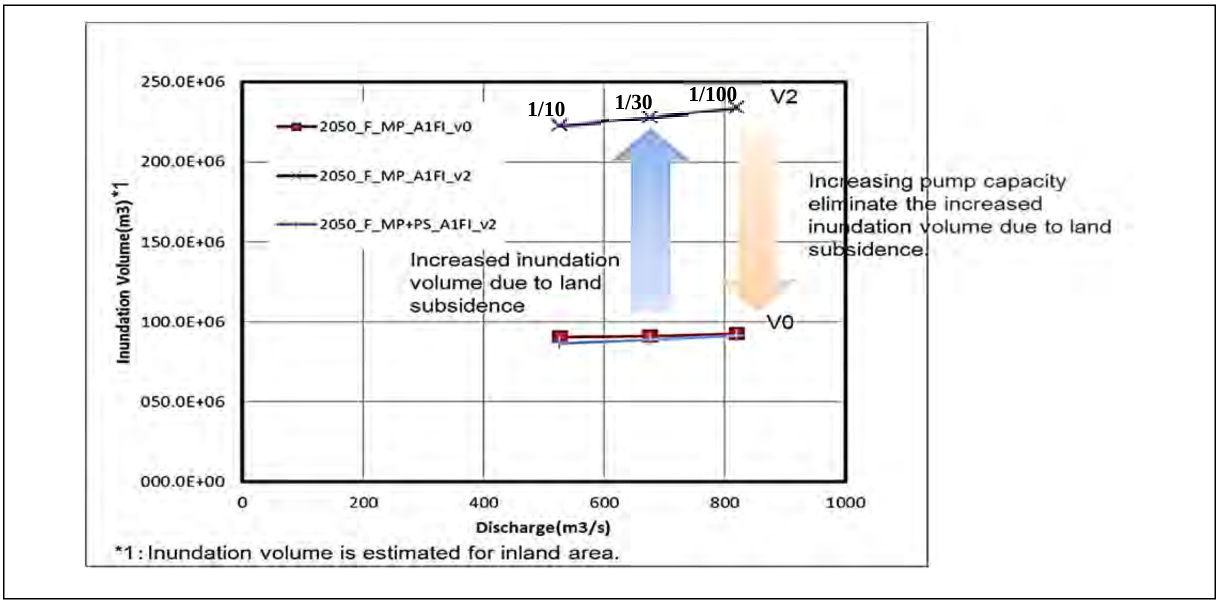


Figure- 3.3.23 Change of Inundation Volume by Increasing Pump Capacity

As mentioned above, in the case that the amount of land subsidence increased in DKI Jakarta, the whole area of north Jakarta would suffer from flood. The total volume of inner water pumps which are needed to mitigate the flood damage in that area is estimated approximately 800m^3 which is equivalent to Rp 15.4 Trillion of project cost.

The results revealed the importance of the prevention of the progress of land subsidence in DKI Jakarta.

CHAPTER 4 Impact Analysis on Socio-Economy

4.1 Methodology to Assess Damage Costs

4.1.1 Setting-up Scenarios

Flood damage costs were assessed with 45 scenarios which were set out in terms of land use changes (urbanization), infrastructure, climate change (rainfall change and sea level rise) and land subsidence. In each scenario, flood damage costs were estimated with different return period (flood intensity) – such as 1-in-10-year flood (1/10), 1-in-30-year flood (1/30) and 1-in-100-year flood (1/100). Interpretation of the scenarios is summarized in Table- 4.1.1.

Table- 4.1.1 Interpretation of Scenarios

Factor	Description	Symbol
Year	2008 2050	**2008_** **2050_**
Land Use	Present (2008) Future (2050)	**P_** **F_**
Infrastructure	Status Quo (without MP) Master Plan Master Plan + Pumping Station (strengthening pump capacity)	**SQ_** **MP_** **MP+PS_**
Climate Change	No climate change B1 (Sustainable Development Society Scenario) A1FI (Growth-oriented Society Scenario Valuing/Set Implementation on Fossil Energy Resources)	**P_** **B1_** **A1FI_**
Land Subsidence	No land subsidence relative to current level in 2008 (0m) Relatively stable land subsidence (max. 2.5m) Sever land subsidence (max. 5.9m)	**v0** **v1** **v2**

4.1.2 Direct and Indirect Damages Caused by Floods

This Study focused on the main impacts of climate change which are assumed to be in the form of increased flooding. There are direct and indirect damage, and tangible and in-tangible damages to humans, property and environment.

This Study follows in principle the approach and methodology developed in the preceding joint study in Bangkok and Manila. Thus, following direct and indirect impacts associated with flooding were identified in terms of damage costs:

【Direct Damages】

- Damages to buildings (residential, commercial and industrial buildings)
- Damage to assets and inventories (residential, commercial and industrial buildings)
- Damage to infrastructure (road and public services including urban sanitation)

【Indirect Damages】

- Income losses (commercial and industrial units)
- Losses of revenue (electricity and water supply companies)

4.1.3 Assumptions for Estimating Damage Costs

Jakarta including surrounding municipalities (JABODETABEK) would be changed broadly by 2050 in terms of population size and distribution, poverty, regional economic growth, urbanization, infrastructure including flood control related, etc. These changes are likely to expose larger areas and population to floods unless flood control infrastructure is sufficiently improved. However, to forecast the future of JABODETABEK area is a huge task and there is no specific basis at present to predict it over the next forty years. Therefore, this Study made several assumptions for estimating damage costs in 2050. Among other things, it is important to note the following assumptions:

- The damage costs in 2050 are estimated basically based on the socio-economic conditions and prices in 2008;

- Similarly, in terms of GRDP, all damage costs are represented in Indonesian Rupiahs (Rp) in 2008, thus to estimate percent of GRDP, current 2008 GRDP[1] were used;
- Basic data concerning assets, value and prices etc. were based on available statistical data obtained from the Indonesian authorities such as Badan Pusat Statistik Republik Indonesia (BPS), Bandan Pusat Statistik Provinsi DKI Jakarta etc. These data were supplemented and adjusted with information from relevant projects, studies and the consultants; and
- Since there was no proper benchmark to estimate flood damage in Indonesia, damage coefficient and rates revealed in "Manual of Economic Study of Floods", MLIT of Japan[2] listed in Appendix to this report were applied, where available, for the assessment of damage costs.

4.1.4 Assessment of Damage Costs by Sector

(1) Damage to Buildings

Using the information from housing statistics and other official statistical books, buildings in Jakarta were categorized first into "residential", "commercial" and "industrial" buildings. Residential buildings were further subcategorized into two groups – such as "permanent" and "non-permanent" houses. Note that category of large and medium scale manufacturers represent industrial buildings in this Study.

Once buildings were categorized, counted and valuated on average based on available government data by categories of building, different damage coefficient depending on the level (depth) of the flood was applied to estimate damage costs from floods for each category of building (see Table- 4.1.2 and Table- 4.1.3). The damage coefficient of the MLIT of Japan was applied to this Study (see Table- A.2 in Appendix).

Figure- 4.1.1 Flow Chart for Estimating Direct Damage Costs to Buildings

Table- 4.1.2 Number of Buildings by Municipality and Type of Building, 2008

Municipality	Residential Bldg.	Commercial Bldg.	Industrial Bldg.*
Jakarta Selatan	511,843	35,902	108
Jakarta Timur	580,351	40,707	332
Jakarta Pusat	213,821	14,998	75
Jakarta Barat	526,458	36,927	565
Jakarta Utara	348,800	24,466	786
DKI Jakarta	2,181,272	153,000	1,866

Source: Based on Jakarta in Figures 2010, Housing Statistics of DKI Jakarta Province (Housing Census 2000)
*Large and Medium Scale Manufactures

Table- 4.1.3 Unit Rate of Buildings

Bldg. Type	Average Floor Area (m^2)	Unit Value per m^2 (000Rp/m^2)
Permanent House	70	2.500
Non-permanent House	70	1,700
Shop/Office	300	4,400
Manufacture	3,000	6,500

Source: Estimated by JICA Study Team

[1] GRDP of DKI Jakarta in 2008: Rp 677,411 Billion
[2] Ministry of Land, Infrastructure and Transportation of Japan

(2) Damage to Assets and Inventories

Household assets were valued by categories of residential buildings based on available government data, i.e., permanent and non-permanent houses. Assets and inventories of commercial and industrial units such as machinery, office furniture, and inventories damaged by floods were also estimated (see Table- 4.1.4 and Table- 4.1.5). Value of assets and inventories of commercial and industrial units was based on the data from BPS Provinsi DKI Jakarta and so on.

Different damage coefficient depending on the level (depth) of flood was applied to estimate damage costs to assets and inventories of residential, commercial and industrial units (see Table- A.3 in Appendix).

Table- 4.1.4 Estimated Value of Household Assets

Type of House	Estimated Value (000Rp/household)
Permanent House	35,000
Non-permanent House	24,000

Source: Estimated by JICA Study Team

Table- 4.1.5 Estimated Value of Assets & Inventories of Commercial Unit and Industrial Unit

	Assets (000Rp/capita)	Inventories (000Rp/capita)
Commercial Unit	13,200	13,200
Industrial Unit*	29,000	29,000

Source: Estimated by JICA Study Team
*Large and Medium Scale Manufacture

(3) Damage to Infrastructure

This Study examined direct damage costs mainly to the transport infrastructure (roads, rail and bridges) and public services including sanitation services. This does not mean that the other infrastructure like irrigation and drainage would not be flooding.

In Jakarta, transport infrastructure, mainly roads has been taken much possibility of flooding into account because of the height (location) at which they are built. However, it was also considered that the damage to transport infrastructure is supposed to be limited as roads in Jakarta include a number of municipal roads (small streets).

In estimating the damage costs to infrastructure, when considered on the basis of damage rate of infrastructure which was read off as a percentage to the sum of the damage costs of buildings and assets, the percentage of damage to transport infrastructure was assumed at 13 percent of the sum of the damage costs of buildings and assets.

Including damages to other infrastructure, the total damage rate of infrastructure was assumed to be 22 percent of the sum of damage costs of buildings and assets, and this rate is a relatively restricted compared to the rate employed in Japan by the MLIT of Japan.

(4) Indirect Damages from Floods

Indirect damage from floods will generally be extended widely. There are also tangible and in-tangible costs associated with flooding, for instance, damage costs to transport sector such as time costs caused by traffic disruption and increase in vehicle operating costs.

As a result, this Study examined only the following two indirect damages resulting from a loss in the flow of goods and services to the economy.

- Loss of income of commercial and industrial units
- Revenue losses to water and electricity companies

1) Loss of Income of Industrial and Commercial Units

Not only with floods result in a direct damage to industrial and commercial buildings, it will likely result in a loss of income during the duration of flooding. This Study separately estimated losses of income for commercial unit and for large and medium scale manufacturing enterprises. The calculation of income loss for industrial and commercial units due to flood damage was made as follows:

Loss of Income =
Average No. of employee per unit × Value added amount (Rp/employee/day) (see Table- 4.1.6) **×**
Flood duration (day) (see Table- A.5 in Appendix)

Table- 4.1.6 Unit Rates for Commercial & Industrial Units

	Average No. of Employee per unit	Value Added Amount (Rp/Employee/day)
Commercial Unit	10	600,000
Industrial Unit	180	800,000

Source: Estimated by JICA Study Team

2) Revenue Losses to Water and Electricity Companies

With direct damage to plants and equipment for water and energy supply services – such as electricity transmission and distribution lines, water main lines, water distribution networks etc., electricity and water supply services to the population may become dysfunctional; thus the companies incur revenue losses.

Losses of revenue to electricity and water companies were calculated with the formula stated below based on the data published by PT. PLN and PAM Jaya:

Loss of Revenue =
Average consumption (sold)/user/day × No. of affected user × Sales tariff (see Table- 4.1.7) **×**
Flood duration (day) (see Table- A.5 in Appendix)

Table- 4.1.7 Loss of Revenue in Water Supply Companies

User	Water Vol. Sold (m^3/user/day)	Number of User (000units)	Water Sales Tariff (Rp/m^3)
Household	0.642	677	5,538
Non-household	0.270	101	3,873

Source: Based on PAM Jaya

Table- 4.1.8 Loss of Revenue in Electricity Supply Companies

User	Electricity Sold (kWh/customer/day)	Number of PLN Customer (000units)	Electricity Sales Tariff (Rp/kWh)
Household	9	3,246	694
Business/Offices	111	259	763
Manufacture	2.116	11	662
Others	49	57	1,457
Average	23	3,573	735

Source: Based on PT. PLN (Persero)

4.2 Summary of Flood Damage Costs

Table- 4.2.1 presents the costs incurred from flood damages to buildings, assets, infrastructure, and income and revenue losses for a range of 45 different scenarios prepared for this Study.

It is important to note that all the scenarios except **2008_P_SQ_P_v0** were prepared based on the premise that implementation of the Master Plan is in place by 2050.

Table- 4.2.1 Summary of Flood Damage Costs

Scenario	Return Period					
	1-in-10-year flood (1/10)		1-in-30-year flood (1/30)		1-in-100-year flood (1/100)	
	Cost (Billion Rp)	Percent to GRDP	Cost (Billion Rp)	Percent to GRDP	Cost (Billion Rp)	Percent to GRDP
2008_P_SQ_P_v0	60,759	9.0	63,183	9.3	66,498	9.8
2050_P_MP_P_v0	55,655	8.2	56,684	8.4	57,870	8.5
2050_F_MP_P_v0	56,660	8.4	57,989	8.6	60,513	8.9
2050_F_MP_B1_v0	65,783	9.7	67,119	9.9	70,288	10.4
2050_F_MP_B1_v1	100,230	14.8	103,408	15.3	107,579	15.9
2050_F_MP_B1_v2	122,838	18.1	126,527	18.7	132,051	19.5
2050_F_MP_A1FI_v0	71,076	10.5	73,229	10.8	77,218	11.4
2050_F_MP_A1FI_v1	107,243	15.3	110,696	16.3	115,716	17.1
2050_F_MP_A1FI_v2	132,372	19.5	136,812	20.2	143,786	21.2
2050_F_MP+PS_B1_v0	62,418	9.2	63,829	9.4	66,970	9.9
2050_F_MP+PS_B1_v1	78,972	11.7	81,252	12.0	84,527	12.5
2050_F_MP+PS_B1_v2	85,604	12.6	88,211	13.0	92,612	13.7
2050_F_MP+PS_A1FI_v0	67,173	9.9	69,616	10.3	73,379	10.8
2050_F_MP+PS_A1FI_v1	84,667	12.5	87,420	12.9	91,937	13.6
2050_F_MP+PS_A1FI_v2	92,977	13.7	96,388	14.2	101,809	15.0

4.3 Main Findings from Analysis

4.3.1 Substantial Flood Damage Costs in 2050

A comparison across scenarios shows that the minimum and the maximum damage costs in the context of these scenarios are as follows:

Damage cost for **2050_F_MP_P_v0** in 1-in-10-year flood where there is no climate change nor land subsidence (relative to the level in 2008) was estimated to result in Rp 56,660 Billion and showed the minimum damage costs among all the scenarios where future land use in 2050 is assumed. In terms of GRDP, this would constitute about 8.4 percent of the current 2008 GRDP of DKI Jakarta.

Whereas, under the assumption of severe land subsidence and A1FI climate scenario (high emission case), namely **2050_F_MP_A1FI_v2** with 1-in-100-year flood, the damage costs was estimated to increase remarkably and amounted to Rp 143,786 Billion, which was approximately 2.5 times as high as **2050_F_MP_P_v0_10** and revealed the maximum damages with approximately 21.2 percent of the 2008 GRDP.

4.3.2 Impact to Increase Flood Damage Costs by Factor

In the context of the scenarios for this Study, factors to increase or decrease in damage costs from flooding are future land subsidence, land use, and infrastructure for flood prevention and mitigation in addition to climate change. Impact of each factor in increase of damage costs is explanatory by looking at a difference of damage costs. Impact of infrastructure will be discussed later.

For instance, as shown in Table- 4.2.1, in 1-in-30-year flood which is a medium-sized flood, the difference of damage costs between **2050_F_MP_A1FI_v0** and **2050_F_MP_A1FI_v2** was Rp 63,583 Billion. This difference represents the increased damage costs due to land subsidence.

Similarly, the increased damage costs owing to climate change and land use in the same return period

(1/30) were obtained by computing the differences between **2050_F_P_MP_v0** and **2050_F_MP_A1FI_v0**, and **2050_P_MP_P_v0** and **2050_F_MP_P_v0** respectively. They were calculated Rp 15,240 Billion in climate change and Rp 1,304 Billion in land use change respectively.

Consequently, as shown in Figure- 4.3.1, of the total increase identified as a difference in damage costs between **2050_P_MP_P_V0_30** and **2050_F_MP_A1FI_V2_30**, 79 percent is attributable to land subsidence; it dominates the major factor of increased damage costs. Climate change and land use in increased damage costs were estimated to constitute approximately 19 percent and 2 percent respectively.

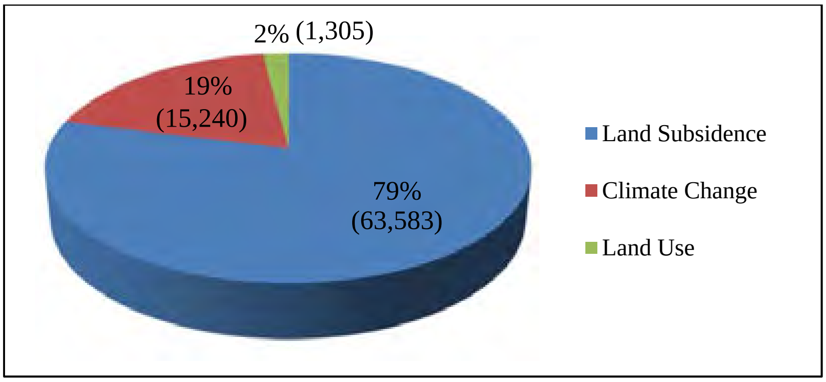


Figure- 4.3.1 Amounts and Percentage of Increased Flood Damage Cost by Factor (Billion Rp)

In terms of GRDP, the increased costs associated with land subsidence, climate change and land use account for approximately 9 percent, 2 percent and 0.2 percent of the 2008 GRDP of DKI Jakarta respectively.

4.3.3 Flood Damage Costs by Damage Sector

Table- 4.3.1 shows breakdown of damage costs by damage sector for **2050_F_MP_A1FI_v0** in 1-in-30-year flood. In the context of this scenario, the direct damage costs to buildings (residential, commercial and industrial buildings) including the physical damage to assets and inventories were estimated at Rp 54,513 Billion. This would constitute about 74 percent of the total damage costs. It was a dominant sector of damage from flooding. Direct damage cost to infrastructure and indirect costs at commercial and industrial units identified in the form of income and revenue losses were 16.4 percent and 9.0 percent respectively.

Table- 4.3.1 Damage Costs by Damage Sector in Billion Rp (2050_F_MP_A1FI_v0_30)

Damage Item	Direct Damage	Indirect Damage	Total Damage	%
Residence	28,685		28,685	39.2%
Commerce	17,261	4,699	21,960	30.0%
Industry	8,567	1,759	10,326	14.1%
Infrastructure	12,044		12,044	16.4%
Public Services		214	214	0.3%
Total	66,557	6,672	73,229	100.0%
%	91%	9%	100%	

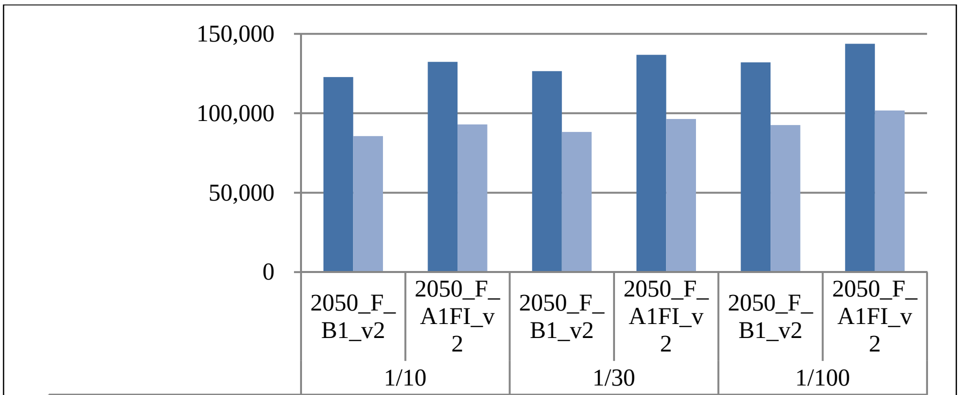
4.3.4 Damage Costs "With" and "Without" Pumping Stations Project

As discussed earlier, land subsidence as a result of ground water utilization is a major problem in Jakarta. For instance, under these circumstances, the eastern and western part of Jakarta and coastal area from west to east along the Jakarta Bay is likely to experience significantly worse flooding. Furthermore, they do not have insufficient pump capacity to drain the flooded water into the sea, rivers, and channels etc.

As one of the options to mitigate damages from flooding, this Study assumed a set of scenarios where a project for strengthening of pumping station (PS project) is in place. Based on the result of hydrological estimation, required pumping capacity was estimated to be 760 m^3/sec (12 drainage districts).

Reduction in damage costs expected from implementation of PS project was identified as the differences in damage costs between the scenarios with PS (MP + PS) and without PS (MP only).

As shown in Figure- 4.3.2, the result of estimations indicates that in every scenario where PS project was assumed, it was estimated to reduce by approximately 30 percent of flood damages.



	1/10		1/30		1/100	
	2050_F_B1_v2	2050_F_A1FI_v2	2050_F_B1_v2	2050_F_A1FI_v2	2050_F_B1_v2	2050_F_A1FI_v2
Damage Costs MP	122,839	132,372	126,528	136,813	132,051	143,787
Damage Costs MP+PS	85,605	92,978	88,212	96,389	92,612	101,809

Figure- 4.3.2 Flood Damage Costs Comparison between With and Without PS Project (Billion Rp)

4.3.5 Expected Average Annual Damage Cost

Expected average damage costs are calculated based on the probability of floods of different return periods occurring (1/10, 1/30 and 1/100). In economic point of view, the difference in flood damage costs estimated as stated above are identified as the expected annual average reduction in flood damage costs or the average annual benefits of having flood control or damage mitigation projects like MP and MP+PS in different return period.

Figure- 4.3.3 illustrates total flood damage costs for different scenarios against the probability of flood occurrence, such as **2008_P_SQ_P_v0**, **2050_F_MP_A1FI_v2** and **2050_F_MP+PS_A1FI_v2**. It is important to understand that as shown in the said figure, flood damage costs increase for higher intensity of floods (1/100), while, there is a little possibility of such bigger floods occurring. Also note that the difference in the areas between different loss exceedance curves represents the incremental average annual damage costs resulting from different scenarios.

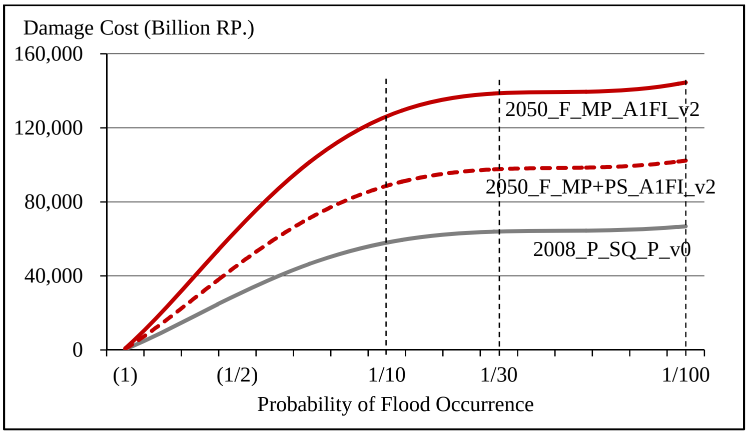


Figure- 4.3.3 Loss Exceedance Curves

4.3.6 Economic Viability of Implementation of MP Project

Economic viability of the investment for PS Project was briefly examined based on some assumptions including expected average annual benefit (reduction in flood damage costs) as discussed above. The assumptions involved in this examination were made in a simple manner as stated below:

- Expected Average Annual Benefit: US$ 331 Million (Rp 3,622 Billion)[3]
- Investment Costs: US$1,875 Million (US$ 2.47 Million/m^3/sec, 760 m^3/sec) (based on construction cost of pumping station estimated by JICA Study Team)
- Period of Analysis: 37 years (2014-2050), of which the first 5 years are for construction works (2014-2018), and the first benefits are estimated in 2015, and increase gradually according to the progress of the construction works.
- Discount rate: 12 percent (commonly used as a standard discount rate for public investment in Indonesia)

As presented in Table- 4.3.2, result of examination revealed that PS project would be economically feasible in terms of reducing flood damages as it provides B/C ratio of 1.38 under the 12 percent discount rate.

Note that the above mentioned examination was made based on numerous assumptions as repeatedly stated before, including rough calculation of investment costs without details. In addition, neither detailed investment plans nor benefits were taken into account. Therefore, it is necessary to carry out a detailed feasibility study if and when PS project(s) is taken up in the future.

Table- 4.3.2 Net Present Value of Investment of PS Project

Description	Result
Present Value of Cost (Million US$)	1,576
Present Value of Benefits (Million US$)	2,181
Net Present Value (Million US$)	605
Benefit-Cost Ratio (B/C Ratio)	1.38

4.3.7 Districts Vulnerable to Flooding

From the flood simulation analysis, it is found that there is a certain increase of inundated area according to the scenarios. For instance, when compared the inundated area and depth between **2050_F_MP_P_v0** (current climate condition and no land subsidence case) and **2050_F_MP_A1FI_v2** where high emission and sever land subsidence is assumed (1-in-30-year flood), the area exposed to flooding and expected depth will increase from about 237km^2 in area and 0.65m in depth in **2050_F_MP_P_v0** to about 324km^2 in area and 1.22m in depth in **2050_F_MP_A1FI_v2**. This translates in terms of damage costs that the damage costs will rise sharply for **2050_F_MP_A1FI_v2**, with nearly 230 percent increase compared to **2050_F_MP_P_v0**.

In district-wise, it is evident from the maps in Figure- 4.3.4 and Figure- 4.3.5 that the downstream area of the Cengkareng Channel in the northwest of Jakarta (Jakarta Barat) and a part of Jakarta Utara and Jakarta Timur will have the extreme damages for the **2050_F_MP_A1FI_v2** scenario. Many of these areas are topographically low and flat and under the tidal influences, including the certain area under surface of sea which consists of swamp area. In addition, from socio-economic point of view, it is noted that there is a number of manufacturing establishments and condensed housings and buildings including low-income residents; thus vulnerable to flooding, currently and in 2050.

[3] Exchange rate: US$1=Rp10,942

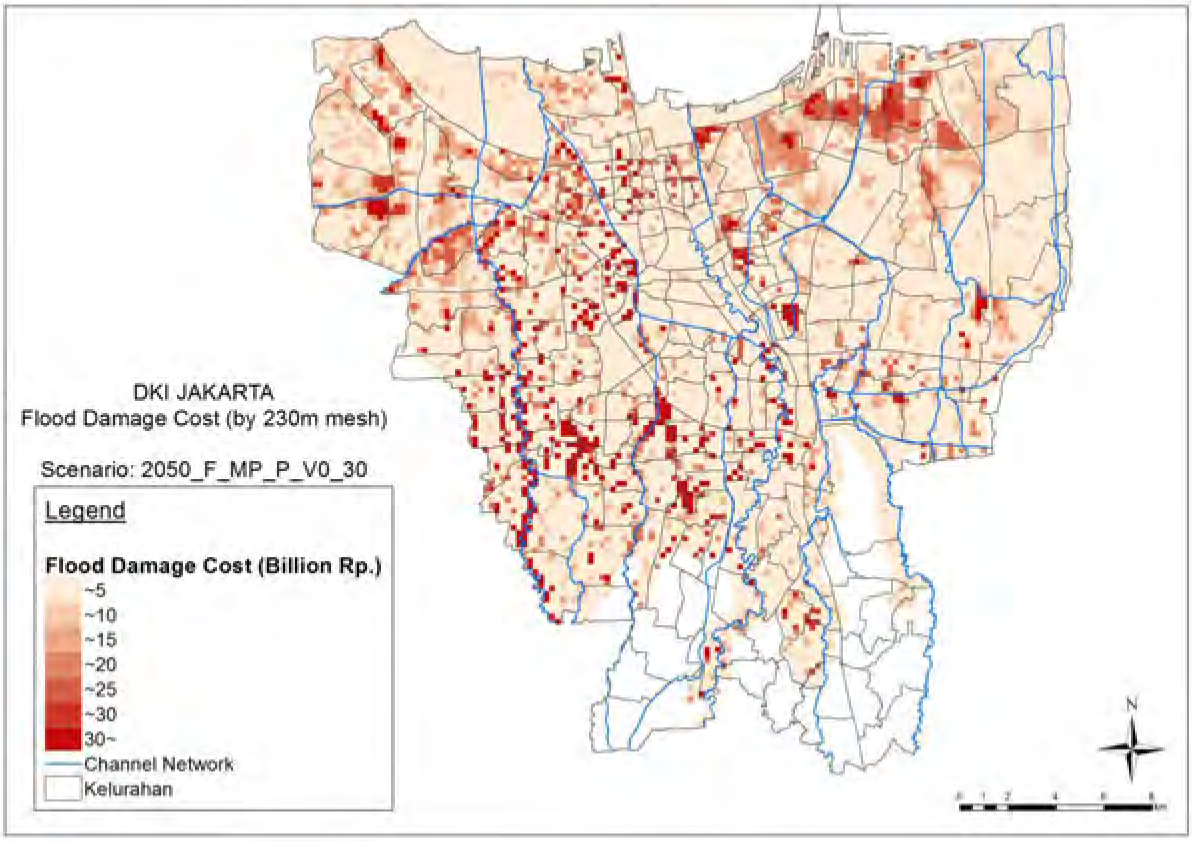


Figure- 4.3.4 Flood damage cost by 230m mesh (Scenario: 2050_F_MP_P_V0_30)

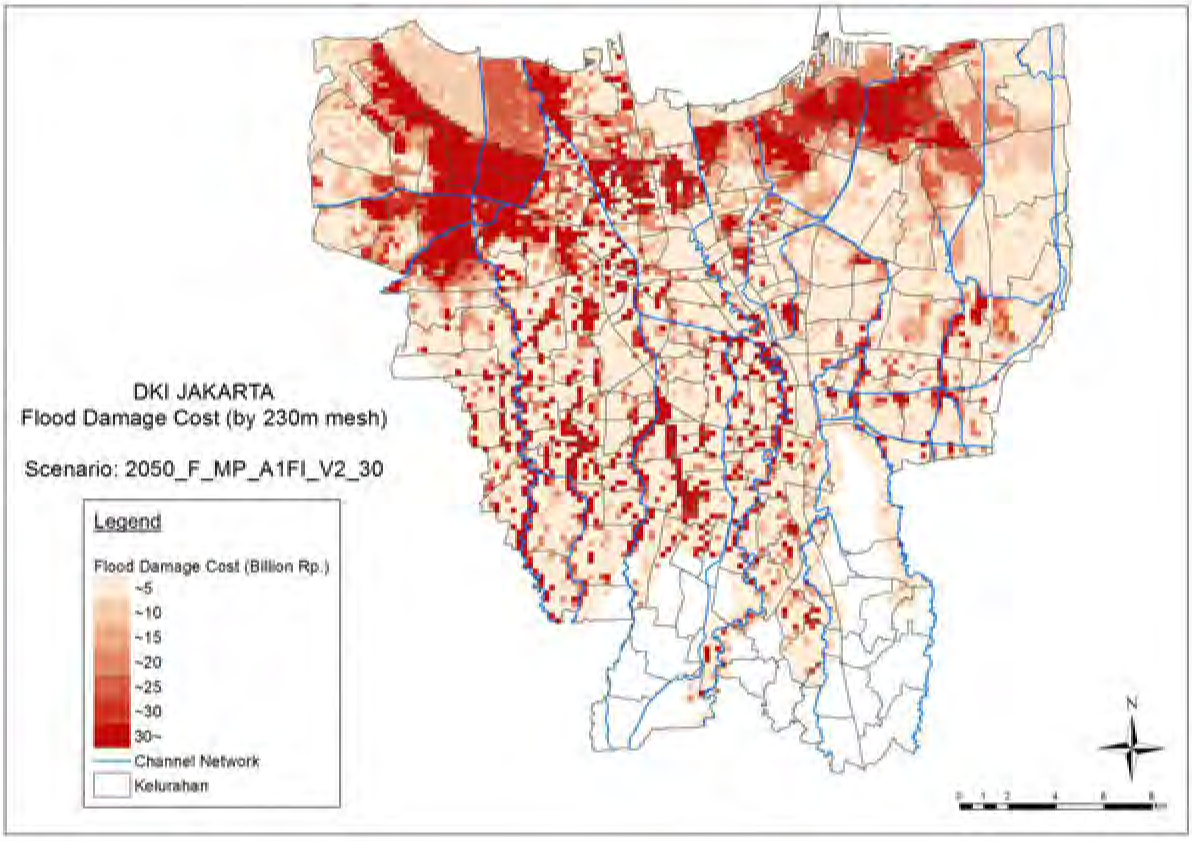


Figure- 4.3.5 Flood damage cost by 230m mesh (Scenario: 2050_F_MP_A1FI_V2_30)

CHAPTER 5 Impact Analysis on the Urban Poor

5.1 Background and Objective

5.1.1 Outline of the Survey

Table- 5.1.1 shows an outline of the household survey on the urban poor. As shown in Item e (Compiling Report), the details and results of the survey were compiled separately as "the Final Report of the Study on Impact of Climate-Change-Related Flood on the Urban Poverty in Jakarta, Indonesia".

Table- 5.1.1 Outline of the Survey

Items	Scope
a. Preparation Work	● Preliminary Field Survey for Making Assumptions about the Questionnaire Sheet ● Making Questionnaire Sheet for Pre-test
b. Pre-test and Revision of Questionnaire Sheet	● Enumerator Training for Pre-test and Questionnaire Survey (Pre-test) ● Entry and Analysis of Data ● Revision of Questionnaire Sheet
c. Full-scale Household Survey	● Making Questionnaire Sheet for Full-scale Survey ● Enumerator Training ● Full-scale Household Survey (Interview Survey) ● Data Entry and Making Database
d. Data Processing and Analysis	● Data processing ● Data analysis
e. Compiling Report	● Draft Final Report ● Final Report

5.1.2 Objective of the Survey

The main objective of the survey is to identify the impact of flood inundation on the poor in Jakarta. The survey will be conducted along with the following aims:

1. Identify the living status and the environment of the poverty group in Jakarta;
2. Assess the direct effects of inundations on the poverty group;
3. Identify the secondary and tertiary impacts of inundation on the poverty group;
4. Specify the direct factors of the secondary and tertiary impacts of inundation on the poverty group.

5.2 Methodology

5.2.1 General Framework

The existence of rural to urban migration implies that urban areas have a substantive attraction, and in many countries the number of urban residents seems to exceed available land and capacity there. Jakarta is not an exceptional; based on the data of life time migration in DKI Jakarta shown in Table-5.2.1, net-migration figures since the year 1971 to 2005 still showed a positive value. According to 2010 census data, the population has reached 9,588,198 people with population density of 14,447 person/km^2. Population growth rate of Jakarta in the period 2000-2010 is about 1.41 percent; this figure is higher than that of 1990-2000 which was only 0.14 percent. Unless addressed by the policy that can significantly mitigate the current urbanization in Jakarta, the rate of population growth will continue to increase, and thereby population density will also increase.

Table- 5.2.1 Life Time Migration: DKI Jakarta Province 1971 – 2005

	1971	1980	1985	1990	1995	2000	2005
In-migration	1,821,833	2,599,367	3,079,693	3,170,215	3,371,384	3,541,972	3,337,161
Out-migration	132,215	400,767	593,936	1,052,234	1,589,285	1,836,664	2,045,630
Net-migration	1,689,618	2,198,600	2,485,757	2,117,981	1,782,099	1,705,308	1,291,531

Source: Sensus Penduduk 1971, 1980, 1990, 2000 dan Survei Penduduk Antar Sensus (SUPAS) 1985, 1995, 2005

Urbanization put an impact on the population structure of Jakarta by ethnicity. According to 2000 population census data, Betawi, who originally have lived in Jakarta, reached only 27.86 percent and it is lower than Javanese that was 35.16 percent. As Betawi people marginalized geographically, they have been pushed out to the outskirt of Jakarta or even outside Jakarta such as Bogor, Bekasi, Tangerang, and Depok. Besides, some of them were not able to compete with the migrants; hence they were also marginalized economically and socially due to the progress of urbanization.
Similar to the other megacities in developing countries, in Jakarta, there is huge diversity in people's livelihood. On one hand, those who highly educated and can earn enough money enjoy well-being in the city. On the other hand, those who migrate with little money and Betawi people manage to live in Jakarta with limited land. Most of them live in poorly developed areas, so-called 'kumuh' which is the expression used by DKI Jakarta and means slum in Bahasa, Indonesian language. There are many poorly built temporary houses on places such as along the river bank and coastline with rudimentary materials such as cardboard and zinc. Some of them have improved the quality of housing to be semi-permanent or even permanent according to the improvement of welfare. Nevertheless, the layout of house building which is a mess, high density, and have dirty environment---salient features for "slum"--- seem almost impossible to be improved.

UN-HABITAT[1] defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following:

1. Durable housing of a permanent nature that protects against extreme climate conditions;
2. Sufficient living space which means not more than three people sharing the same room;
3. Easy access to safe water in sufficient amounts at an affordable price;
4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people; and
5. Security of tenure that prevents forced evictions.

Meanwhile, Housing Department of DKI Jakarta describes the characteristics of slum areas using eleven indicators as follows: 1) population density, 2) location close to economic activity, 3) inadequate road condition which four-wheeled vehicles cannot pass 4) inadequate drainage system, 5) inadequate air quality, 6) inadequate ventilation inside housing building, 7) no privacy inside house building, 8) lack of toilet facilities, 9) lack of clean water availability, 10) untidiness of building layout, 11) illegality of land ownership.

Overcrowding is one of the characteristics of urban poverty; the other dimensions of poverty are low income, poor health condition, low education attainment, individual and housing insecurity, and powerlessness (BPS, 2007)[2].

In terms of dimension of housing insecurity as mentioned above, the poor who reside in slum are vulnerable to the occurrence of eviction and to disaster risk by man-made disaster such as fire or natural disaster such as inundation. While disaster occurs, the poor suffer the most since they cannot afford the cost of repair or reconstruction of their assets.

The inundation is still occurring in Jakarta, although many efforts have already been conducted by government and other parties to overcome. Explanation related to inundation control infrastructure was obtained from secondary data, while public understanding of climate change issues, the impact of inundation, and counter measures which have been done within the framework to mitigate the disaster were obtained from primary data. In this study, inundation prone area was divided into 4 types:

- HT_U, means inundation mainly affected by high tide
- HT_IW, means inundation mainly affected by high tide and inland water
- RW_U, means inundation mainly affected by river water
- RW_IW, means inundation mainly affected by river water and inland water

This study focuses on the impact of climate change related to flood on the urban poor. Considering two

[1] www.unhabitat.org
[2] *"Analisis Tipologi Kemiskinan Perkotaan, Studi Kasus Jakarta Utara"*. 2007. Badan Pusat Statistik. Jakarta.

criteria, i.e., characteristics of slum areas and typology of inundation, the analytical framework was created in order to provide a descriptive overview on characteristics of living status and environment based on typology of inundation. Figure- 5.2.1 depicts the general framework for this study.

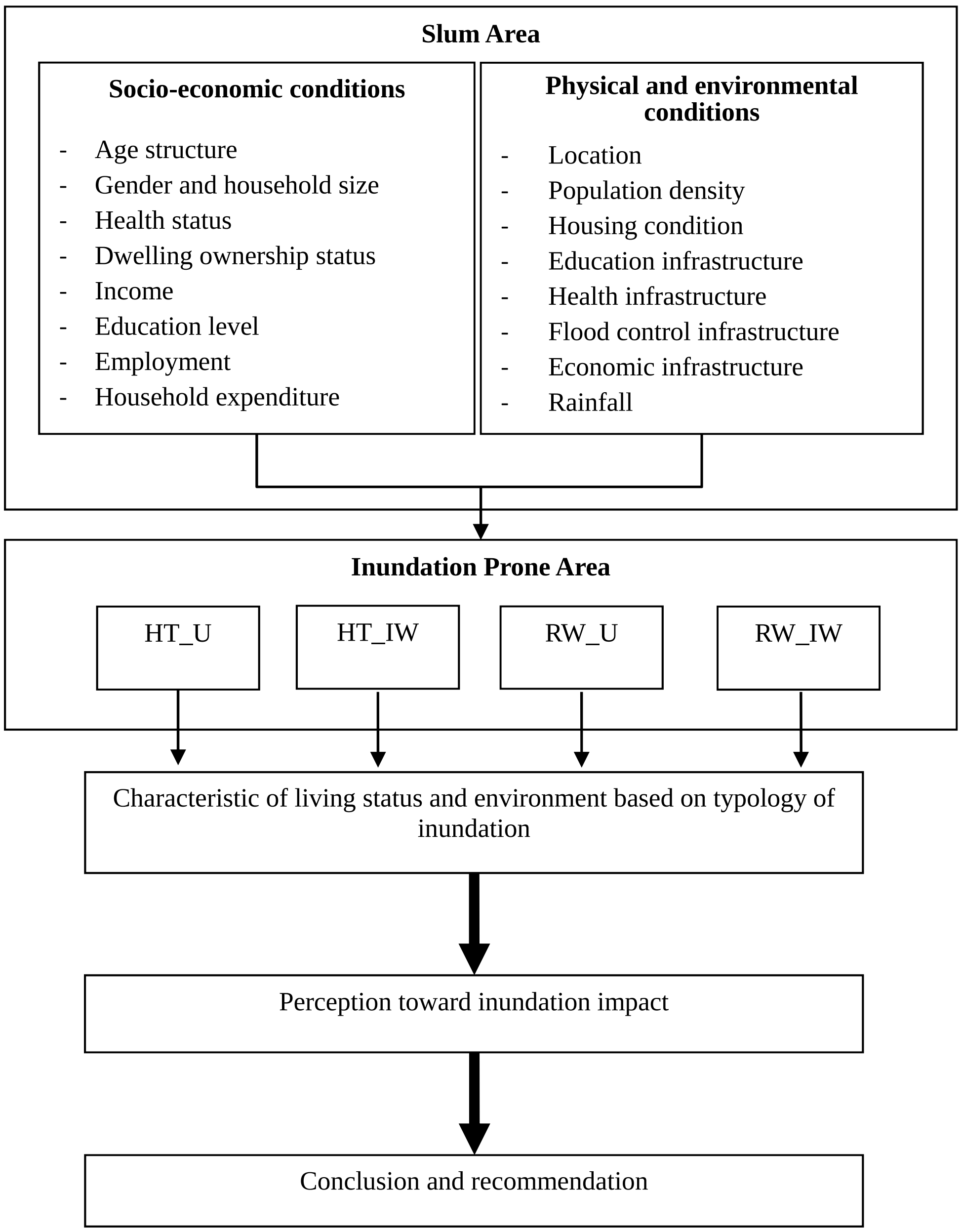


Figure- 5.2.1 General Framework Flowchart

5.2.2 Type and Method of Data Collection

We use two categories of data in this study: primary and secondary data. The primary data, which is on socio-economic characteristics and inundation impacts at the household level, were collected through interviews conducted to the heads of household or household members considered most knowledgeable about the households. Besides, semi-structured interviews with some key informants, such as Kelurahan officers, the head of RW and RT, and government officials, who were considered knowledgeable about issues related to our study, were carried out to get general information.

The secondary data were gathered from relevant documents and literatures, such as the number of poor households and poor household members by Kelurahan from BPS, slum area by RW level from Housing Department of DKI Jakarta.

5.2.3 Survey Instrument

The survey was conducted using household questionnaires in July 2011. Prior to the full scale survey, pre-test was conducted in May 2011 in three Kelurahans: Penjaringan in North, Kampung Melayu in East, and Petamburan in Central Jakarta. Based on the pre-test result and internal discussion, the questionnaire was modified and finalized.

5.2.4 Sampling Frame Procedure

The study was conducted in poor and inundation prone areas in the mainland of Jakarta. The sample size is 300 households from 15 Kelurahans in which 20 households are selected.

(1) Kelurahan Selection

We employed multi-stage sampling to select 15 Kelurahans for our survey based on two criteria: the poverty level and being areas affected by inundation. The first criterion on Kelurahan selection is poverty level; the data of poor and slum indicators in 2008 at RW level provided by Housing Department of DKI Jakarta were used in this research. Categorized as a slum if it met the following criteria:[3]

1. Population density: the number of people per hectare;
2. Layout of the building: considered if the layout of building is small and neatly arranged;
3. Construction of residential buildings: housing condition and whether it is permanent or not, indicated by percentage of building materials to be used: plywood, chamber (made from bamboo), woods-clay brick;
4. Ventilation: It can receive light from outside or air can spin out of the building;
5. Land used for building construction;
6. Road condition: percentage of soil or un-pavement road;
7. Drainage condition: duration of stagnant drainage per day;
8. Clean water availability: percentage of household using tap water;
9. Toilet facility: percentage of household using toilet in river or public/shared toilet; and
10. Waste/garbage transporting: frequency of garbage/waste pick up in a week.

Table- 5.2.2 depicts the distribution of the number of RW with the slum level by Kotamadya. Comparing among Kotamadyas, South Jakarta is relatively better than others; there is no RW categorized as heavily slum (level 4). On the other hand, concentration of slum area at level 3 and 4 are mostly in West and North Jakarta. In line with the research objective, we only chose Kelurahans which were categorized as slum level 3 and 4.

[3] Then, based on the weight given to each indicator, 4 categories of slum level are respectively defined as follows: 0) non slum {>35}, 1) very lightly {31-35}, 2) slightly {29-30}, 3) continuously {21-28}; 4) heavily {<=20}

Table- 5.2.2 Distribution of the Number of RW with the Slum Level by Kotamadya, (2008)

Slum Level	Kotamadya					Total
	South	East	Central	West	North	
1	24	10	15	19	26	94
2	13	15	9	18	19	74
3	32	50	41	48	47	218
4	0	2	4	10	6	22
Total	69	77	69	95	98	408

Source: Housing Department of DKI Jakarta, 2008

The second criterion is inundation prone areas, which are identified based on the inundation maps on 2007. The maps categorize inundation prone areas into four types of causes as mentioned in Section 5.1 above.

Based on these criteria, 61 Kelurahans were shortlisted (details are shown in Table- A.6 in Appendix). Since judging only by the slum level allows some Kelurahans which have very small inundation-prone areas to be included, we additionally employed another criterion, the grade of the population of the poor[4]. Then, 24 Kelurahans were shortlisted which were graded as slum level 3 and populated with more than 450 poor people, or slum level 4.

This short list represented each group which was categorized by the combination of four causes of inundation: high tide, high tide and inland water, river water, river water and inland water. Since inundation data used for the selection was of 2007, there was some disparity between the current condition and the information. Because of that, we had to additionally select Kelurahans which were dropped from the long list but have severe inundation. At the first screening, there was no single Kelurahan in the South Jakarta included in the short list; there was only one Kelurahan which met the criteria as slum and inundation area, and there was very small chance of being selected since random sampling method was applied. South part of Jakarta gets inundation mainly by the river which cannot flow rain water properly any more. In this condition, pumping stations do not function since the volume of water is too huge. Hence, one Kelurahan was picked from South Jakarta.

Besides, 8 additional Kelurahans were taken from the lower reaches areas. The degree of inundation and quality of inundation water are worse in the lower reaches, so health risk is higher and in fact the poorer concentrated in the areas where people are not willing to choose as resident site normally. Therefore, it would be better to choose more Kelurahan from the lower reaches, which met a balance within current shortlist.

Through discussions and the screening process, a list of 33 Kelurahan was finally gained in which field verification would be carried out. Field verification was done with the aim of confirmation whether Kelurahan would be properly selected or not based on predetermined criteria. After all the information was gathered, the list of 15 Kelurahan for full scale survey was finalized (details are shown in Table- A.7, Figure- A.10~ Figure- A.12 in Appendix). Besides, the 15 Kelurahans selected, we selected several backups for each type of inundation.

[4]Second screening was choosing Kelurahans which had slum level 3 with grading of the population of the poor was 451-750 or 751 to 1050, while those which had 1-150 and 151-450 poor population were dropped. Hence, the shortlist were made up of poor population was more than 450 at slum level 3, and all the Kelurahans at slum level 4.

(2) RW and RT selection

Next phase was area selection within Kelurahan. Kelurahan is broken down into smaller units called RW (community association), and then further broken down into a number of RT (neighborhood association). In order to obtain appropriate RWs for each Kelurahan, two criteria were also applied as well. Information about slum gathered from Jakarta Housing Agency, and inundation from Kelurahan Officer. Table- 5.2.3 depicts long list on RW selection.

Table- 5.2.3 Inundation and Slum Area within Kelurahan Selected

No	Code	Kelurahan	Based on Field Survey		Data from DKI Jakarta		Flood and Slum Area based on Survey and Data from DKI Jakarta			
			Inundation Area by RW		Slum Area by RW		By RW		Total RT within RW	
			Total	RW Number	Total	RW Number	Total	RW Number	Slum	Flood
1	78	Bidara Cina	6	3,5,6,7,11,14	2	6.15	1	6	4	8
2	131	Petamburan	2	2.3	4	3,4,8,9	1	3	2	6
3	141	Kebon Jeruk	3	1,4,9	1	5	1	4	n/a	n/a
4	171	Rawa Terate	2	4.5	2	2,6	2	4, 5	n/a	n/a
5	179	Kedoya Utara	3	1,2,8	2	2,8	2	2, 8	28	21
6	212	Kedaung Kali Angke	4	1,2,3,8	2	1,2	2	1, 2	10	17
7	227	Pademangan Barat	5	3,7,8,9,13	4	7,11,13,14	2	7,13	12	28
8	228	Pademangan Timur	4	1,2,3,10	2	1.1	2	1, 10	9	9
9	235	Kapuk	16	1 to 16	6	1,3,4,7,13,16	6	1,3,4,7,13,16	34	59
10	245	Ancol	1	2	2	2.4	1	2	7	6
11	247	Tegal Alur	5	1,3,8,9,11	1	8	1	8	8	8
12	253	Penjaringan	5	3,7,9,12,17	10	2,7,8,11,12,13,14,15,16,17	2	7,12	19	12
13	254	Marunda	2	1,7	2	1.2	1	1	5	1
14	256	Tanjung Priok	2	7, 6	4	6,7,11,13	4	6,7,11,13	18	18
15	260	Bukit Duri	3	10,11,12	3	10,11,12	3	10,11,12	25	25
Total			**61**	-	**47**	-	**24**	-	-	-

There were 61 RW categorized as inundation prone and 47 as slum RW. We picked up 24 RWs as short list which met with categories as slum and inundation prone area. If there was Kelurahan that had more than one RW, then random selection was conducted for main location and back up RW. Otherwise, there was no back up for Kelurahan that only had one RW. Table- 5.2.4 depicts details of RW and RT selected.

Meanwhile at RT level, it was not selected randomly or purposely, but followed household sample selection (See Table- 5.2.4 for further details).

Table- 5.2.4 RW and RT Selected

No	ID	Kelurahan	Main Location		Back up	
			RW	RT	RW	RT
1	253	Penjaringan	17	07,15	07	
1	212	Kedaung Kali Angke	01	03, 04	02	
2	227	Pademangan Barat	07	01, 14, 15	13	
3	228	Pademangan Timur	10	06, 09, 10, 15	01	
4	235	Kapuk	16	11, 12, 13	04	
5	245	Ancol	02	01, 03, 09, 10, 11, 12	None	
6	247	Tegal Alur	01	01, 06, 07, 11	None	
7	254	Marunda	01	02, 03	None	
8	256	Tanjung Priok	07	01, 03	06	
1	171	Rawa Terate	04	16	05	
2	179	Kedoya Utara	02	13, 14, 15	08	
3	131	Petamburan	03	16	None	
1	78	Bidara Cina	06	12, 13, 14, 15	None	
2	141	Kebon Jeruk	04	02	None	
3	260	Bukit Duri	10	10, 11, 12	12	

(3) Household Sampling Frame

This household survey required 300 samples of poor household in slum and inundation area in Jakarta. A quota sample was distributed among selected Kelurahan that are 20 samples of household in each.

Since there was no official list of poor household at Kelurahan level, the sampling frame as a basis for random sampling was developed by gathering information about RASKIN beneficiaries from RT head. This program is intended for the poor, and those who are the beneficiaries have to be met with the specified requirements set by government[5]. While the household meets with at least 9 or more of 14 requirements, it is entitled to become beneficiaries of RASKIN program. In practice, the authorities in the lower level such as RW and RT level, not all of them know these requirements, and even if they know, it seems to be ignored. Assessment for gathering data of poor household is more emphasized on field observation and their own understanding than to refer to the official documents.

Based on an interview with selected RT Head, their tasks at RT level are just to make a list of candidate beneficiaries enclosed copies of ID card and Family Card, and final decision is conducted by higher level after dispatching verification team. Therefore, the beneficiaries of this program are often biased when a formal referral is not applied.

The number of beneficiaries varies in each location, and the sample frame contains the list of names of RASKIN beneficiaries numbered from 1 to N. There were 20 names selected randomly, besides, 2 households in each RT were also provided as back up. Table- 5.2.5 depicts the number of poor households in selected Kelurahans. Specifically for Kelurahan Kebon Jeruk had only 20 households, then all of them were picked up as sample households. To overcome the shortage of samples, back up were provided by selecting randomly from another Kelurahan which had the same type of inundation and was in the adjacent area that was Kelurahan Kedoya Utara.

[5] Poor household requirements: (1) size of floor less than 8 m^2, (2) main material of the floor is soil/bamboo/thick wood, (3) main material of wall is bamboo/rumbia/low quality wood/brick without plaster, (4) does not have own toilet, (5) does not have electricity for lighting, (6) only have access to water for drinking from well/uncovered spring/river/rain water, (7) main source energy for cooking from wood/charcoal/kerosene, (8) consume meat/milk only once a week, (9) buy only one piece of new cloth per year, (10) have meal once or twice a day, (11) cannot afford the fee for Puskesmas or private clinic, (12) monthly income of the household head is less than 600,000 Rupiah and her/his occupation is farmer with 500 m^2 land ownership/landless peasant/fisherman/construction labor/plantation labor, (13) education attainment of household head; no formal education/not graduated from elementary school/elementary school graduated, (14) saving or asset household value less than 500,000 Rupiah, including motorcycle, gold, livestock, and boat.

Table- 5.2.5 Population of Poor Household by RW and RT Selected

ID	Kelurahan	Main Location			Back up		
		RW Number	RT Number	Number of Poor	RW Number	RT Number	Number of Poor
253	Penjaringan	17	7,15	57	07		
212	Kedaung Kali Angke	01	03,04	21	02		
227	Pademangan Barat	07	01, 14, 15	36	13		
228	Pademangan Timur	10	06, 09, 10, 15	40	01		
235	Kapuk	16	11, 12, 13	34	04		
245	Ancol	02	01,03,07, 09,10,11,12	151	None		
247	Tegal Alur	01	01, 06, 07, 11	63	None		
254	Marunda	01	02, 03	78	None		
256	Tanjung Priok	07	01, 03	38	06		
171	Rawa Terate	04	16	38	05		
179	Kedoya Utara	02	13, 14, 15	34	08		
131	Petamburan	03	16	29	None		
78	Bidara Cina	06	12, 13, 14, 15	48	None		
141	Kebon Jeruk	04	02	20	None		
260	Bukit Duri	10	10, 11, 12	27	12		

5.2.5 Data Processing and Analysis

It began with data entry using Microsoft Excel program, then the data processing performed using SPSS statistical analysis program including descriptive analysis and tabulation.

5.3 Results

5.3.1 Survey Sites

Our survey areas belong to the neighborhood scale which is called *Rukun Tetangga* (RT), the smallest neighborhood unit in Jakarta. We selected 15 RTs based on the condition of Kelurahans affected by floods and dominated by poor households in DKI Jakarta province as described in Chapter 2 above. They spread diversely in entire Jakarta but are mostly located in north Jakarta. Figure- 5.3.1 shows the location of survey sites.

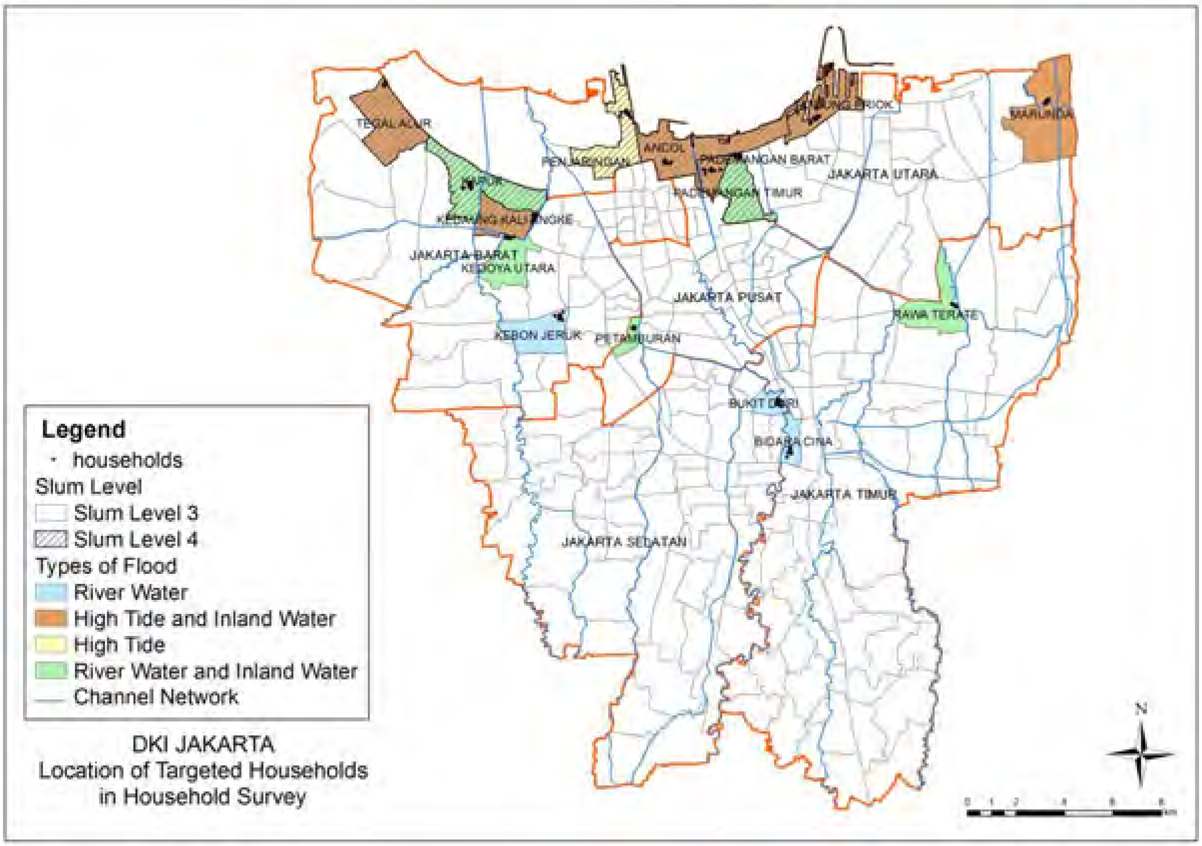


Figure- 5.3.1 Location of Survey Sites

(1) Kelurahan Kebon Jeruk (RT 12)

Brief profile of Kebon Jeruk located in West Jakarta is shown in Table- 5.3.1.

Table- 5.3.1 Brief Profile of Kelurahan Kebon Jeruk

Kelurahan	Area (km^2)	Population	Household	Number of RW	Number of RT
Kebon Jeruk	369.15	52,295	8,838	11	131

This area is often inundated, but it is just temporary. Usually, the inundation is caused by heavy rainfall or a river overflow. According to the respondents in this Kelurahan, areas which experienced inundation were RT 04 and RT 02. Inundation that occurred in RT 04 was only momentary inundation. It was caused by the small trench on the side of Jalan Arjuna which could not have enough capacity to accommodate rainfall water. Time duration of inundation is around 1 hour on average. RT 02, in which most of houses are categorized as slums, also has quite frequent experiences of inundation because of their location in the river banks of Kali Sekretaris.

When it has heavy rain and river overflowing, highway safety wall of Tomang-Kebon Jeruk embanks water to the other side of the highway and inundate South Arjuna Road. The Inundation often hit not only RW 04 but also RW 12 because their location is under the highway and the parent tract of Kebon Jeruk territory was disconnected. The level of inundation water in this area usually reaches about 0.5 meter.

(2) Kelurahan Bidara Cina (RT 12, 13, and 14)

Brief profile of Bidara Cina located in East Jakarta is shown in Table- 5.3.2.

Table- 5.3.2 Brief Profile of Kelurahan Bidara Cina

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Bidara Cina	126	32,281	16,150	16	189

Kelurahan Bidara Cina directly abut to the riverside, so many settlements are located on the river bank. Heavy local rainfall in the rainy season, the shallowness of the river due to waste, and lack of water infiltration are the factors that trigger the occurrence of catastrophic floods in this region (PMI, 2005). Last year, Bidara Cina was still experiencing inundations, especially in the Ciliwung River bank. Inundation usually comes from flooding posts from upstream and poor local drainage. According to Banpol PP and Tramtib officers, flood prone areas in this Kelurahan is RW 3, 5, 6, 7, 11, and 14. The most severely affected by inundation is RW 05 and 07. The height of inundation could reach an adult's chest (1.5 meters) and the duration of flooding is usually just a day and/or night at low tide.

(3) Kelurahan Kapuk (RT 11, 12, and 13)

Brief profile of Kapuk located in West Jakarta is shown in Table- 5.3.3.

Table- 5.3.3 Brief Profile of Kelurahan Kapuk

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Kapuk	562.68	92,099	22,688	16	222

Kelurahan Kapuk is part of the northern coastal area of Jakarta which experienced significant land subsidence for about 0.87 cm/year. Kampung Apung is one of the areas in Kapuk which has the evidence of land subsidence. A pool of water used to cut off traffic to Soekarno Hatta Airport, which shows that the Jakarta area is slowly sinking. This declining process was caused by a variety of impacts which reduced water catchment areas, unstable soil conditions, and the exploitation of ground water.

Under these circumstances, Kelurahan Kapuk is a flood-prone area. Inundation often occurs because of heavy rain, poor drainage, and flooding river. Based on the information gathered from interview with staff in Kelurahan Kapuk, all of RW in this Kelurahan are often hit by inundation in which water level is ranging from 0.2 to 0.5 meter.

(4) Kelurahan Kedoya Utara (RT 13, 14, and 15)

Brief profile of Kedoya Utara located in West Jakarta is shown in Table- 5.3.4.

Table- 5.3.4 Brief Profile of Kelurahan Kedoya Utara

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Kedoya Utara	314.78	40,535	19,152	11	131

In this Kelurahan, especially RW 01, 02 and 08 are flood prone areas. Poor and stagnant drainage channels cause the flood. The water level sometimes reaches 1 meter.

(5) Kelurahan Penjaringan (RT 07 and 15)

Brief profile of Penjaringan located in North Jakarta is shown in Table- 5.3.5.

Table- 5.3.5 Brief Profile of Kelurahan Penjaringan

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Penjaringan	395.43	82,564	16,528	17	165

The position of Kelurahan Penjaringan is lower than sea level (approximately one meter below sea level) and crossed by three rivers (Ciliwung, Angke and Kali Krukut) that flow into the sea. These conditions have caused some RW settlements in some beaches around, including RW 01, 02, 03 and 17, flooding in the rain or high tide season. Inundation caused by high tide is now happening all the time due to levee breaches.

Based on data from the Office of Housing Government of DKI Jakarta in 2009, RW 12 is categorized by heavily slummed area. There are 45 poor households in 5 RTs are being flood prone area. Some of them are generally immigrants. Although most people have decades of living in this area, most of them still occupy a rented house or build a temporary house on land along the river. Their livelihood is dependent on odd jobs or jobs in the informal sector.

(6) Kelurahan Petamburan (RT 16)

Brief profile of Petamburan located in Central Jakarta is shown in Table- 5.3.6.

Table- 5.3.6 Brief Profile of Kelurahan Petamburan

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Petamburan	90	26,428	12,904	11	119

Kelurahan Petamburan is traversed by the West Flood Canal as well as railroads Serpong - Jakarta, between stations Palmerah and Tanah Abang. In general, this Kelurahan is a fairly dense neighborhood called *kampung* bordering the Flood Canal. Based on data from the Office of Housing Government of DKI Jakarta in 2009, RW 03 is categorized as heavily slummed area.

RW 03 is located in a river basin where all the streams in Petamburan lead to. Therefore, type of inundation was the seasonal flooding due to heavy rainfall from October to February. The level of water can reach 2 meters; it is still complained that the water level sometimes exceeds the height of Flood Canal levee due to water flow from upstream.

(7) Kelurahan Bukit Duri (RT 10, 11, and 12)

Brief profile of Bukit Duri located in South Jakarta is shown in Table- 5.3.7.

Table- 5.3.7 Brief Profile of Kelurahan Bukit Duri

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Bukit Duri	107	42 337	20,868	12	152

Based on the height from sea level, Kelurahan Bukit Duri area is divided into two; namely the high land area that lies along the road Bukit Duri Grade, and low land area on which mainly RW 10, 12, 14 are located and lie along the Ciliwung river banks.

In the rainy season, Kelurahan Bukit Duri area always submerges in floods caused by an overflow from Ciliwung River, especially in the lower mainland. Besides located in inundation-prone areas, the low-lying areas in Bukit Duri are also a densely populated area formed by narrow alleyways and dominated by small and thick houses with poor sanitation.

(8) Kelurahan Ancol (RT 01, 03, 09, 10, 11, and 12)

Brief profile of Ancol located in North Jakarta is shown in Table- 5.3.8.

Table- 5.3.8 Brief Profile of Kelurahan Ancol

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Ancol	377.28	17,387	5,249	7	64

Our survey site is RW 02 which covers 3 poor households in RT 09, 5 households in RT 10, 2 households in RT 11, 4 households in RT 12, 4 households in RT 01, and 2 households in RT 03. RW 02 is located in coastal areas impacted by high tidal flood (rob flood) due to the arrival of the rainy season instead. This RW has also been impacted by land subsidence which occurs continually.

(9) Kelurahan Kedaung Kali Angke (RT 01, 03, and 04)

Brief profile of Kedaung Kali Angke located in West Jakarta is shown in Table- 5.3.9.

Table- 5.3.9 Brief Profile of Kelurahan Kedaung Kali Angke

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Kedaung Kali Angke	281.35	26,816	7,021	8	81

Our survey area is RW 01 which covers 8 poor households in RT 01, 8 households in RT 03, and 4 households in RT 04. This area is also prone to flood because of the location in the coastal area and local poor drainage.

(10) Kelurahan Marunda (RT 02 and 03)

Brief profile of Marunda located in North Jakarta is shown in Table- 5.3.10.

Table- 5.3.10 Brief Profile of Kelurahan Marunda

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Marunda	791.69	18,084	5,320	9	80

Kelurahan Marunda is a coastal area in which tidal flood occurs frequently. The maximum height of water level in the event of tidal flooding caused by high tide is 1.1 meters.

Specifically, inundation prone areas are RW 01, 02 and 07.

(11) Kelurahan Pademangan Barat (RT 01, 14, and 15)

Brief profile of Pademangan Barat located in North Jakarta is shown in Table- 5.3.11.

Table- 5.3.11 Brief Profile of Kelurahan Pademangan Barat

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Pademangan Barat	353.35	61,507	20,758	16	211

Our survey area is RW 07 which covers 5 poor households in RT 01, 8 households in RT 14, and 7 households in RT 15. This Kelurahan is very dense and even shabby because the location is very strategic next to the commercial trade center where people in the Kelurahan come to find a job. Nearly 70 percent of the population is urban migrants, and Kelurahan Pademangan Barat is one of the typical slum areas in Jakarta.

(12) Kelurahan Pademangan Timur (RT 06, 09, 10, and 15)

Brief profile of Pademangan Timur located in North Jakarta is shown in Table- 5.3.12.

Table- 5.3.12 Brief Profile of Kelurahan Pademangan Timur

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Pademangan Timur	261.24	40,474	11,907	10	145

Our survey area is RW 10 which covers 7 poor households in RT 06, 9 households in RT 09, 2 households in RT 10, and 2 households in RT 15. In general, Kelurahan Pademangan Timur is lowland area. Floods caused by local rainfall are frequent in this Kelurahan. In addition, the condition of drainage filled with garbage and mud also causes the flood in RW 05 and 07. Most of incidents are accompanied by a little rain, and the water level reaches up to 0.5 meters.

(13) Kelurahan Rawa Terate

Brief profile of Pademangan Timur located in East Jakarta is shown in Table- 5.3.13.

Table- 5.3.13 Brief Profile of Kelurahan Rawa Terate

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Rawa Terate	330	15,425	8,157	6	60

Our survey area is in RW 16 which covers 20 poor households in RT 16. This area is prone to inundation if heavy rainfall flushed Jakarta, especially from five-year cycle of flooding. This Kelurahan has specific characteristics of the morphology which is concave and formerly was a swamp. Therefore, when heavy rainfall occurs, it is mostly flooded. The Kelurahan is lowland and most of the area is located on the riverbank Cakung; on the edge of the river is prone to inundation during the rainy season.

(14) Kelurahan Tegal Alur (RT 01, 06, 07, and 11)

Brief profile of Tegal Alur located in West Jakarta is shown in Table- 5.3.14.

Table- 5.3.14 Brief Profile of Kelurahan Tegal Alur

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Tegal Alur	496.69	65,699	24,310	16	159

Our survey area is RW 10 which covers 5 poor household in RT 07, 6 households in RT 06, and 9 households in RT 01 and RT 11. Kelurahan Tegal Alur is on a coastal region and adjacent to the sea. Conditions as a flood prone area are further exacerbated by the existence of two streams of Semonggol River and Tanjungan River which currently run through the Kelurahan and the streams are becoming shallow by the sedimentation of sludge.

Semonggol River reaching 2 km in length located in this village became shallow and narrow due to temporally occupied buildings over a long period, therefore water overflows when it has heavy rain. Water level in the event of inundation can reach 0.5 meters in RW 1, 3, 9, 11 and 15.

(15) Kelurahan Tanjung Priok (RT 01 and 03)

Brief profile of Tanjung Priok located in North Jakarta is shown in Table- 5.3.15.

Table- 5.3.15 Brief Profile of Kelurahan Tanjung Priok

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Tanjung Priok	554	25,174	6,547	16	157

Kelurahan Tanjung Priok is a coastal region bordering the sea north of Java. Because of the location on the coast, the Kelurahan suffered from flood particularly caused by high tide. The location near the harbor and dense housing make the Kelurahan flood prone area.

5.3.2 Physical and Socio-Economic Condition

(1) Settlement Status

According to the interview with 300 Households in 15 Kelurahans, the average household size is 4-5 members. Since our survey area is poor settlement, it can be argued that the living standard of our respondents refers to the condition of the poor. One of the indicators is the fulfillment of modest healthy house criteria.

According to the regulation of “Rumah Sehat Sederhana” which means modest healthy house by Ministry of Public Works, the standard of threshold area for modest healthy house occupied by four people is 28.8m^2 (7.2m^2 per one person). Our survey shows that all of the houses did not have front yard or back yard. Of the households who have five or more members live in a house, 21% occupy a house with an area less than 19m^2, and 78.9% occupy a house with an area of 20-49m^2; they have been forced to live in fairly narrow house compared to the regulation.

So, it can be shown that one of the typical characteristics of poor settlement in Jakarta is high density of both population and houses. The population increase in Jakarta is not accompanied by the expansion of intensive settlements. Meanwhile, every year the population in Jakarta has been added primarily as a result of migration into Jakarta. Jakarta as the capital city of the State has a strong appeal for residents in other provinces to move to Jakarta. This becomes an aggravating factor for untidy density of population.

(2) Migration Pattern

The problem of services for housing and settlement facilities is very pronounced. It is caused by the rapid increase of urban population due to migration and the limitation of land for an adequate settlement. As for the migration, 54.3 percent of the head of the family were born in Jakarta and 45.7 percent were not. In addition, 49 percent of the head of household came from their hometown and 51 percent had lived in Jakarta since they were born; those whose original hometown is West Java (*Jawa Barat*) account for 27.6 percent and Central Java (*Jawa Tengah*) account for 23 percent of all (see Figure- 5.3.2).

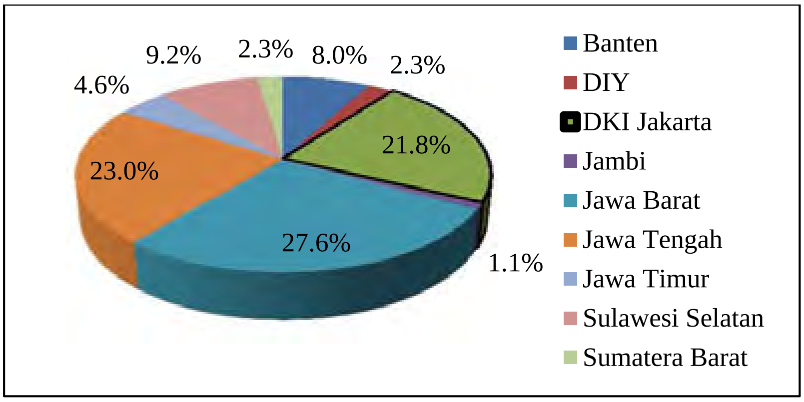


Figure- 5.3.2 Original Hometown of Head of Households

The main reason of migration is to rely on their relatives and/or friends (39.8 percent), to get better job though had job (11.7 percent), and to get job because lost job (11.7 percent). But in reality, their expectation for better income is not always realized. The data show that the average income before moving to Jakarta is not much different from that of the present. As shown in Figure- 5.3.3, the average income in Jakarta ranges from zero to five hundred thousand rupiahs per month, meanwhile 46 percent of them had average income only in the range zero until three hundred thousand rupiahs before moving.

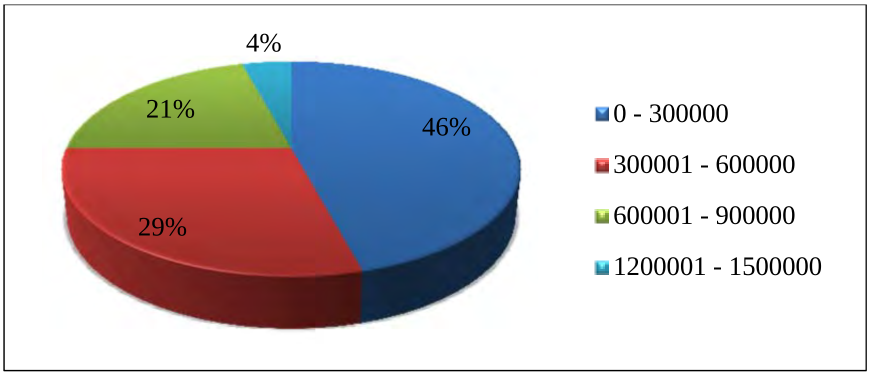


Figure- 5.3.3 Range of Head of Households Income before Moving

The other characteristic of the migrated poor is their relationships to their original community. Although settled in Jakarta, 95 percent of them still have access to community in the original village and 93 percent of them have relationships through ethnic and religious relations; the form of relationships is the bond of friendship (called *silahturahmi in Bahasa*). Such relationships are fostered very well though many of the households which have no assets or liabilities there; 98 percent of respondents answer that they have no any dependents who live separately and 99.7 percent of them answer that they have no assets at their hometown.

(3) Health Status

According to the survey, the health status of the respondents seems to be in good condition; only 4 percent of household members are currently ill and 9.3 percent of household members suffered from pain in the last 12 months. If pained, 63 percent of household members choose to seek medical treatment. But if their conditions are not serious, 53 percent of them do not seek the medical treatment. The types of health facilities are physician practices (47 percent) and clinics (31 percent). On the other hand, 63 percent of them do not visit doctors or medical facilities because of financial reasons as shown in Figure- 5.3.4. It needs to be noted that even though their health status is not bad at this moment the possibility of becoming ill is not low considering sanitary conditions in such vulnerable areas.

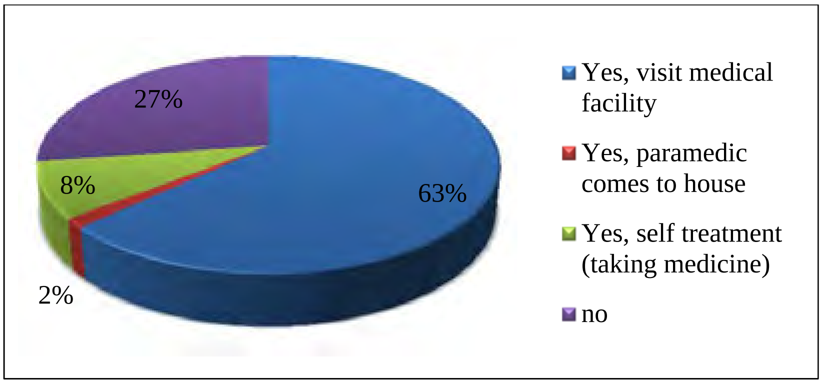


Figure- 5.3.4 Type of Illness Treatment

(4) Education Level

In general, the educational status of household members is not so bad in the sense that 81.9 percent of them have ever attended school; 46.9 percent of them are at elementary school and 25.6 percent of them are at junior high school as shown in Figure- 5.3.5. On the other hand, almost 61 percent of household members that have ever attended school have not completed 1st level.

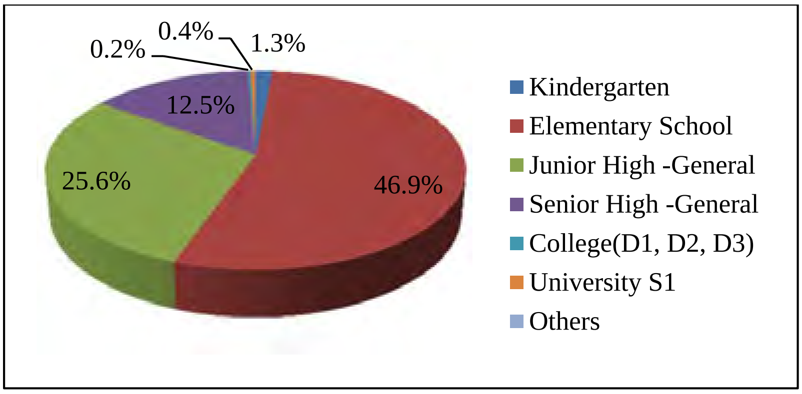


Figure- 5.3.5 Level of Highest Education ever Attended by Household Members

The data also show that 39 percent of household members are in a school age, but only 41 percent of them are enrolled in academic year 2010/2011. Focusing on how the household pay for school, 61.7 percent of them do not spend money for school. It is possible because the primary education system as the 9-year compulsory education program in Indonesia is free. The other 29.5 percent of them are students receiving scholarships.

Focusing on the reason to quit school and work for living, it is mainly financial limitation. Therefore, due to inadequate educational background, many head of households are part-time worker or casual job (12.6 percent) and housework servant (18.1 percent) as shown in Figure- 5.3.6.

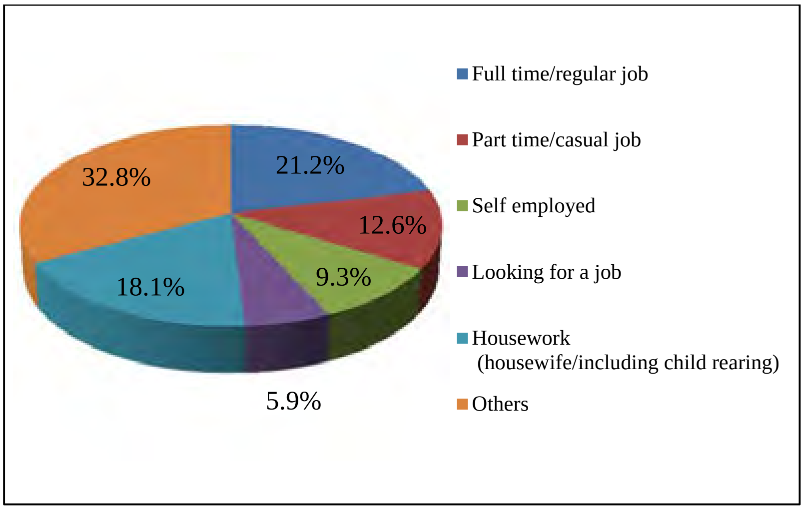


Figure- 5.3.6 Main activity of Head of Household

(5) Financial Status

Parsudi Suparlan (2007) states that slum dwellers are not socially and economically homogeneous, and the livelihood of its citizens has diverse income levels, as well as their origins. Most slum dwellers are those who work in the informal sector or have additional livelihood in the informal sector. The condition was also seen from our respondents. There is no dominant livelihood based on survey results. In addition, most of our respondents are classified as low income.

Figure- 5.3.7 shows that 34.2% of respondents have monthly income of five hundred thousand or less and 40.8% have monthly income above five hundred thousand to one million rupiahs. While the Jakarta regional minimum labor wage in year 2011 is one million two hundred thousand rupiah (Rp 1.200.000,-), 83.0% of them have monthly income of less than the minimum labor wage. Income can be defined as the consumption and savings opportunity gained individual within a specified time frame, which is generally expressed in monetary terms (Barr, 2004). Meanwhile, except income there is the source of economics from their savings. It is defined as income not spent, or deferred consumption (Random House, 2006). 96 % of them are not saving their money; only 0.33% of them save the maximum value 14,000,000 – 15,000,000 rupiahs. Therefore, it can be interpreted that households do not have a reserve fund in the form of savings or the other.

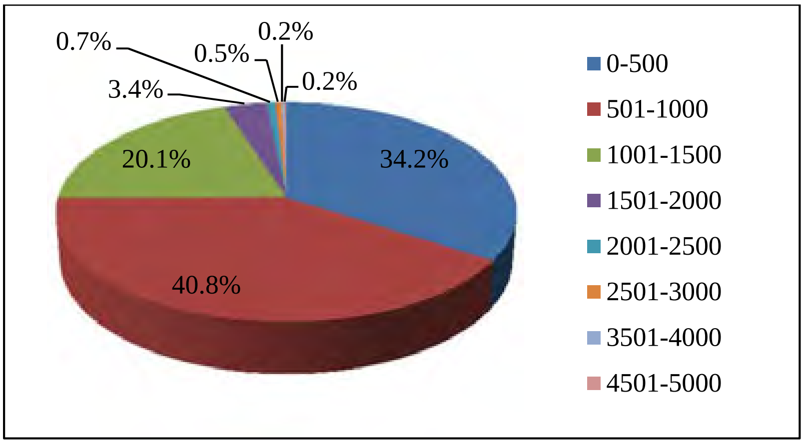


Figure- 5.3.7 Monthly salary of Head of Households per Month (in 1,000 rupiah)

The types of job which they engage in are largely classified as informal activities; it is difficult for them to get financial assistance from formal financial institutions. According to the survey, 65 percent of them did not have a loan. As for those who have a loan, borrowing from relatives, friends, or neighbors is still the main choice for 40 percent of them (see Figure- 5.3.8).

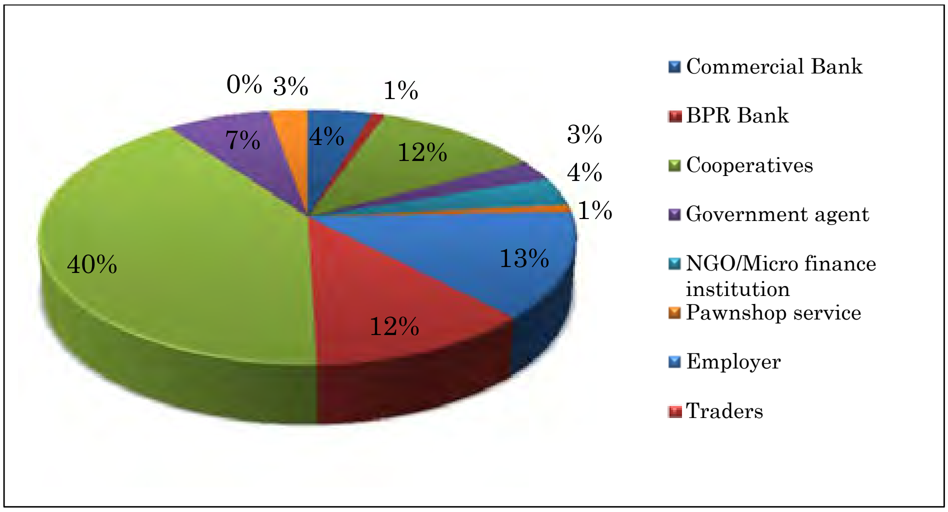


Figure- 5.3.8 Types of Lenders

The nominal of debt value is dispersed. 84.7 percent of households have average debt rate 0 – 250.000 rupiahs. In addition to money, 28 percent of households also have a loan in the form of goods. In general, the amount of loans in kind with a value range of 0 - 5,000,000 rupiah reached 62.1 percent. More details of the amount of debt can be seen in Figure- 5.3.9.

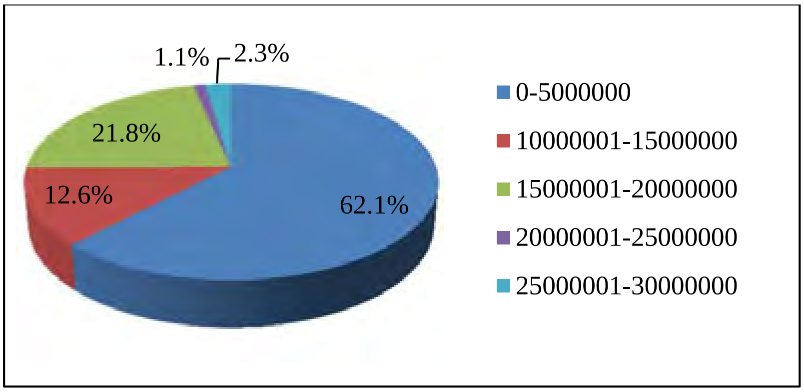


Figure- 5.3.9 Total Amount Borrowed

As for asset value, 62 percent of respondents have land and housing with area of 1-50 m^2. According to the respondents, the approximate prices of house and residential land owned by households are under 10 million rupiahs. It can be seen in Figure- 5.3.10.

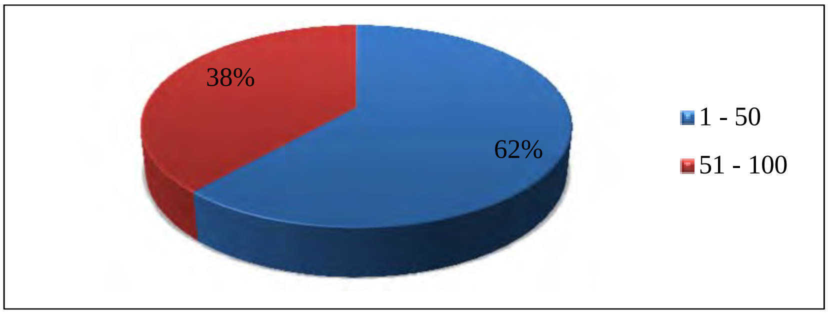


Figure- 5.3.10 Area of Residential

(6) Housing and its Facilities

Housing and its facilities are basic needs for human welfare. The urban people who have low income will have difficulties to fulfill the need of feasible housing and its facilities.

1) Housing Structure Condition

In terms of housing, there are several factors that can be described from the survey: ownership, structure conditions, and basic infrastructures. As for the ownership, there are three types of poor housing ownership that belong to the conditions of Jakarta, which are:

a. The poor households which have their own house and land
b. The poor households which have their own house, but temporally occupy the land
c. The poor households rent the house and has no right on the land

According to our study, it is found that 68.7 percent of them had their own house and 23.3 percent of them rent the house. As for house size, according to Ministry of Public Works, the criteria of the modest healthy house can be seen in Table- 5.3.16.

Table- 5.3.16 Standards of Modest Healthy House

Standard /people (m2)	House units	Total Area (m2) for 3 people Land (L)			House units	Total Area (m2) for 4 people Land (L)		
		Minimal	Effective	Ideal		Minimal	Effective	Ideal
threshold (7.2)	21.6	60	72-90	200	28.8	60	72-90	200
Indonesia (9)	27.0	60	72-90	200	36.0	60	72-90	200
International (12)	36.0	60	----	200	48.0	60	----	200

Source: www.pu.go.id

The majority (47.3 percent) households have a house with an area of 20-49 m^2; 31 percent of households have a house with an area less than 19 m^2, and 20 percent of household have a house with an area of 50-100 m^2. Referring to house health standards by the Ministry of Public Works, the majority households did not meet criteria for modest healthy house.

As for house building, the type of houses in the study area can also be classified by the number of floor level related to conditions of frequent flooding. According to our survey, 49 percent of the households still live in a house which is not terraced nor has storage, 44.3 percent of households live in single-story house (see Table- 5.3.17).

Table- 5.3.17 Size of Floor Number

1 story house

Type of house	Proportion
Not terraced house	49.0%
1 story house	44,3%
2 story house	5,7%
1 story apartment	0,3%
3 story apartment	0,3%
Other	
boat	0,3%

Landed house

We can also describe the condition of building structure of houses through the material of wall, roof, and floor.

- Wall is generally made by brick (55 percent) and the rest 22 percent made by mortar, and 16 percent made by wood. However, there are also made by bamboo, plastic, plywood, and mix material but in a little percentage (see also Figure- 5.3.11).

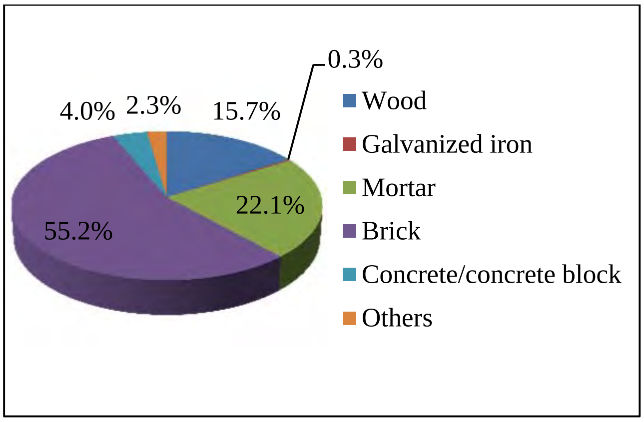


Figure- 5.3.11 Material of House Wall

- The majority of households having the house with the roof of asbestos are 58 percent of the total and 31.3 percent are tile-roofed houses (see Figure- 5.3.12).

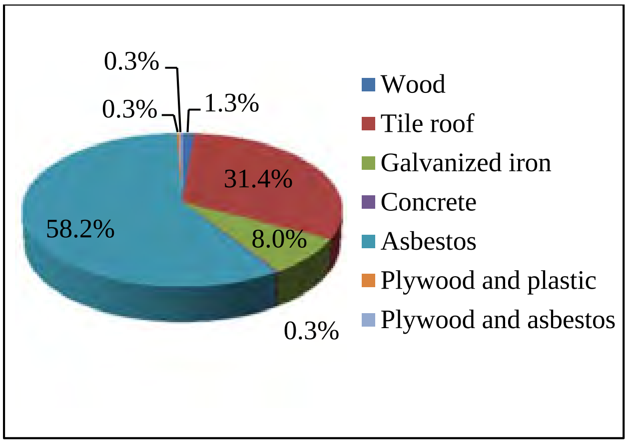


Figure- 5.3.12 Material of House Roof

- In general, 54.5 percent of them have the house with floor of marble / ceramic and 38.8 percent of them have the house with floor tile (see also Figure- 5.3.13)

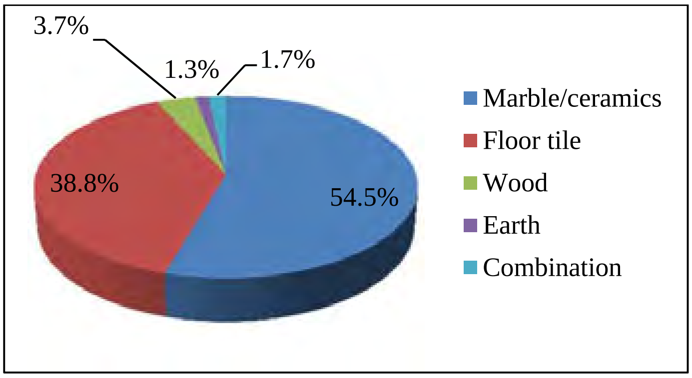
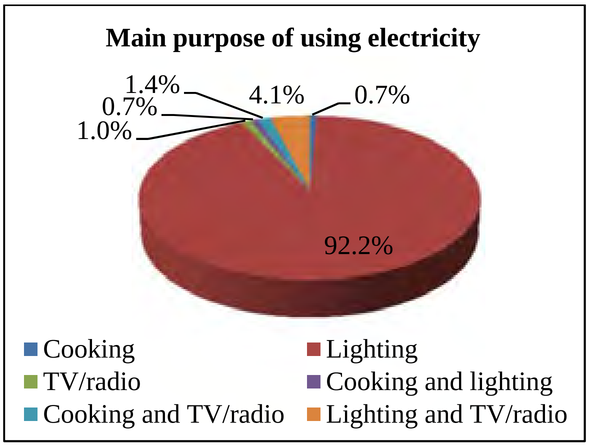


Figure- 5.3.13 Material of House Floor

2) Electricity and Energy

As shown in Figure- 5.3.14, 92.2 percent of respondents dominantly use electricity for lighting, and the rest is for television/radio (1.0 percent) and cooking (0.7 percent). Their consumption in electricity can be categorized high in a matter of usage duration because 45.9 percent of the households can use electricity for 24 hours/day and 45.7 percent of them can use electricity for 10-18 hours/day. However, 49.5 percent of them only pay below 50,000 rupiahs/month.



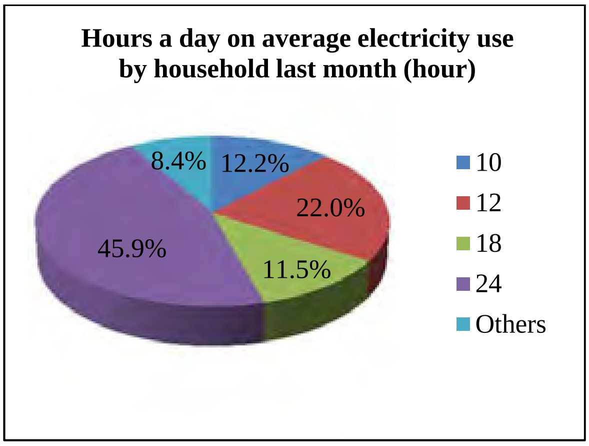


Figure- 5.3.14 Electricity Use of Households

As shown in Figure- 5.3.15, the reason for low percentage of using electricity for cooking is that 78.5 percent of households use fire wood as an energy source for cooking. In addition, the electrical cooking equipment is expensive.

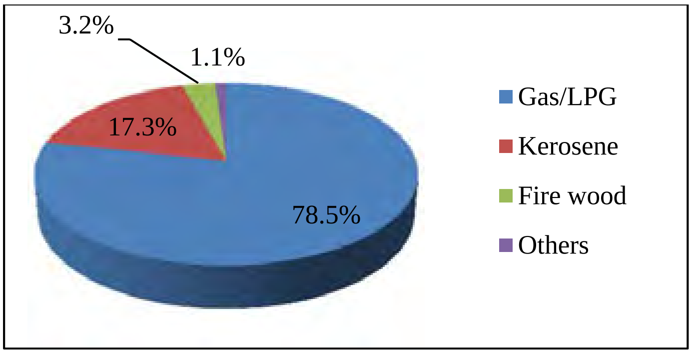


Figure- 5.3.15 Source Energy for Cooking

3) Clean water

There are four main sources of clean water used by poor households: water pipes, drilled water (deep well), bottled water, and water from encircling water sellers. For daily consumption, the households choose pipe water both in dry and rainy season. But for drinking, the majority chooses bottled water in dry season; only 10.3 percent of them still use the well (see Figure- 5.3.16).

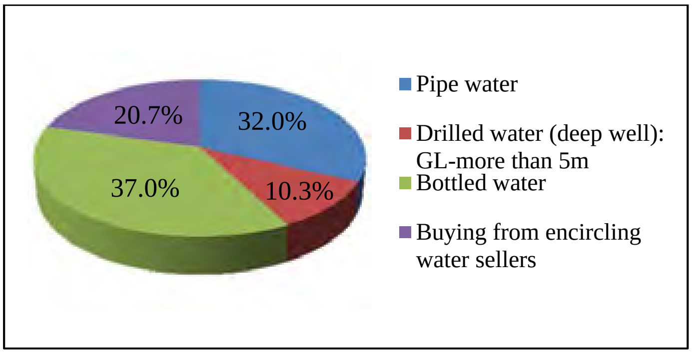


Figure- 5.3.16 Sources of Clean Water in Dry Season

As for water storage, 81.0 percent of households choose to save in containers (buckets and jerry can) and 7.9 percent save in Roof tank / cistern, but 11.1 percent of households have no stored water (see Figure- 5.3.17). As for the main water sources for them, 61.7 percent of them say that they buy it from water seller, so only 15.3 percent of them use tap water or water from well. .

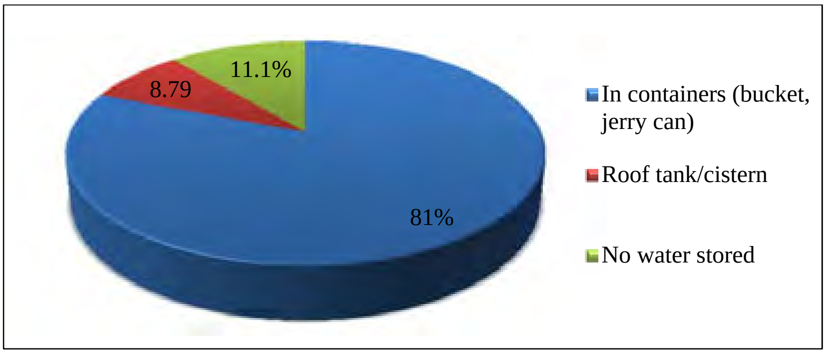


Figure- 5.3.17 Storage Drinking Water

4) Waste water management

The waste water management usually becomes last priority of poor communities. According to our survey, waste water is generally managed in the local neighborhood scale, which is RT or RW with percentage of 73.2 percent and rest by other parties such as government body, private institution, and household as seen in Figure- 5.3.18.

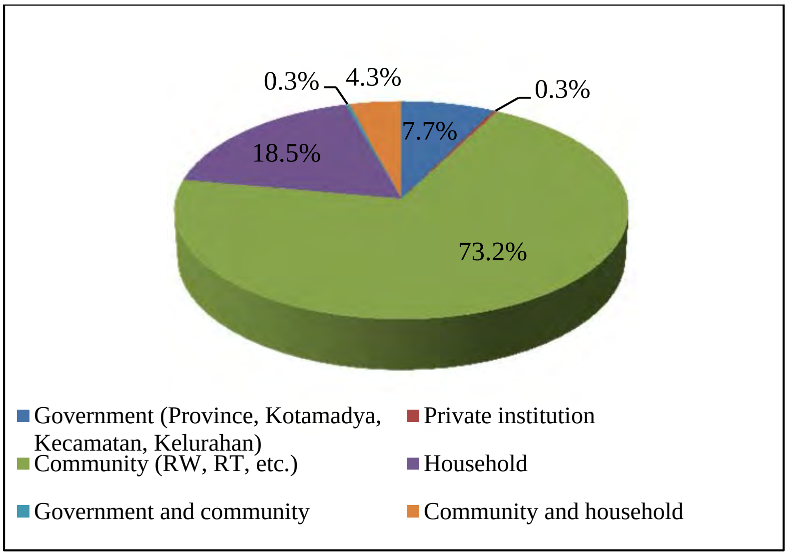


Figure- 5.3.18 Waste Water Management Parties

The participation rate of households in maintaining drainage is quite good as it reaches about 77.3 percent. They generally use maintenance method such as working together to clean clogged drainage systems (72.6 percent), but there are still 22 percent of them who choose to clean by themselves when clogged. As for frequency, 56.5 percent of them do the maintenance once a month and 26.1 percent of them once a week.

5) Sanitation

It is important to identify sanitation facilities since most of the urban poor settlements lack them. As shown in Figure- 5.3.19, 81.3 percent of households drain their sewage at drainage ditch (flowing) and only 11.3 percent at drainage ditch (stagnant).

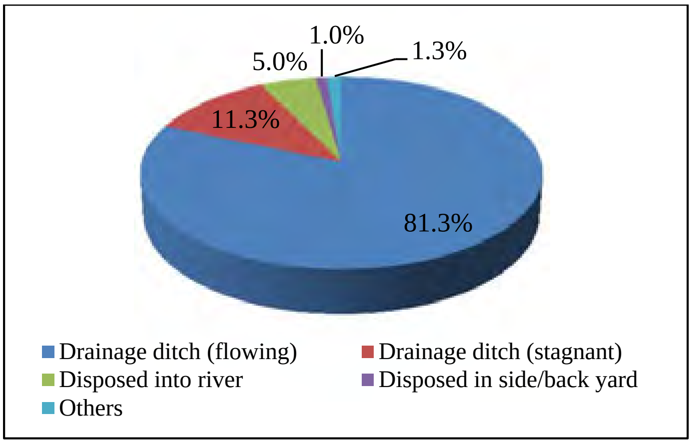


Figure- 5.3.19 Household Sewage Pattern

As for other aspects such as shower and toilet place, 75.7 percent of respondents said that the majority of household members take a shower at their own bathroom, 12.7 percent of them use public bathroom, and 11 percent of them use shared bathroom with other households. As for the frequency of bathing, around 93 percent of them bathe twice a day in normal condition, but not all of households have a toilet with good standard. As shown in Figure- 5.3.20, only 42 percent of household members go to own toilet with septic tank and 33.3 percent of them go to public toilet.

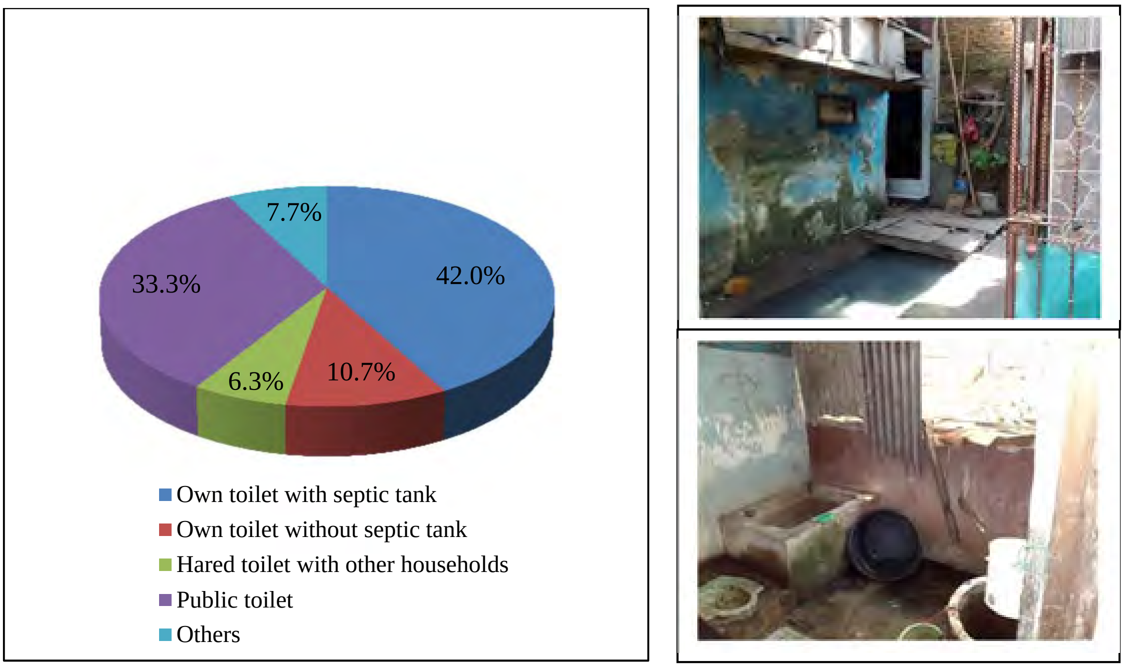


Figure- 5.3.20 Toilet Access

5.3.3 Experiences with Inundations

As one of the biggest urban area in South East Asia, Jakarta is a megacity facing many kinds of problems related to demographical and environmental pressures. The problems are generally combination of natural and manmade disasters. As a megacity and the capital city of Indonesia, Jakarta has complex disorders particularly to sustain its environment from hazards include caused by climate change effect.

According to Yusuf et al (2009), five municipalities in DKI Jakarta are considered one of top 10 cities vulnerable to climate change together with other 530 urban areas in seven ASEAN countries, namely Indonesia, Thailand, Cambodia, Laos, Vietnam, Malaysia, and the Philippines. One of the worst hazards in Jakarta is flood or inundation that lasted in a few days at several critical points. In 2002 and 2007 were the severe conditions in which the level of inundation hit 7 meters depth. However, people get used to be familiar with the five years flood cycle. In this section, we will describe the inundation incidents and respondent's perceptions particularly in responding floods or inundation as a part of climate change impact.

(1) Inundation Incidents

Yusuf et al (2009) stated that there are 3 municipalities in DKI Jakarta which were the three worst inundations in South East Asia: Jakarta Pusat (Central Jakarta), Jakarta Utara (North Jakarta) and Jakarta Barat (West Jakarta). Joga (2011) said that floods usually hit Jakarta in January-February based on experiences of severe inundation in some point of location.

In the past 15 years, the two worst inundations were in 2002 and 2007. In 2002, during one week in February, several main rivers including Ciliwung overflowed and Jakarta were inundated with a height of 0.5 - 2.0 meters (Lobo, 2008). In 2007, during three days, almost 70 percent of total area in Jakarta was hit by flood with a height of 0.3 - 6 meter. In that year total loss of asset is 8.8 trillion rupiahs which consist of 5.2 trillion losses in state's infrastructure and 3.6 trillion for lost income (Lobo, 2008).

This study tries to capture inundation incident based on the perception of respondents through quantitative indicators. There are several aspects that can be drawn through their experiences last year, which are:

1. Occurrence time of flood, 21.5 percent of them said that February was the worst month of inundation that happened in the past twelve months
2. Duration time of flood, 25.6 percent of them stated the inundation lasted for less than 6 hours and only 4.7 percent of respondents stated that inundation lasted for a month at their settlement as shown in Figure- 5.3.21.
3. Frequency of flood, 4.7 percent of them said that inundation incident often hit their settlement area once a month.

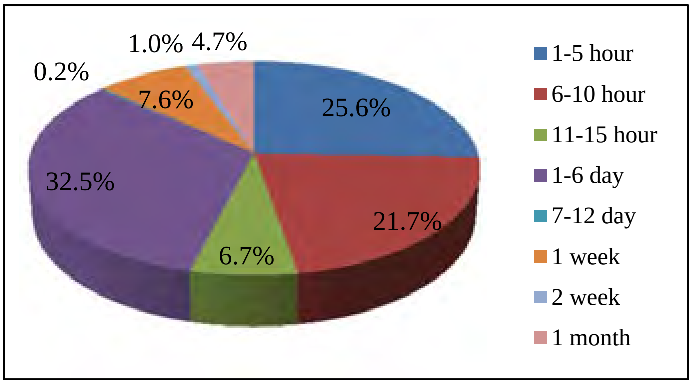


Figure- 5.3.21 Frequency of Flood in the Past 12 Months

4. Scale of Flood, both inside the house and in the street

   a. Inside the house, 53.4 percent of them said that the maximum height of water due to the inundation occurred in the past 12 months was under the ankle and 37.8 percent said that the depth was under the hip (0.2 – 0.5 meter)

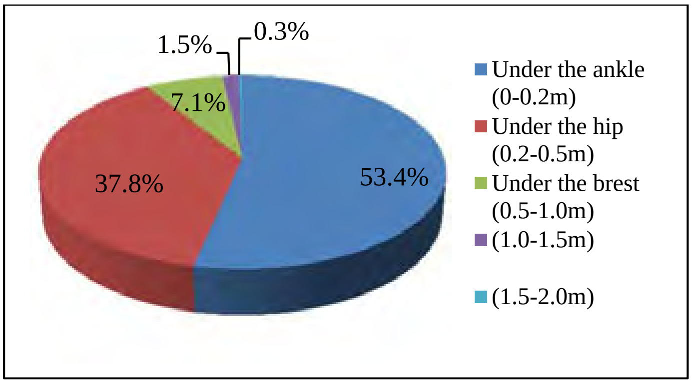


Figure- 5.3.22 Maximum Depth of Inundation inside the House in the Past 12 Months

b. As can be seen in Figure- 5.3.22, the maximum depth of inundation on the street (in front of the house), 26.7 percent of them said that the maximum depth on the street is under the hip (0.2 – 0.5m). If we compare the depth of inundation between inside and outside the house, it is clear that each of houses had prepared for inundation in many ways. Some of them were equipped with simple dike or the door attached above the ground level so that the inundation did not overflow into inside the house.

Besides respondents' experiences last year, this study can also provide the information about their experiences during past five years. 89.1 percent of them stated that the most severe inundation occurred in 2007. At that time, the inundation lasted in a week and 24.6 percent of them stated that the depth of the inundation is around 0.2-0.5 meters in the street.

(2) Perception of Inundation and Climate Change

One of the perceptions of inundation that can be seen from this survey is about the impact of inundation on the households. The most serious disruption that they suffered from inundation in daily life was external activity. 24.9 percent of respondents stated that working and attending to school are significantly disturbed by inundation (see Figure- 5.3.23). However, the local residents do not think it is a serious problem because they have got used to deal with that condition. The other additional effect considered by respondents is related to healthy status of them. Skin disease was the most common illness that occurred after inundation.

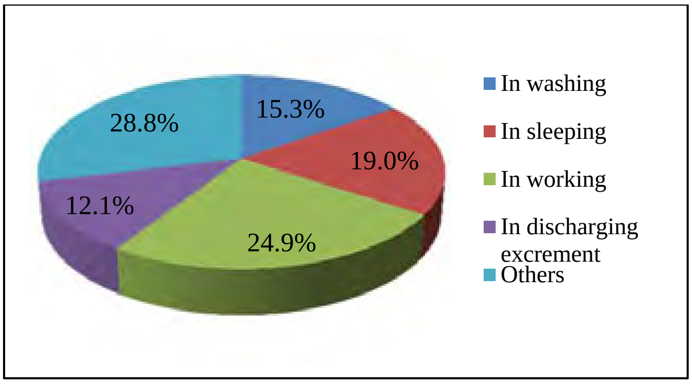


Figure- 5.3.23 the Most Difficulties Caused by Inundation

In understanding perception of respondents to climate change, each individual has an opinion about the impact based on not only his/her experiences but also his/her feeling to the conditions. Therefore, climate change issues cannot be enforced as scientific understanding to poor people which are the vulnerable ones, but adjusting to their own perception as dysfunctional system of environment.

One of the climatic factors asked to respondents is rainfall changes. As shown in Figure- 5.3.24, 57 percent of them said that they get the information from television. The interesting one is the high percentage of those who "do not know the weather prediction". It means that weather itself is not so important among the poor to practice daily life, evidenced from the percentage of ignorance to the weather information is quite large. Therefore, there are 35.7 percent of respondents who do not really aware of weather changes.

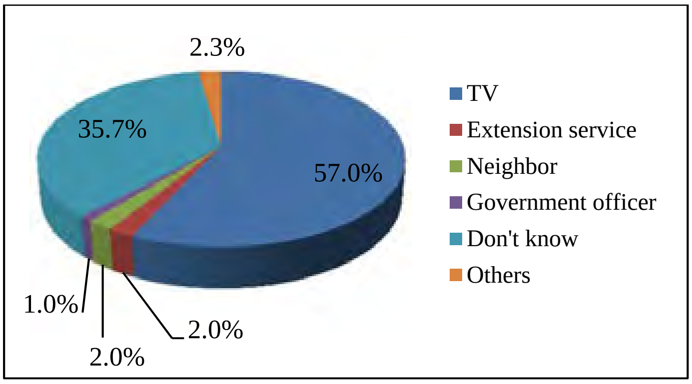


Figure- 5.3.24 Source of Weather Prediction

But compare to the condition of 20 years ago, as shown in Table- 5.3.18, 63.3 percent of them believe that the rainy season starts more erratic nowadays and 26.7 percent of them stated that it is more difficult to determine when the rainy season starts. It means that according to their perception, there are some changes related to climate pattern especially on the rainy season in recent 20 years.

Table- 5.3.18 Determining of Starting Date for Rainy Season Compare to 20 Years Ago

Determining of Starting date For Rainy Season Compared to 20 years ago	
More difficult	26,7%
Same	3,3%
Easier	2,0%
More steady	0,3%
More erratic	63,3%
Don't know	4,3%

As for rainfall patterns according to their perceptions in the last 3 years (2009, 2010 and 2011) compared to the past 20 years, most of them (88.3 percent) said that the pattern of rainfall is steadier in the last 3 years than that of 20 years ago (see Figure- 5.3.25).

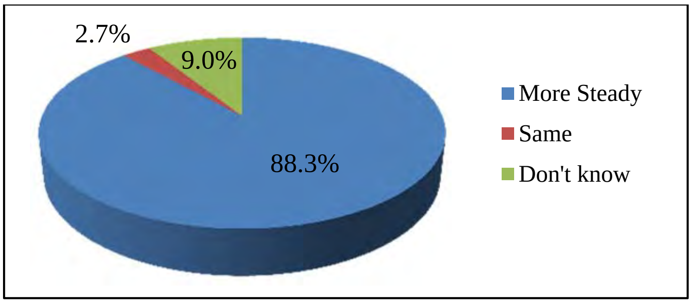


Figure- 5.3.25 Change of Rainfall Pattern Compare to the Past 20 Years

As for the situation in their residential areas, they say that there is no change on the condition of a pool. And most of them stated that there is also no change on the impact of inundation in residential areas over the last 3 years as shown in Table- 5.3.19.

Table- 5.3.19 Changes on the Impact of Inundation in the Past 3 Years

Level of changes	Percentage of perception
Decrease	34,3%
Same	37,7%
Increase	12,3%
Don't know	15,7%

Seeing the results of a survey on perceptions of the poor on climate change, they did not notice for every detail on changing. They already adapt to the situation, so they are not aware of the change as a serious problem for their daily life. Meanwhile, they are aware of the change of weather which becomes more erratic in the long term.

5.3.4 Defining Vulnerability of the Poor in Jakarta

People have to face the frequent inundation or flood depending on their social, economic, or even environmental resources. The resources are various in different part of society identified by people's livelihood. It becomes an integral part seen in daily life and related to each other. On one hand, overpopulated cities can provide their residents with more livelihoods, but on the other hand, they increase vulnerabilities against natural hazards, civil strife, and climate change impacts.
Most of the survey area has severe and frequent inundations. It can be seen from the infrastructure of houses they have, social capital that they built as indirect impact such as *gotong royong* in Bahasa or cooperative attitude which was nurtured from the experience of facing the flood together, and economic activities for the poor. In urban areas, where disaster becomes more severe partially due to overpopulation, the poor tend to be vulnerable. Limited access to infrastructure and public services are the reason why the risks of disaster are getting worse. Moser *et al.* (1994) highlight the contemporary vulnerability of the urban poor to changes caused by structural adjustments.

Three aspects which make the urban poor more susceptible are as follows: 1) Urban life is more commodified than that of rural areas, which means obtaining goods in urban economy nearly always requires money with only limited scope of households. 2) Complexity of environmental risk in urban areas is greater than that of rural area because of so many overlapping risks associated with the household, workplace or neighborhood and with the decreasing environment because of industry waste. 3) Social fragmentation makes the urban poor more vulnerable since high residential mobility and the loss of supportive social network. These three aspects are also identified in our survey area as environmental, social and economic aspects of vulnerability.

As described previously, BPS DKI Jakarta refers to the 14 criteria of poor and poverty line. The 14 criteria are as follows: size of house, main floor material, main wall material, sanitation facility, source of drinking water, main source of fuel for cooking, main source of lighting, consumption of meat/chicken/milk in a week, frequency of eating in a day, buying new clothes for each household member in a year, ability to pay medical expenses, the highest education attained by household head, the highest education attained by household members, ownership of assets/savings. Meanwhile, BPS DKI Jakarta also applies poverty line that is different among regions. Poor is defined as the state of people whose expenditure per capita per month is below the poverty line.

According to Bogardi *et al.* (2005), <u>physical factors</u> encompass susceptibilities of the built environment. <u>Social factors</u> are related to the social issues such as levels of literacy, educations, social equity, traditional values, etc. <u>Economic factors</u> are related to issues of poverty, gender, level of debt and access to credit. <u>Environmental factors</u> include depletion and degradation of natural resources, and natural "vulnerability" towards climate change. Therefore, it is important to recognize the existence of vulnerability in coping capacity within disaster risk reduction.

(1) Environmental and Physical Vulnerability against Inundation

Our survey area is flood-prone and slum[6] based on Government of DKI Jakarta Province. We assume that the surrounding environment of our survey area is not feasible for sustainability of resident's life. It means that the slum area could increase the vulnerability of the area against disaster, including inundations.

According to our respondents, 88 percent of respondents are aware that they live in one of the inundation prone area, and only 12 percent of them are not aware of it (see Figure- 5.3.26). It means they have already known and noticed about the environmental vulnerability, but they are still obliged to choose to live and stay at this inundation prone area.

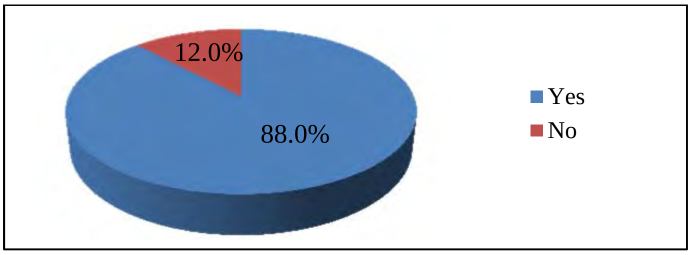


Figure- 5.3.26 Awareness of Inundation Prone Area

Physical risks are also identified from the condition of their houses. As mentioned above, the housing condition does not meet the standard of modest healthy houses, including the water scarcity in most of the houses and the usage of electricity in a long duration for a day.

(2) Social Vulnerability

As stated above, the average number of household member who live in each house is 5 persons, meanwhile the area of house is only 19 m^2. It could be identifying that each house is dense, and if a house denser, it will be more vulnerable against the adverse impact of disaster for people inside. The other factor is their education level. In this study, we can identify respondent's experiences of formal education. 81.9 percent of the entire household members have attended for school and the rest 18 percent have not. But, most of them only attended for elementary school and junior high school (72.5 percent). In addition, as stated above, 61 percent of household members who attended school only completed at the first grade of each stage (see Figure- 5.3.27). That is one of the main reason why we can categorize the vulnerability of the poor identified from respondents is enough high.

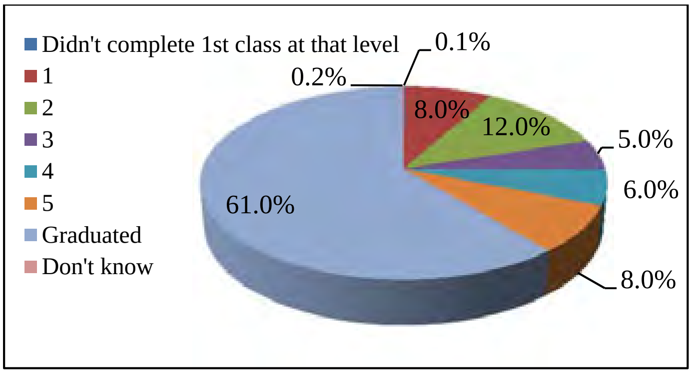


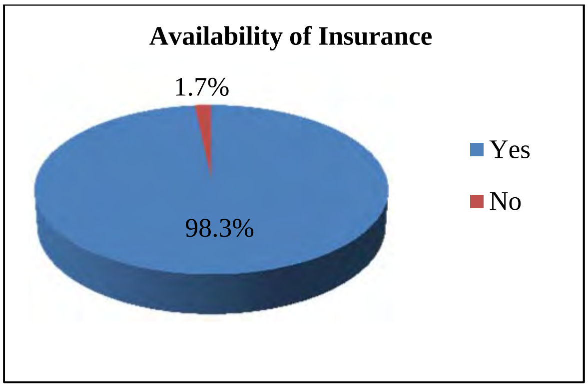
Figure- 5.3.27 Education Level of Household Member

Health status is also determining factors of social vulnerability. As for health status such as the number of unhealthy people and belonging status of health insurance, only 4 percent of entire household members are injured or sick and the rest 96 percent are in healthy condition. This percentage may

[6] The criteria of slum are determined by 10 indicators : 1) density, 2) housing lay out, 3) construction of house, 4) ventilation, 5)land use, 6) road condition, 7)drainage, 8) freshwater availability, 9) toilet, 10) waste transporting. The slum area is mapped by the Housing Agency, Government of DKI Jakarta Province.

encourage them not to use insurance for their security; 98.3 percent of respondents have no insurance as shown in Figure- 5.3.28. The small proportions (1.7 percent) of them primarily use health insurance, secondarily use life insurance, and the rest use both.

Government of Indonesia has provided health insurance for the poor called JAMKESMAS. But practically, JAMKESMAS is widely used by people with limitation including the poor. According to the respondents, only 9 percent of the household members are JAMKESMAS beneficiaries, and the rest have never been. It can be said that the household members have little interest in insurance, and it will make them more vulnerable if they got adverse impact of disaster including inundation.



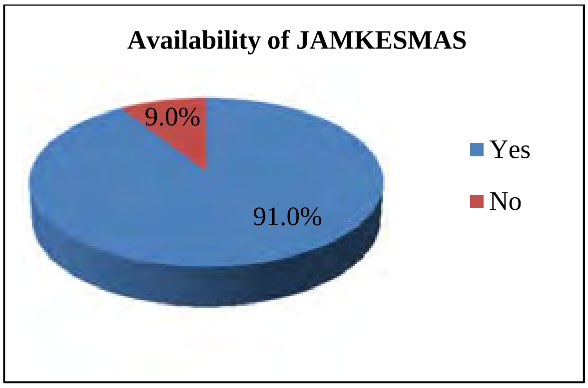


Figure- 5.3.28 Availability of Insurance

(3) Financial Vulnerability

The assumption is that the more economic capital increases, the less vulnerable the poor are in coping disaster. They have a capability to improve their condition, so they could adapt or mitigate for better condition. In detailed scale, economic vulnerability is measured by household assets and income per period of time. Consistency of income is important to maintain the sustainability of life cycle.

According to our survey, only 25.3 % of respondents do not own a house or residential land asset. The rest 74.7 % have a house and/or residential land asset. The asset that belongs to the respondent is mostly residential land of not more than 50 m^2 and a house. So, even though they live in small house, most of them already own their house as their asset. It could decrease their vulnerability against the adverse impact of disasters.

The other factor is availability of saving. If people have savings, they could cope with events which may damage their welfare. In this study, most of the respondents (96%) do not have savings. The rest 4% have savings in range from Rp.600.000 to 1.000.000. The lack of savings can be one of the significant factors representing their high vulnerability.

Then, if we look further about their income per month or monthly salary, most of respondents (almost 80 percent of them) earn less than the minimum regional income as described above (see also Figure- 5.3.29). It is stated that the financial condition of respondents is more vulnerable during the inundation because the income becomes too low to accommodate the daily necessities.

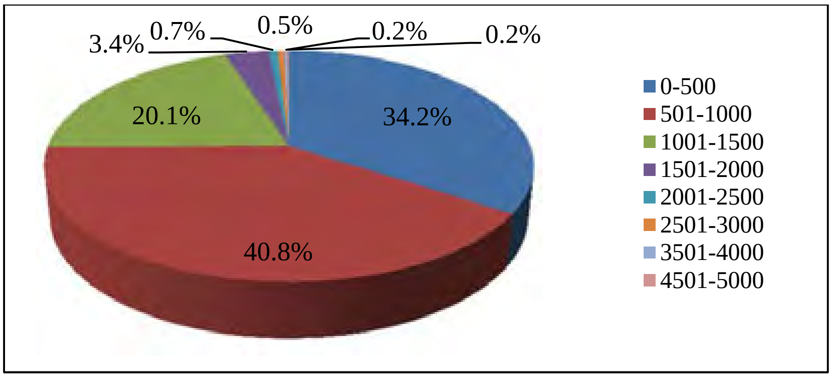


Figure- 5.3.29 Monthly Salary/Income (in 1,000 rupiah)

In the light of the salary of respondents, we could find out that most of them are too vulnerable to reduce the impact of inundation. Crosschecking with the coping action that they do, it convinces become vulnerable because most of them do nothing even if they have medium-high salary (500,000 – 3,000,000 rupiahs). On the other hand, it was shown that those who have the highest salary (4,000,000-5,000,000 rupiahs) use their savings to reduce the impact of inundation.

5.3.5 Adaptation and Mitigation Condition

As for cultural backgrounds of respondents, some of those are from Jakarta and others are from outside Jakarta or even outside Java Island such as Sulawesi or Sumatra Island. Although they came from different regions, they need to adapt themselves to community at the settlement area and also to surrounding environment, including the experience of inundation that happens frequently in their area.

The adaptation process must be based on economic and social capabilities of households. But as mentioned above, few households use insurance to protect their assets and activities to prevent financial losses from occurring. There are many households which are not aware of the necessity of, or cannot afford, insurance, and government contribution is insufficient to run the subsidized insurance for the poor as a vulnerable group.

Adaptation activities are also characterized by how people cope with the threat of disaster such as inundation. As for the hazard which threatened 15 Kelurahans, February 2011 is the month when inundation hit those Kelurahans for 6 hours. Those Kelurahans suffered from inundation once a month in average. Most of the household members (97%) just stayed at home during the inundation and the rest was evacuated to their relatives. It is also stated that 68% of respondents did not change their behaviors inside house facing the inundation; they had already accustomed to that condition. Although they have to deal with many difficulties caused by inundations, it does not seem to be a big deal for them to live side by side with water run-off.

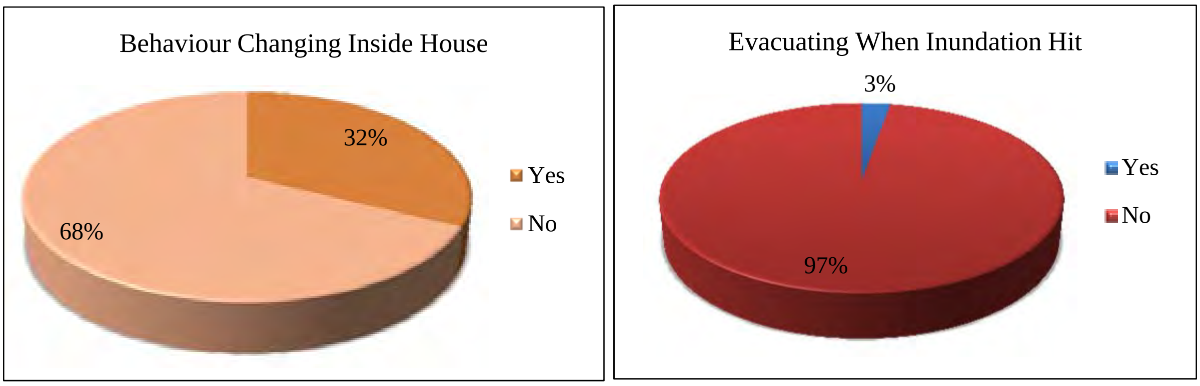


Figure- 5.3.30 Adapting to Inundation

There are some changes of behavior in daily life related to food consumption and sanitation inside house. 57 percent of respondents stated that during the inundation, they satisfy their need to drink bottled freshwater brought by one of household member. Sometimes they buy the bottled water from peddlers or at a shop. Meanwhile they felt that there were no big problems in accessing food outside during inundation. 43.1 percent of them cooked by themselves and were not necessary for buying food outside.

Related to their adaptation measurements, we should know about the scale of inundation impact. According to the survey, the impact of inundation has caused many things: firstly, 42 percent of them said that there were some damages in their houses; secondly, 10 percent of them said that their assets were lost; and thirdly, they were in bad health (see Figure- 5.3.31).

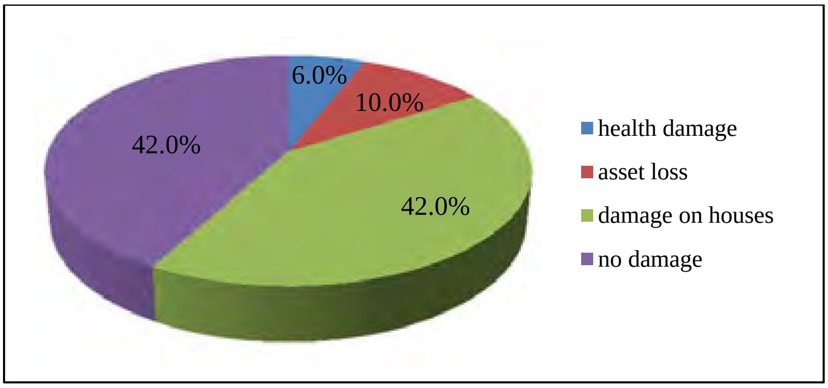


Figure- 5.3.31 Types of Damages of Inundation

In relation to that impact, however, 83 percent of them do nothing for replacing or changing the losses of income and assets; they rarely have actions for rebuilding or repairing their houses or assets. Only 10 percent of them use their savings to renovate their houses, and the rest is supported by any institution to rebuild or renewal their assets.

Related to mitigation, only 36 percent of them do nothing for preventing their assets from suffering from inundation. Others prepare for mitigation, such as raising the floor level, keeping ditch and drain clean, and preparing safer place for their assets (see Figure- 5.3.32)

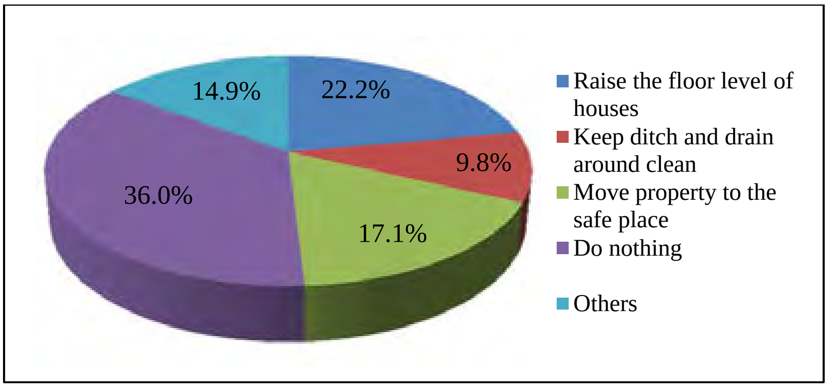


Figure- 5.3.32 Mitigation Measurement for Inundation

Meanwhile from the previous observation and interview in Kelurahan, we also found several statements about how flood warning system functioned in their RW. The RW in Kelurahan at South Jakarta along the Ciliwung riverside (such as Bukit Duri and Bidara Cina) has a systematic flood warning mechanism in the rainy season. The RW staffs have the information of flood from the Kelurahan staffs and dam keepers by radio communication to share what they experienced.

CHAPTER 6 Conclusions and Recommendations

6.1 Conclusions

6.1.1 Conclusions from Flood Simulation Analysis

From the result of the flood simulation analysis, it is found that;

- Analyzing its rainfall, inundation, topography, and the state of flood infrastructure, Jakarta is prone to floods especially due to inner water.
- It is found that land subsidence is in progress in Jakarta, which causes floods due to inner water because inundation water accumulated in urban area is not properly discharged to the sea. Therefore, the possibility that floods cause not only economic but also social damages in large scale has become extremely high.
- Increase of rainfall volume and sea level rise due to climate change would also cause flood damages due to inner water increase through the same process described above.
- Damages caused by floods can be exacerbated in line with the progress of urbanization, climate change, and land subsidence.
- Therefore, it is necessary to establish comprehensive flood management plans in Jakarta including countermeasures against climate change, land subsidence, land use regulations and improvement of river and storm drains etc., which cover the whole river basin.

6.1.2 Conclusions from Damage Cost Assessment

(1) Serious Flood Damage on Regional Economy

It was found from damage cost assessment that impact on flood disaster from climate and non-climate changes is likely to result in substantial damage in 2050. In terms of regional economy, it can range from approximately 8.4 percent (Rp 56,600 Billion) at minimum to 21.2 percent (Rp 143,786 Billion) at maximum of regional GRDP. Note that all damage costs are estimated in 2008 Indonesian Rupiahs in principle; thus in indicating percent of GRDP, 2008 GRDP were used.

As a result, it is concluded that climate and non-climate factors well as infrastructure are responsible for much of the differences of flood damage costs. The reasons for making such differences will be discussed in the following section. However, in climate and infrastructure scenarios, Jakarta is faced with considerable potential damage from urban flooding in 2050. Given that the future of Jakarta with population of more or less 15 million, infrastructure and urban facilities to support the development of regional economy as expected in RTRW DKI Jakarta 2030, impact of damage from flood in Jakarta warrants serious consideration.

(2) Significant Impact of Land Subsidence in Increasing Flood Damage Costs

One of the main findings of this Study is that flood damage cost caused by land subsidence is estimated to be larger than that by climate-related factors in comparison of climate-related factors such as increase in rainfall and sea water level rise etc. For instance, as discussed in the previous section, there is a much difference in damage costs between the one scenario where neither climate change nor land subsidence is assumed and another scenario assuming high emission (A1FI) and severe land subsidence (v2) (Rp 63,583 Billion). The primary reason for such a difference is “land subsidence”; as of the total increase, approximately 79 percent is due to land subsidence. Impacts of other factors such as climate change and land use change contribute approximately 19 percent and 2 percent of the total increase respectively.

It should be noted from the above finding that the governments need to consider countermeasures against land subsidence for a priority of important adaptation measure.

(3) Substantial Damages to Buildings

It was also found that about 74 percent of flood damage is on buildings (residential, commercial and industrial buildings) and the assets that they carry (Rp 54,513 Billion in 2050_F_MP_A1FI_V0_30). It suggests that this is a dominant component in the formation of damage sector with the context of this Study. Further, there is a tendency of having serious damages to residential buildings situated in the low-lying deltas near coast-line, rivers and so on.

It is important to note that this Study examined indirect damage only to income losses of residential, commercial and industrial units and revenue losses of water and electricity companies that enables us to assess it in terms of damage costs. But, there must be more tangible and in-tangible or secondary and tertiary effects by urban flooding. For instance, sales losses of industrial enterprises are most likely to result in secondary effects on suppliers and sub-contractors and all like that. Some of them may be quick on the loss of production, while others may take place later in more medium range. Impacts of floods on public health including environment are also important, especially for the urban poor whose access to sanitation is vulnerable. Given the context of these issues as cited above, it is quite likely that damages from floods and vulnerabilities in Jakarta may have a more wide-spreaded compared to the damage identified in this Study.

(4) Districts most at risk of Flooding

Another important finding from assessment of flood damage cost is that not all the districts of Jakarta are evenly affected due to flooding. As appeared in the past floods in 2002 and 2007, some areas in Jakarta Utara, Jakarta Barat and Jakarta Timur, including the area of downstream of the Cengkareng Channel will be severely affected compared to other municipalities in 2050. It is therefore important that flood control infrastructure based on the 1997 Master Plan will be consistently implemented with higher priority for these districts to have a reduction in flooding in 2050.

6.1.3 Conclusions from Household Survey on the Urban Poor

Analysis on their past experiences in responding inundation shows that the poor in Jakarta are vulnerable in many ways. The vulnerability includes physical factors such as small and fragile structure of their houses and limited basic infrastructures, economic factors such as lack of savings, lack of insurance for their private assets, and low income, social factors such as high population density, low education levels, and no insurance. These vulnerable conditions need to be addressed in order to formulate appropriate and effective policies for the poor.

Poverty is one of the significant and contributing factors to increase their risk to the inundation impact, or in short, exacerbate vulnerabilities. It is shown that half of the people in poor community are migrants who do not have strong relation to Jakarta. Most of them have no ownership rights on land and has limited assets, so they just try to find places where they can live temporally. Therefore, it makes them difficult to access to the programs by government or other institutions, especially to the adaptive capacity building program.

The poor households, however, have strong relationships with their relatives or friends who came from the same originated village, but they have not been able to transform it into solid social capital. Social and economic conditions surrounding them have forced them to focus only in how they can survive economically. Therefore, their awareness and capabilities to take care of their environment and their responsiveness to environmental changes such as climate change are still low. Their adaptive capacity should be enhanced, especially in maintaining their settlement in order to achieve sustainable environment for a long period by at least using their social assets.

According to the perception of the poor households in the coastal area, inundation incident is mainly caused by rainfall and high tide. But, they also add poor local drainage as the other determinant factor. And based on their experiences, the worst inundation event was the flood in the year 2007 and the month of February was the worst time. In addition, it is also shown that several RTs have no longer been inundated significantly because of flood control infrastructure development such as flood canals (BKT), water pumps, polders, and dikes (for example RW 07 in Kelurahan Marunda).

6.2 Recommendations

6.2.1 Policy Recommendations

(1) Countermeasures against Land Subsidence

From the result of assessment of flood damage costs, it is found that the major factor to increase flood damage costs is land subsidence. This requires some countermeasures against land subsidence. It is therefore important to recommend the followings in order for reducing land subsidence caused by extraction and use of groundwater:

- Control the extraction and use of groundwater for business and industrial units by reviewing the regional regulations on the extraction and use of groundwater, based on the actual condition of drawing excessive amounts of groundwater by business and industrial units;
- Taking into consideration of the huge amount of groundwater consumption and the basic needs of households for access to clean water, encourage the conversion of main water sources from existing groundwater to surface water (tap water etc.) including development alternative main water resources, such as river water, re-use of wastewater and so on;
- In accordance with the spatial development policies and strategies of the provincial government revealed in RTRW DKI Jakarta 2030, accelerate resettlement of business and industrial units to the suburbs of Jakarta, particularly for manufacturing enterprises located along the northern coastal area in Jakarta Utara and Jakarta Barat; and
- Support for the development of new industrial zone in the suburbs of Jakarta in cooperation with private sector to meet their interests of business and to maintain the environment of communities in general including level of environmental damage caused by the extraction and use of groundwater.

(2) Land Use Control and Guidance for Urban Plan and Flood Control Infrastructure

To ensure urban plans and flood control infrastructure plans to be prepared with proper consideration on future climate-related risks, it is necessary to execute properly the existing land use control and guidance and hence recommend as follows:

- In terms of urban plans, to reduce damage from flood due to land subsidence over the long run, it is necessary for the local government to review and revise the existing rules, regulations and other instruments concerning urban planning and land use such as zoning regulations, development permits and so on.
- In view of flood disaster risk reduction, developing Jakarta to the west–east direction where destructive force of runoff is relatively unlikelihood.
- Further, notably it is found in the flood simulation analysis, as in such urban districts extending along the downstream of Jakarta, there has been an increased runoff discharged from upper streams, and accordingly they have been at significant risks from flooding. To cope with this situation, it may require implementation of a comprehensive flood protection measure which has to be integrated into non-structural measures or approaches. This may, for example, include some measures proposed in the Project for Capacity Development of Jakarta Comprehensive Flood Management etc. - such as designation of flood-prone area or hazardous proximity, establishment of early warning system, construction of rainwater storage facilities etc.

(3) Establishment of Flood Risk Management Plan

From the result of hydrological analysis, it is found that the area inundated will increase in 2050. Similarly, the number of people affected from flood disaster in 2050 will rise.

Under these circumstances, to reduce the risk of disaster due to both regular flooding and a certain flooding beyond expectation, it is recommended that the local and central governments shall establish a Flood Management Plan based on assessment of the risk of floods, particularly, in relation to residential, commercial and industrial use. Regional flood assessment and flood risk management plan shall be prepared by local government in cooperation with central government as well as communities (district, village etc.) meet the requirements in each community and to ensure sustainable environment including infrastructure for a long period.

(4) Policy Implications to Respond to the Impact of Climate Change on the Urban Poor

1) Issues to be addressed at the central government level

- The urbanization process which occurred in metropolitan area such as Jakarta should be controlled by consistent and continuous policies considering social, demographic, and employment sectors;
- To conduct thorough survey on the status social capital accumulation. The criteria of the poor clearly suited in conceptual framework, but it was liable to be inconsistent in the implementation phases. Some data from the field survey show that the poor households were not identified very well. It means that references used for the identification of the poor (Program RASKIN) was not fully in accordance with local facts; some are listed as the poor, but in reality some are not categorized as the poor. While there are some households which should receive assistance, not all of those are registered. A monitoring and supervision program by the central government need to be implemented to ensure that the data of the poor are suitable to the facts;
- The areas where the poor consequently continue to occupy tend to be vulnerable areas. Such areas are originally vulnerable against inundation and the vulnerability is increasing due to climate change. Therefore, it is suggested to construct land use control mechanism in spatial management by monitoring and evaluating conditions of vulnerable areas.

2) Issues to be addressed at the local government level

- The flood infrastructure has reduced some inundated area, but according to the survey, the impact of inundation is still observed because of their location which is prone to inundation and has poor drainage. Because of the lack of connection bond with any external sources caused by the limitation of the poor, they are forced to have strong internal bond such as good cooperation with others in the community. Therefore, the socialization and internalization of local environmental management by community should be enlarged and enhanced in order to decrease the vulnerability of the poor.
- The land use planning and zoning regulation are the instruments that can manage the environmental degradation continuously and long term phases. But in the short term, the law enforcement of building code and land use permit will be effective.
- The vulnerability and adaptation assessment, especially for urban poor area, needs to be incorporated in the development and spatial plan, so as especially to introduce mitigation and adaptation aspects in planning policy programs.
- Encouraging the activities of microfinance may have favorable effects. Unlike rural areas, however, under high mobility in urban life (especially for seasonal workers), high cost for monitoring borrowers can hamper incentives for the lenders. One possibility is incentivizing residents to settle down (to become permanent residents with proper registration), by prioritizing them to access the financial tools.

6.2.2 Priority Action

Some specific recommendations have already been made at the previous section of this report. In this section, we conclude with highlighting the following priority actions that would be useful for both the local and central governments to consider adaptation options and EA (Execution Agency) which should cope with the actions:

- Studies on status quo of extraction and use of groundwater and impacts by excessive amounts of groundwater drawing. (EA: DKI Jakarta).
- Planning, implementation and completion of switching water resources to those other than groundwater including distribution network system (EA: DKI Jakarta)
- Intervention by the government in formulation and enactment of consistent and continuous policies and strategies that manage to resettlement of business and industrial units, including improvement and development of adequate infrastructure and facilities associated with resettlement (energy, water, wastewater, waste management etc.). (EA: Establishment of New Industrial Parks by the Private Sector)
- Implementation of flood control infrastructure based on the existing Flood Control Master Plan 1997 proposed in the Study on Comprehensive River Water Management Plan in JABOTABEK (1995–1997), including river improvement projects and internal drainage facility projects. (EA: Director General of Water Resources (DGWR), Director General of Human Settlements (DGSH))
- Implementation of countermeasures for runoff control to cope with inadequate channel capacity, taking the proposals (under consideration) that have been taken up in the Project for Capacity Development of Jakarta Comprehensive Flood Management into consideration.
- Review and revise the existing rules, regulations and other instruments concerning land use planning and zoning regulations such as development permits, prescription of incentive and disincentive, criminal punishment and so on. (EA: Director General of Spatial Planning (DGSP), DKI Jakarta)
- For the areas prone to inundation/flooding, especially, where the risks of loss of life or assets is severe, control and manage appropriately “housing administration policy” that seek to minimize vulnerability to flood and to improve housing and working conditions in the suburbs of Jakarta. (EA: DKI Jakarta)
- Carrying out Flood Risk Assessment for Flood Risk Management Plan to be prepared based on Flood Hazard Map and Flood Risk Map. (EA: DGWR, DGSH)

APPENDIX

Figures

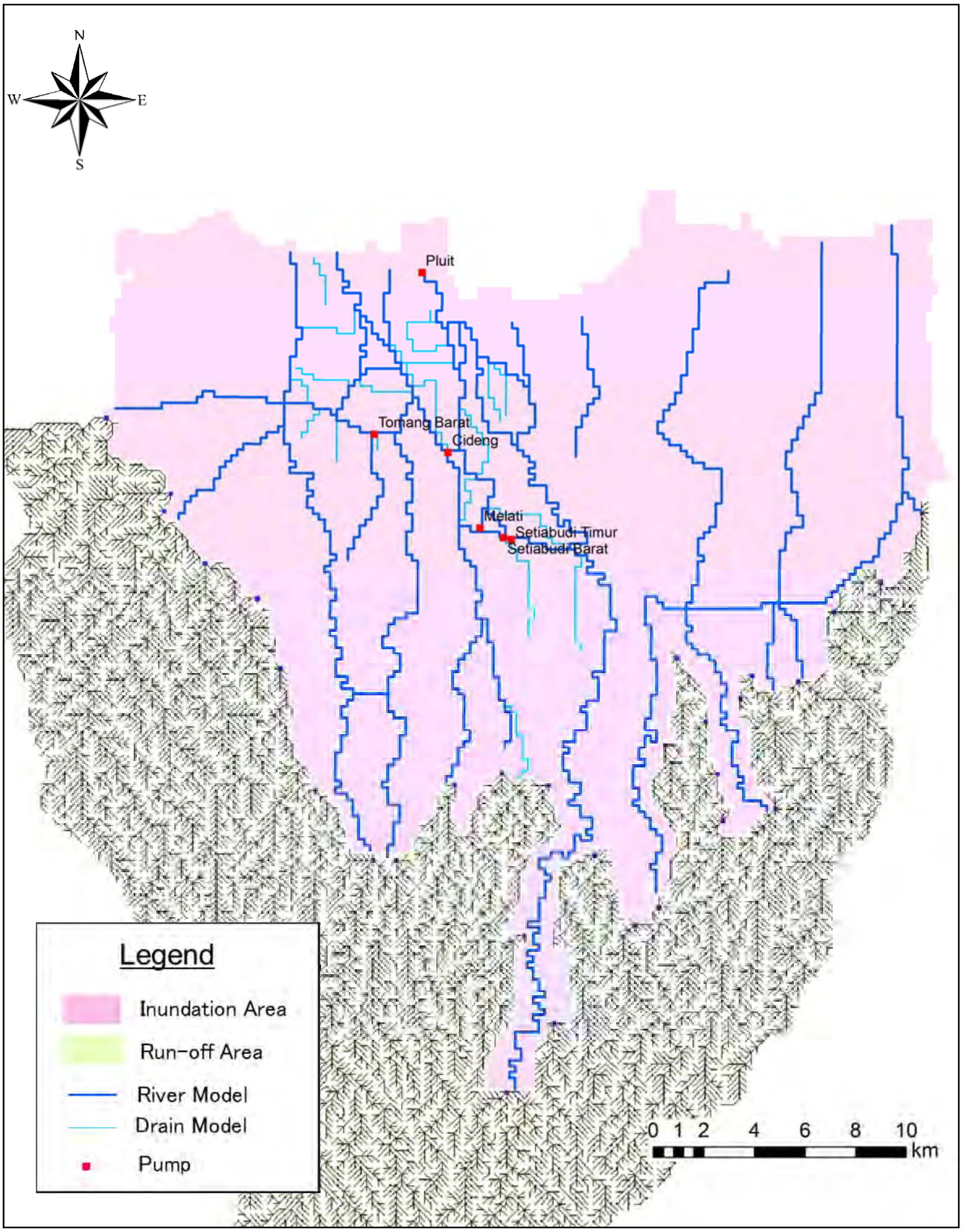


Figure- A.1 Outline of Inundation Area Model

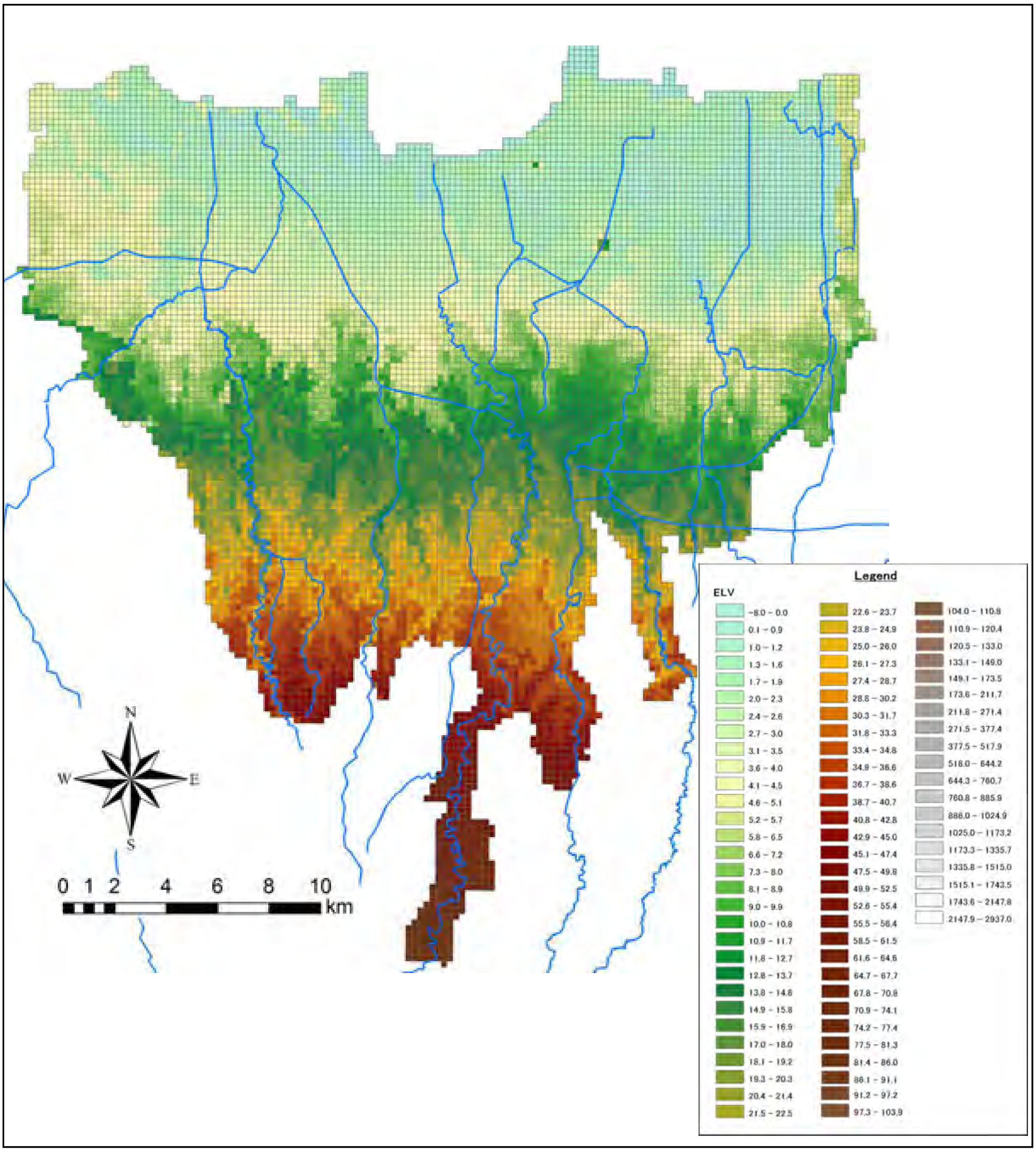


Figure- A.2 Average Ground Level (Inundation Area, as of the year 2008)

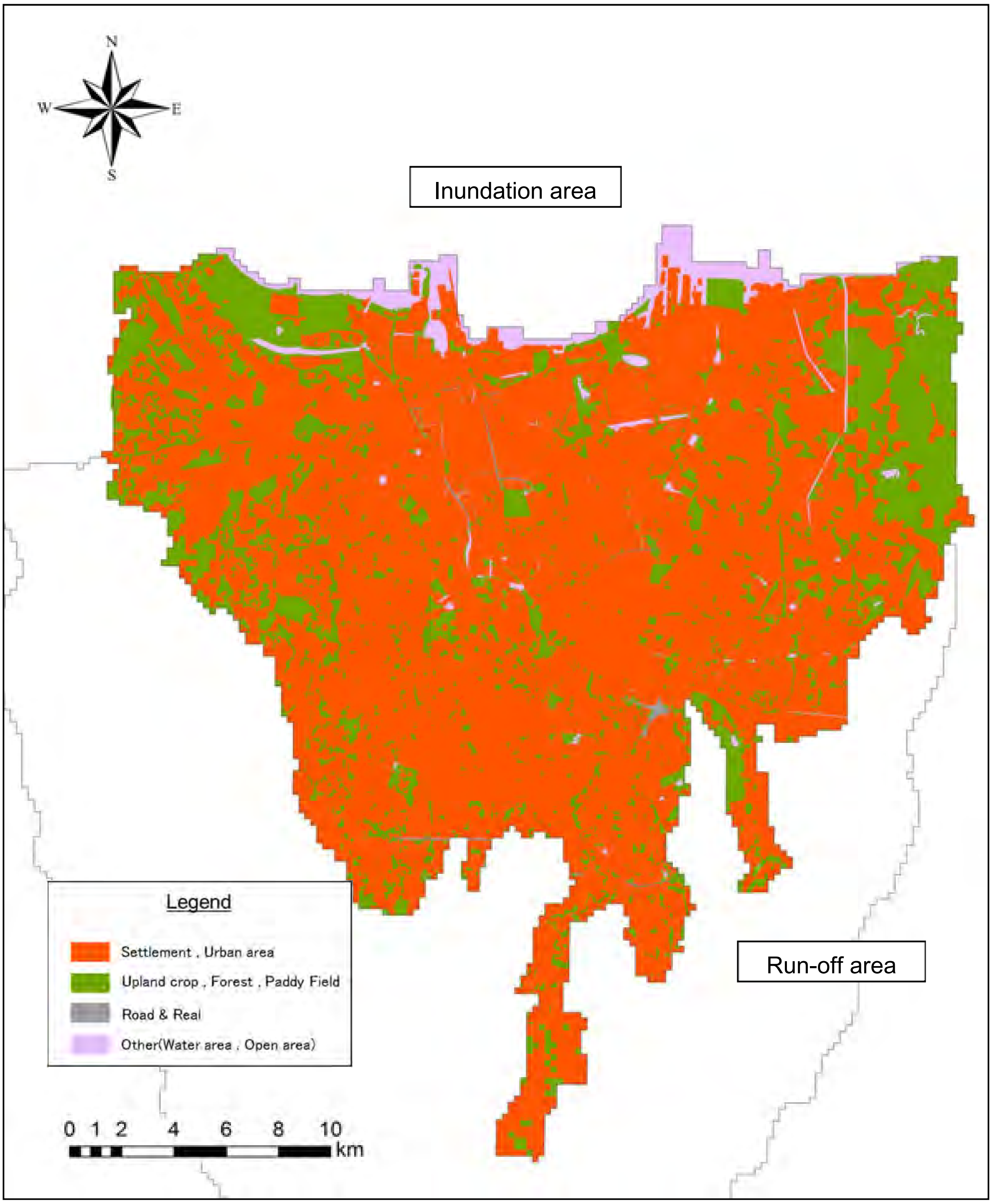


Figure- A.3 (1) Land Use Map (Inundation Area, as of the year 2008)

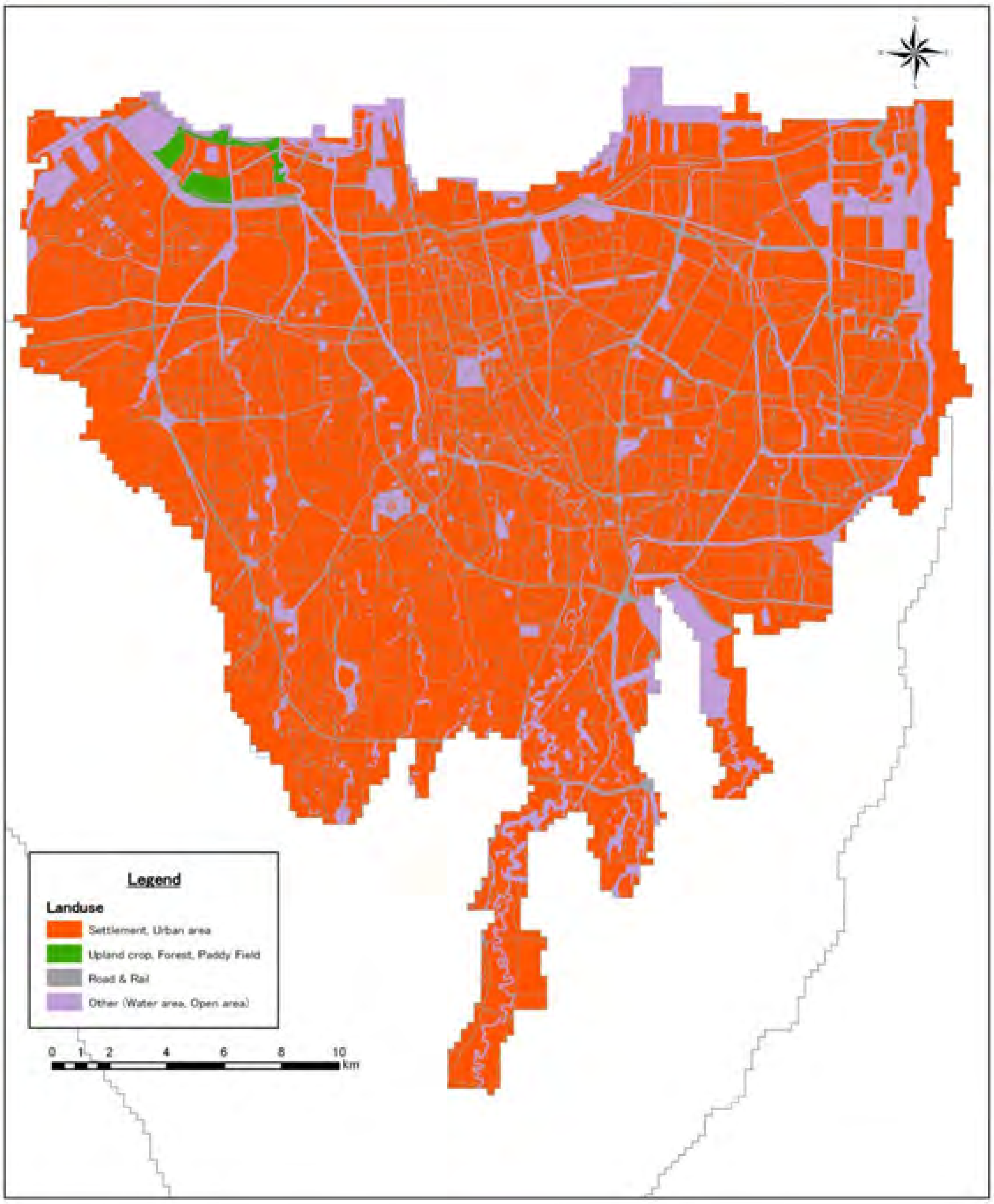


Figure- A.3 (2) Land Use Map (Inundation Area, as of the year 2050)

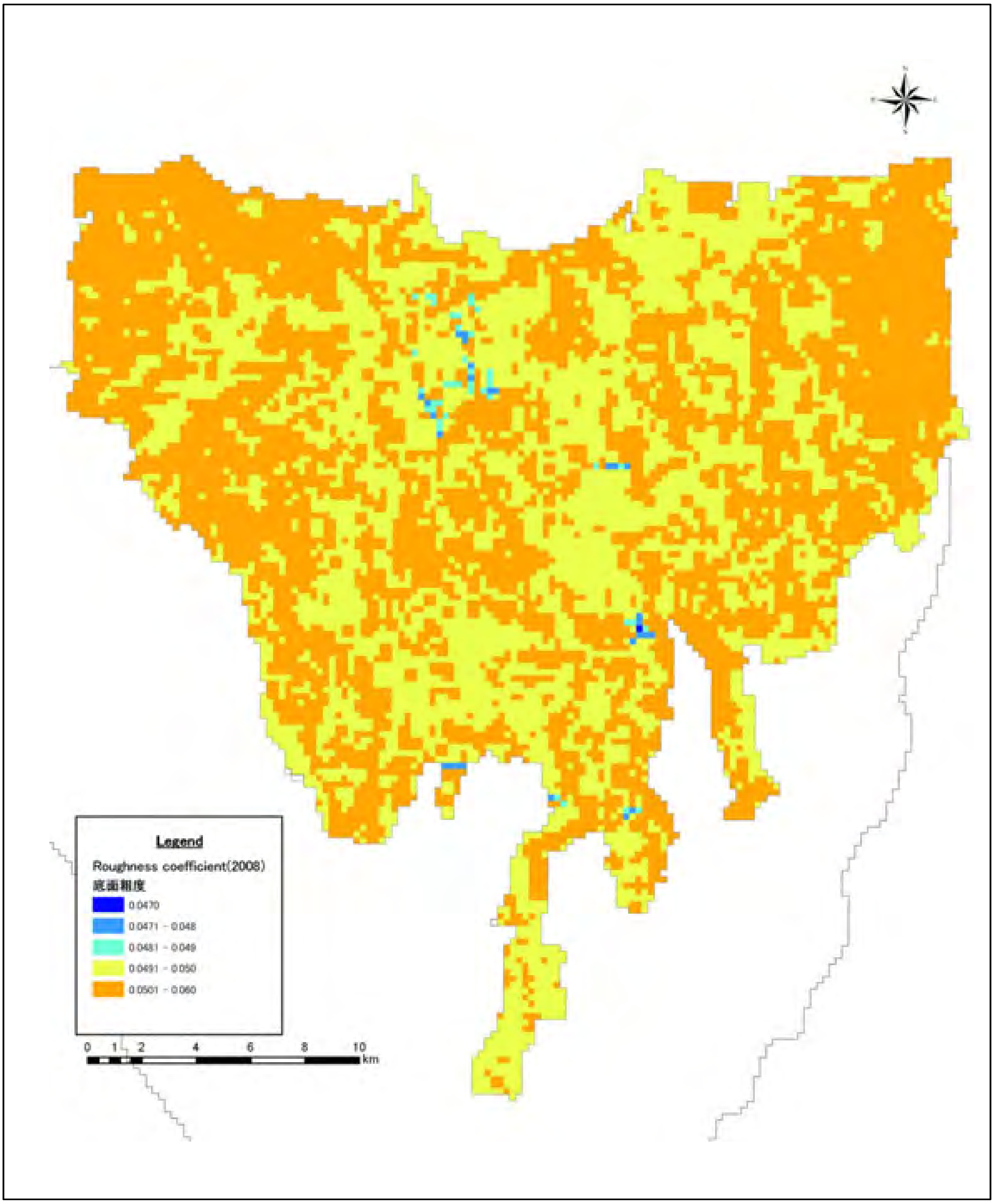


Figure- A.4 (1) Roughness Coefficient (Inundation Area, as of the year 2008)

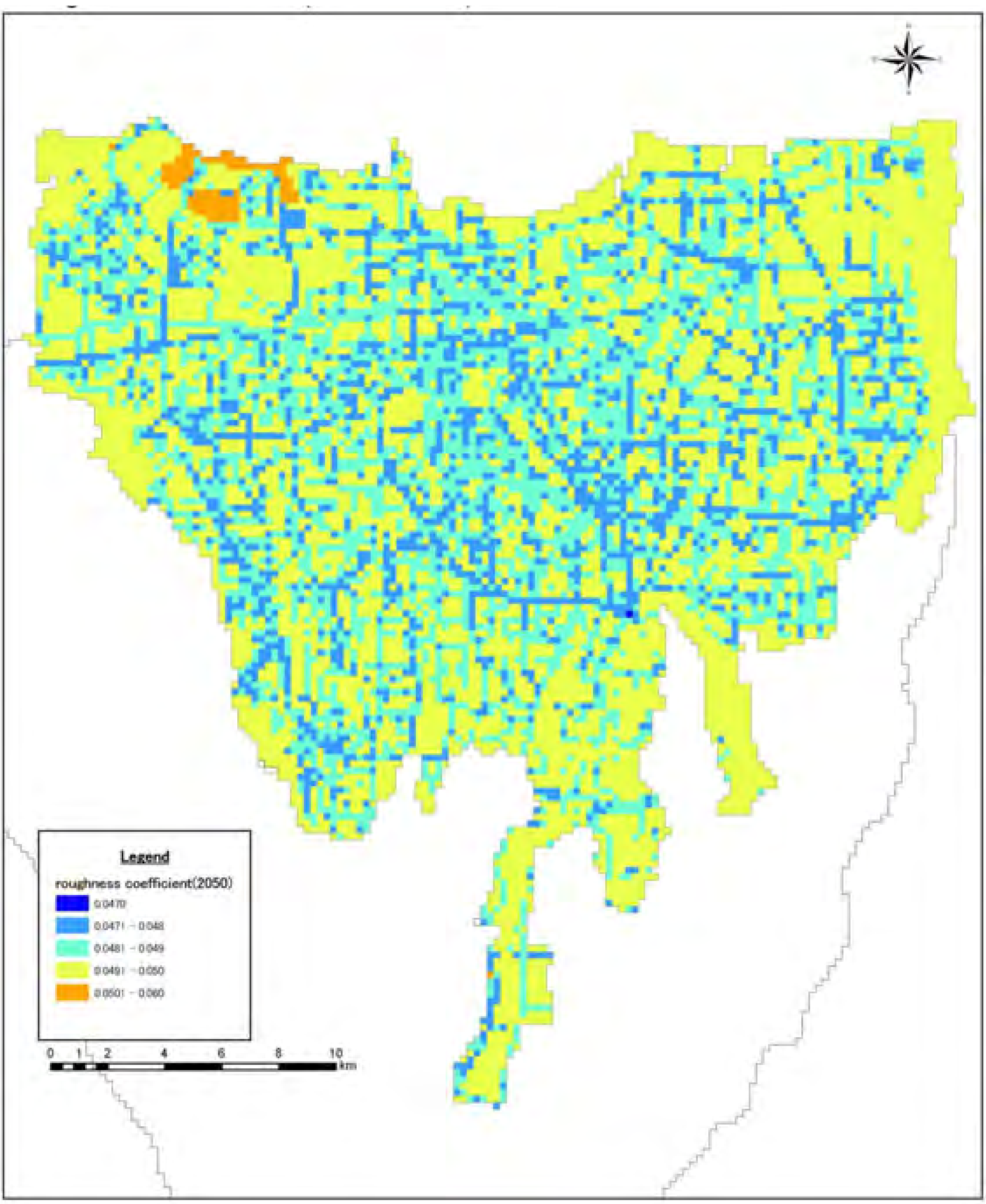


Figure- A.4 (2) Roughness Coefficient (Inundation Area, as of the year 2050)

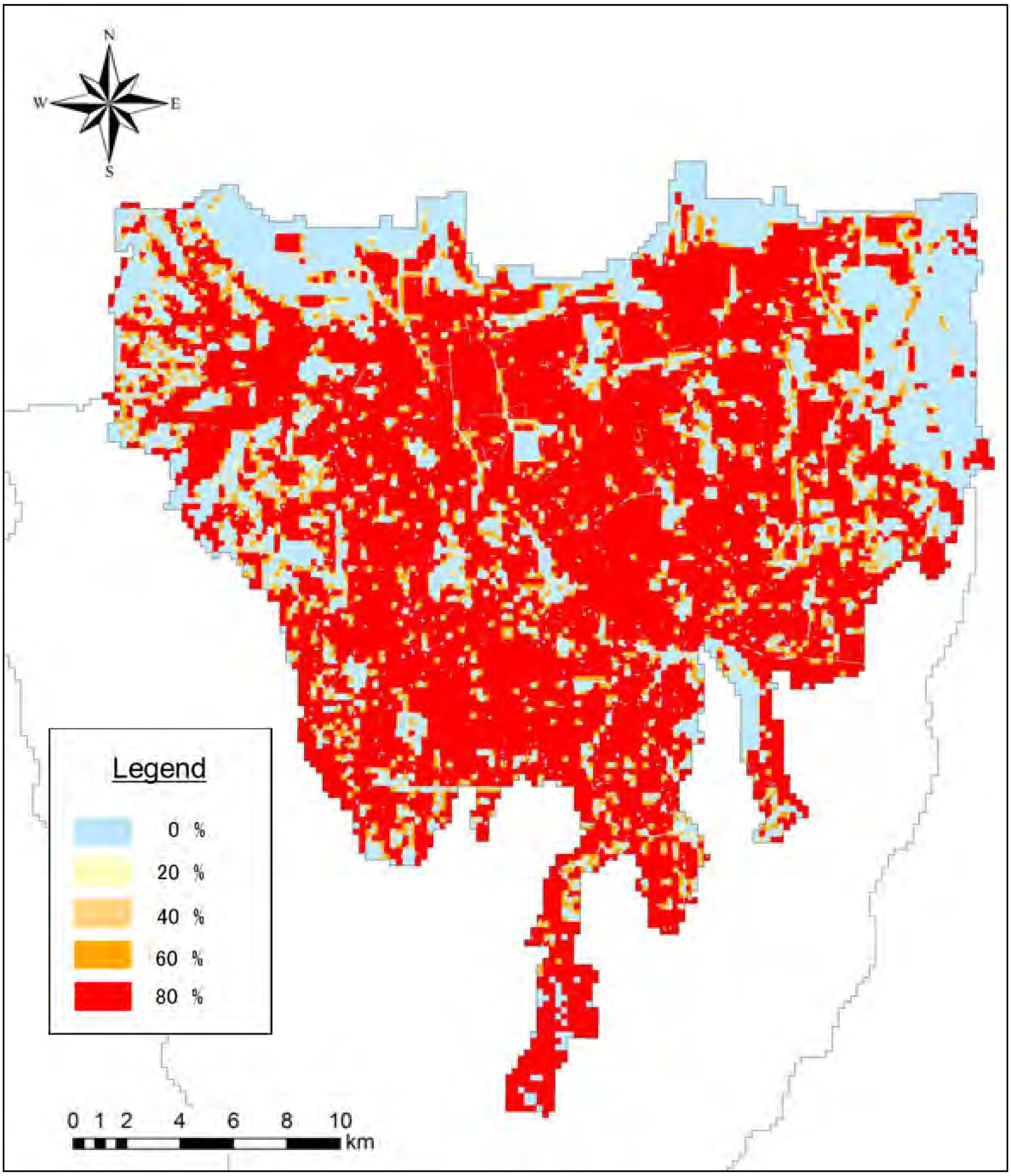


Figure- A.5 (1) Building Occupation (as of the year 2008)

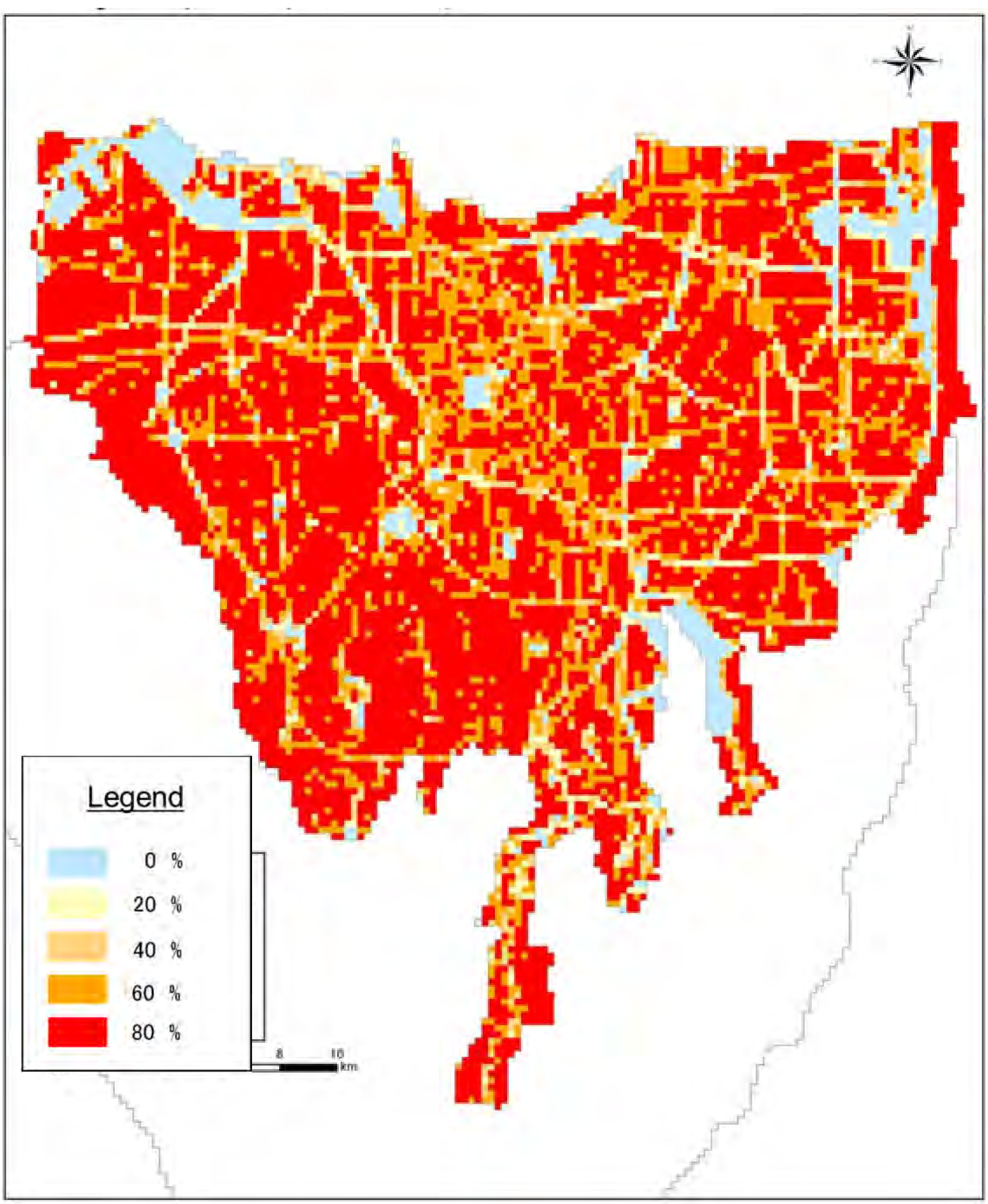


Figure- A.5 (2) Building Occupation (as of the year 2050)

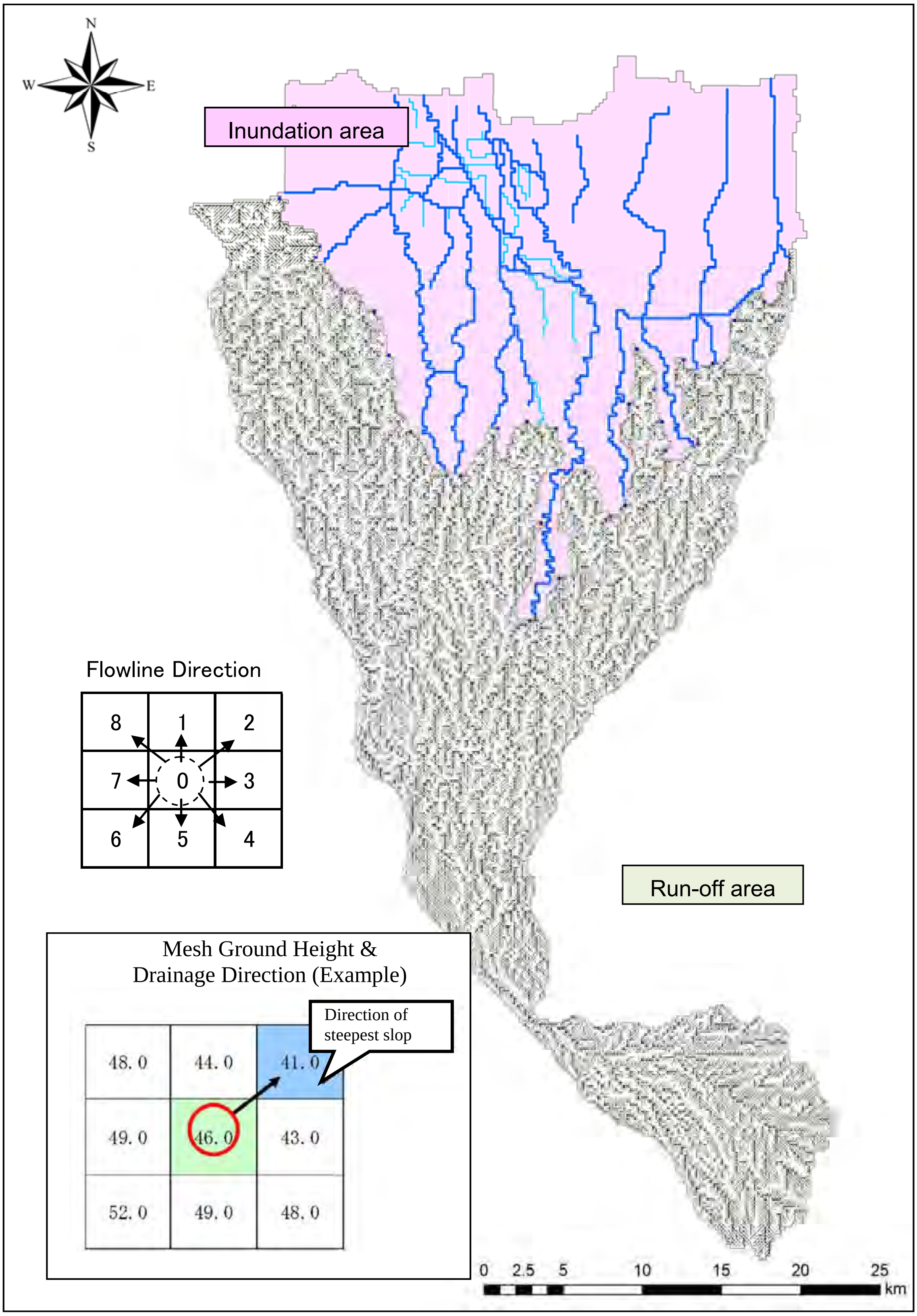


Figure- A.6 Drainage Direction Map (Run-off area)

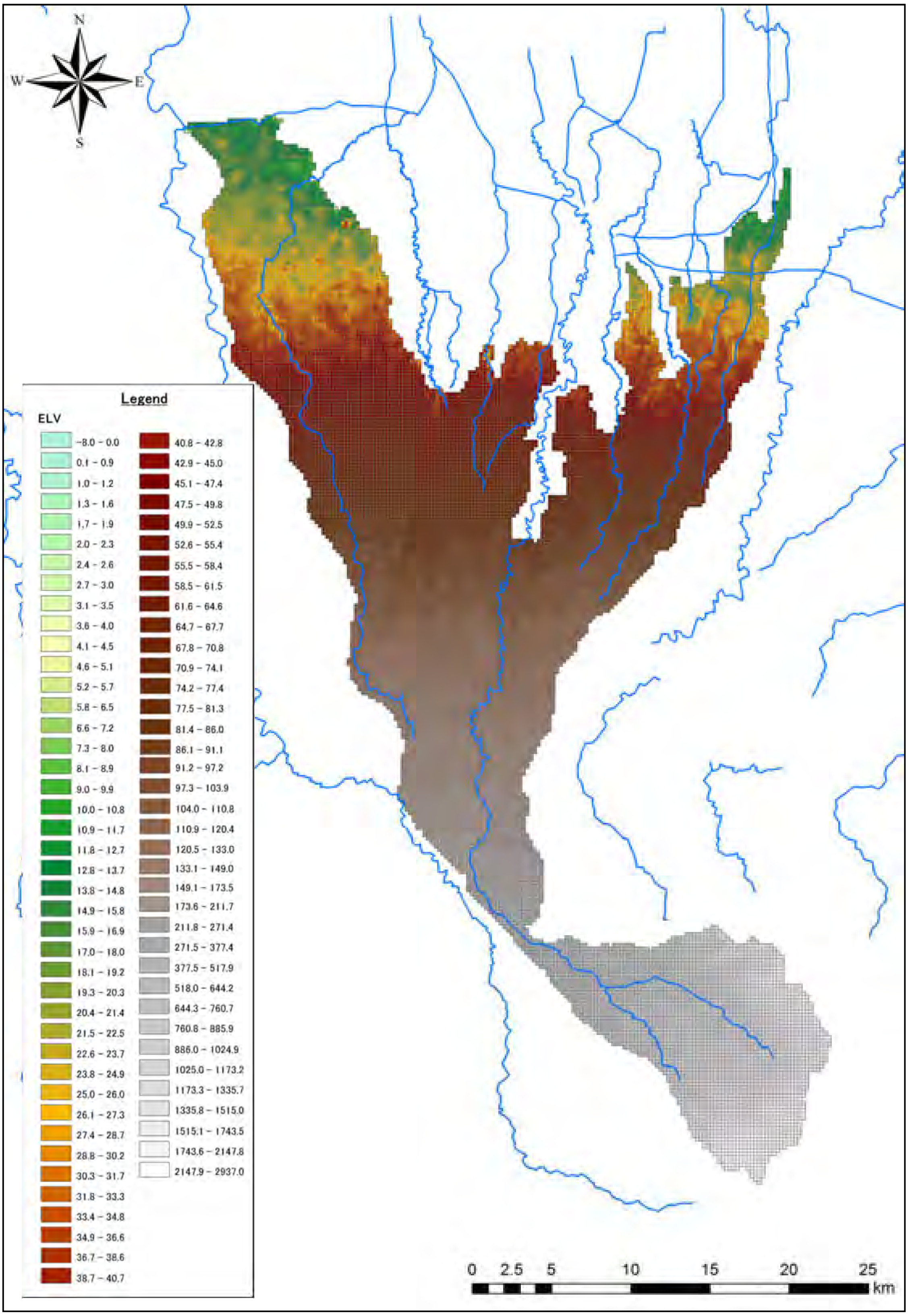


Figure- A.7 Average Ground Level (Run-off area)

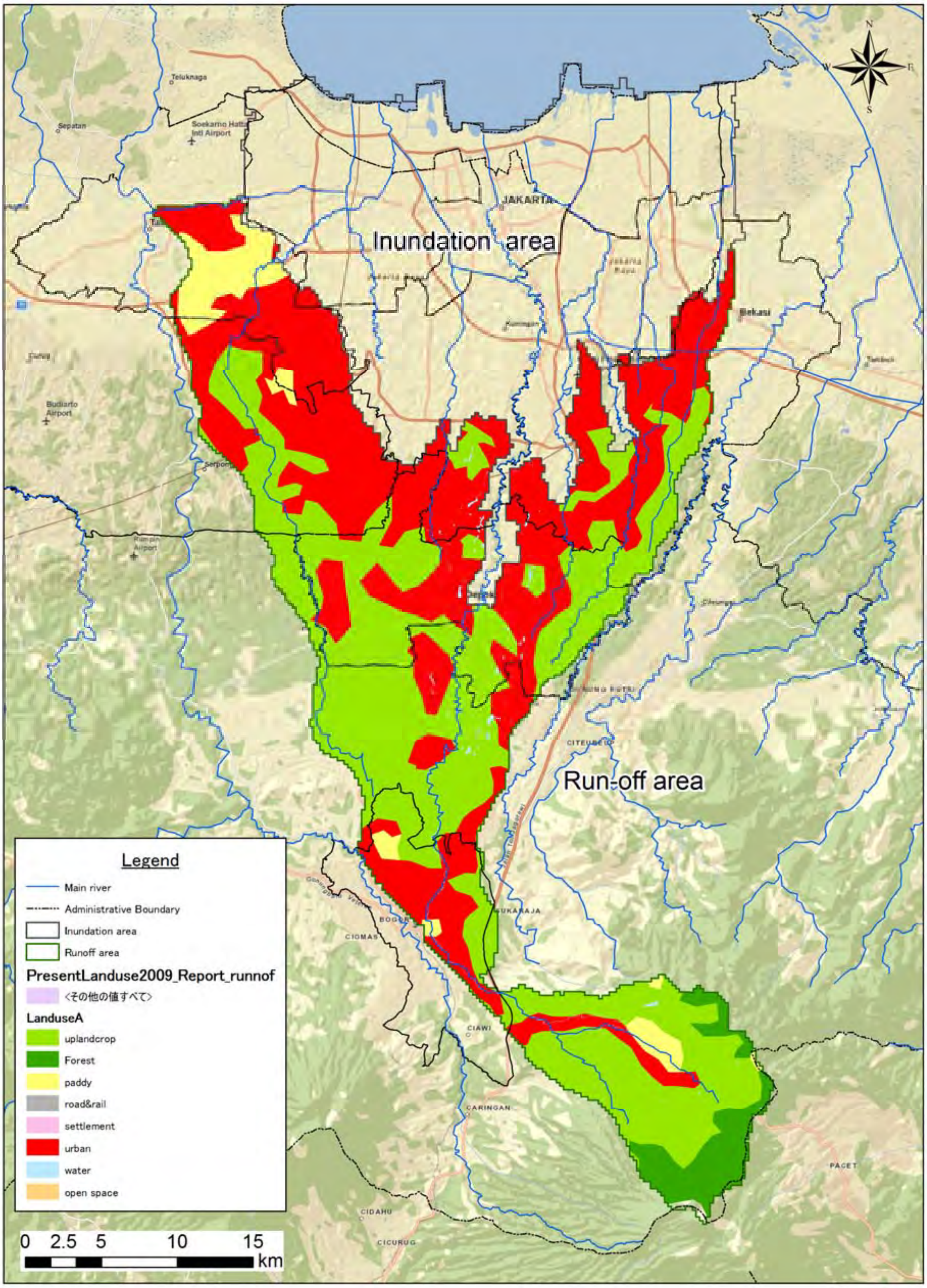


Figure- A.8 Land Use Map (Run-off area, as of the year 2008)

Rainfall Distribution

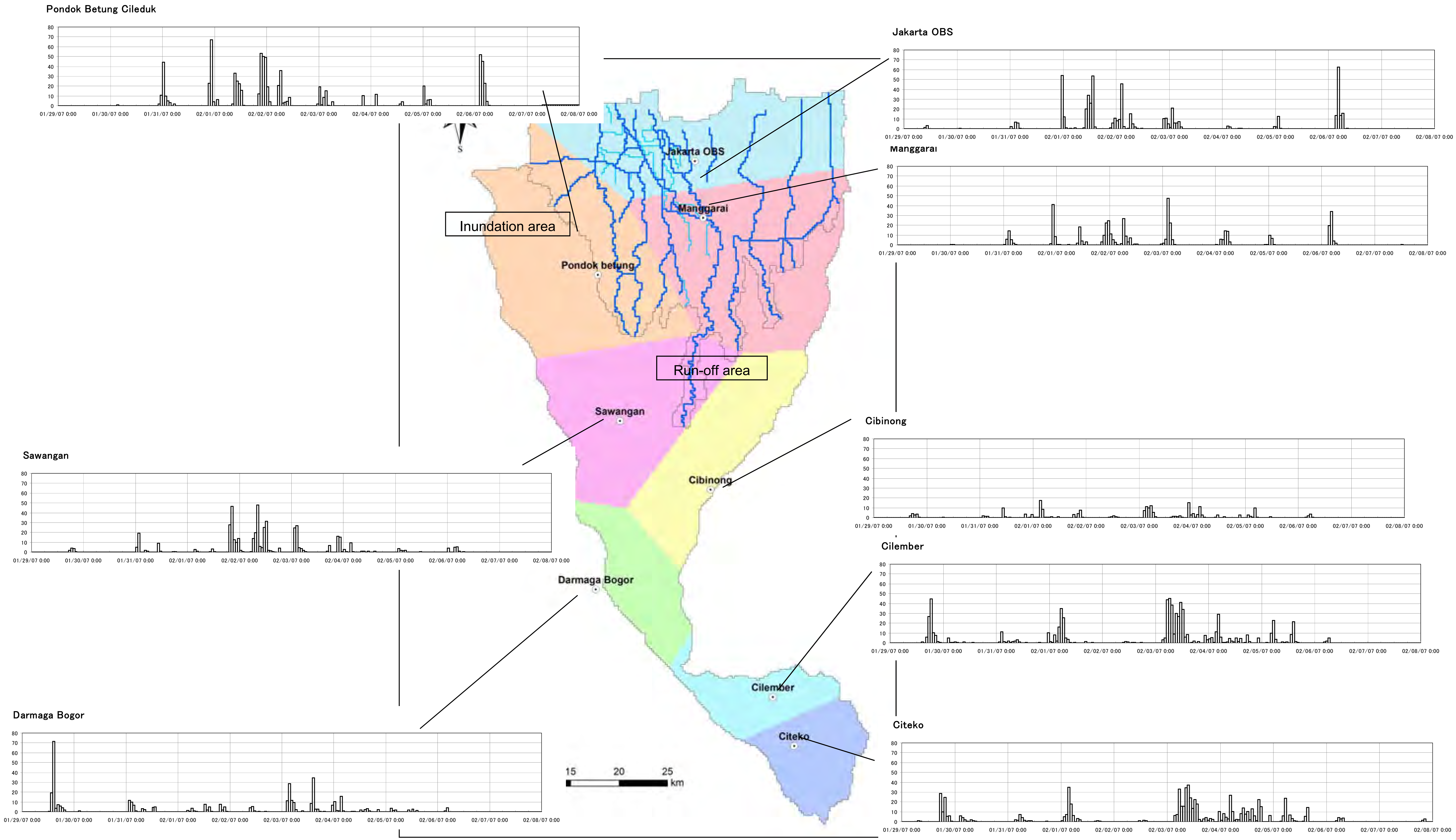


Figure- A.9 Rainfall Distribution by Thiessen Regions (Feb. 2007 Flood)

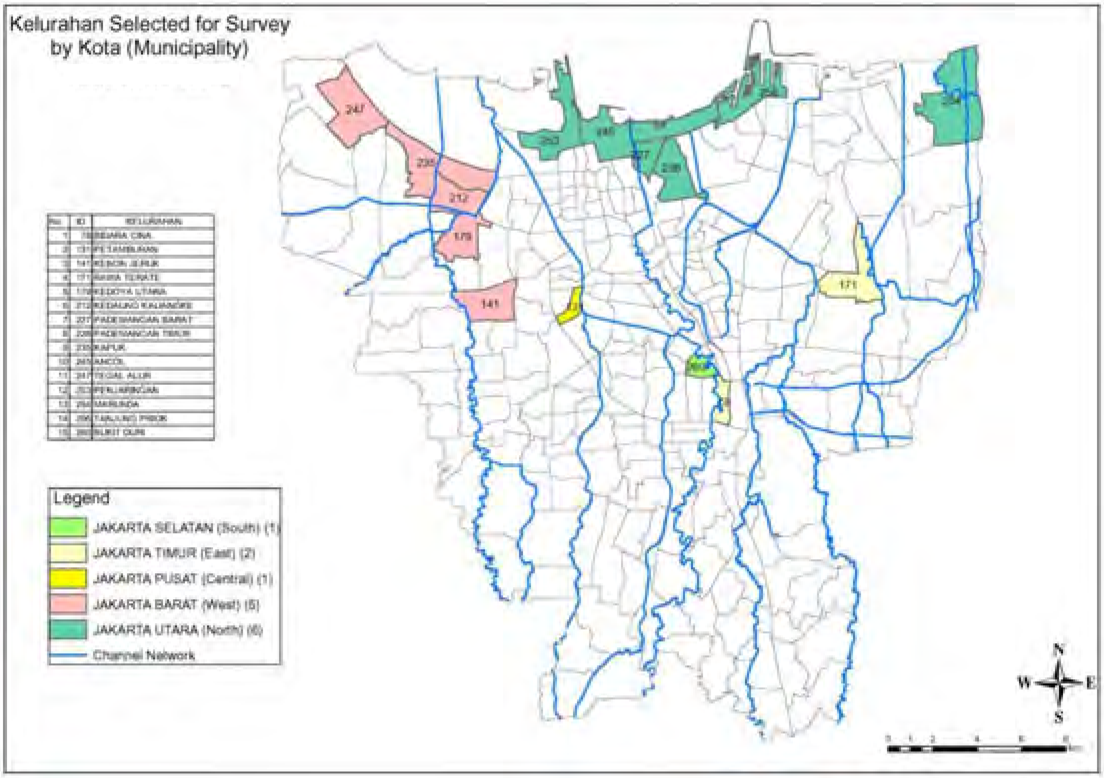


Figure- A.10 Selected 15 Kelurahans by Municipality

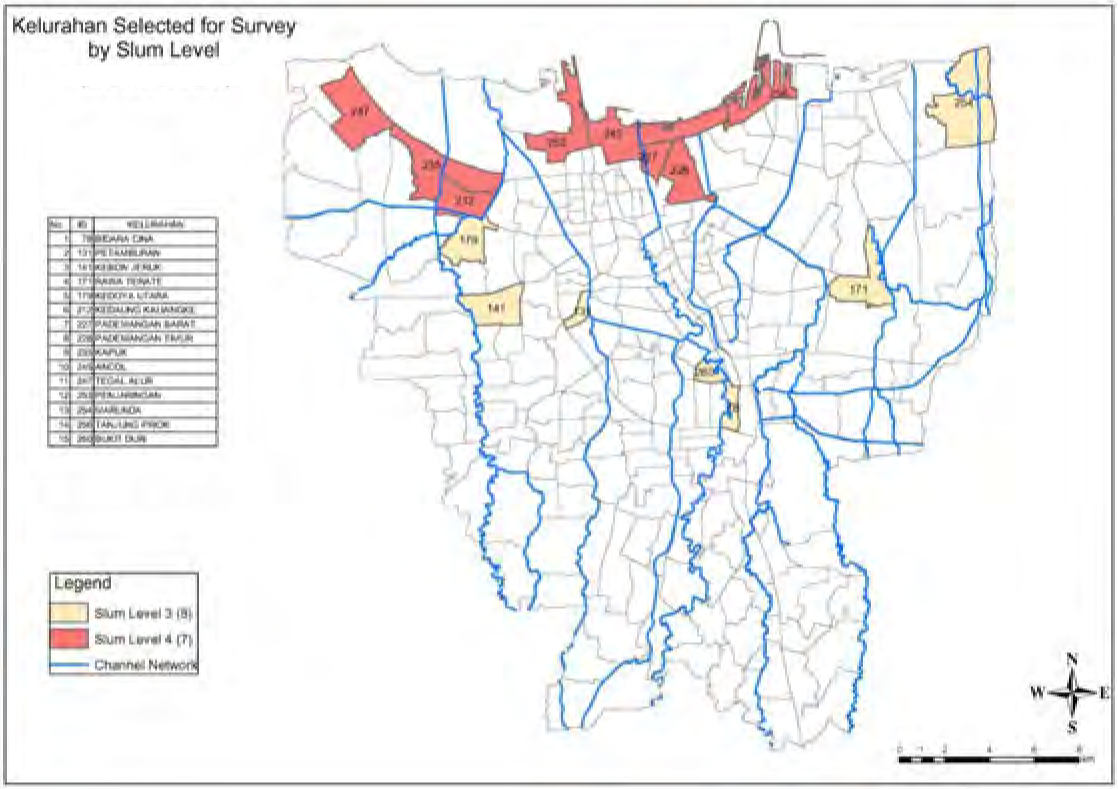


Figure- A.11 Selected 15 Kelurahans by Slum Level

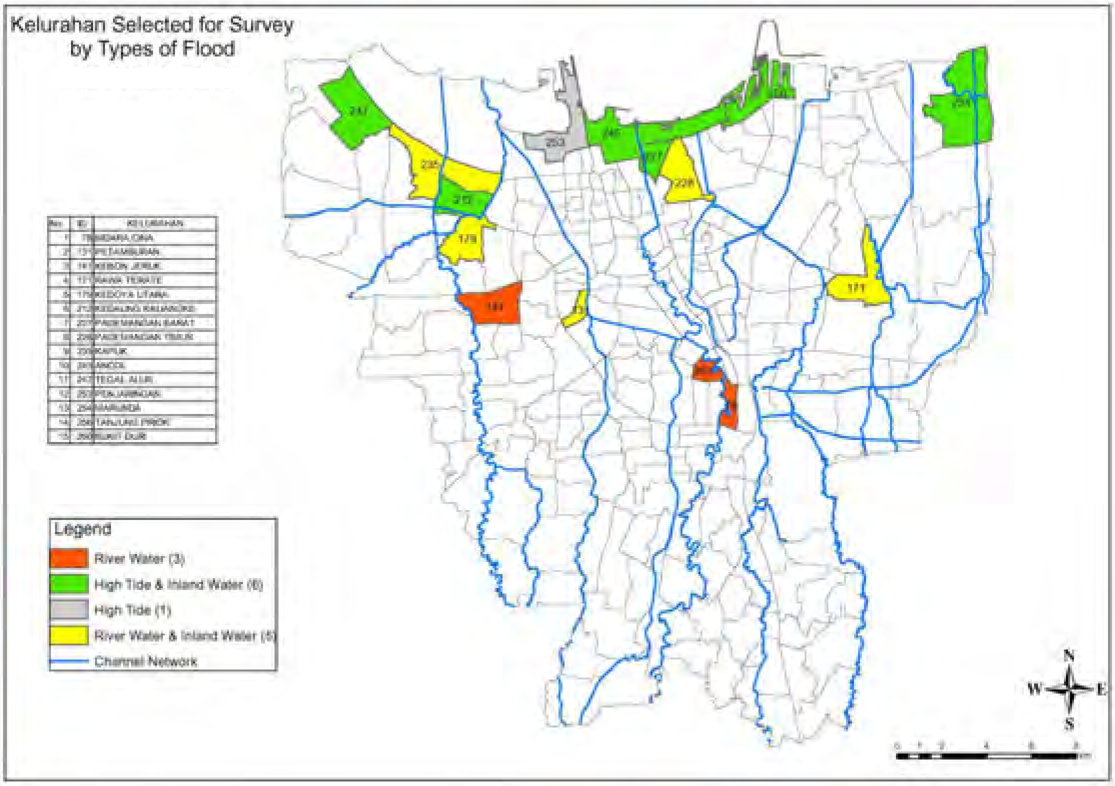


Figure- A.12 Selected 15 Kelurahans by Types of Flood

Tables

Table- A.1 Estimation of Land Subsidence at Station

No	Station	(a)2008 Subsidence(cm)	(b)2050 Subsidence(cm)	Difference between 2008 and 2050 (cm)
1	CIBU	-29.2	-152.2	-123.0
2	CINE	-18.7	-97.6	-78.8
3	KEBA	-48.5	-252.8	-204.2
4	KUNI	-39.5	-205.5	-166.0
5	KWIT	-43.1	-224.7	-181.6
6	MARU	-29.9	-155.9	-126.0
7	MERU	-42.8	-223.1	-180.3
8	MUTI	-42.5	-221.5	-179.0
9	PIKA	-72.9	-379.6	-306.7
10	RAWA	-15.8	-82.3	-66.5
11	RUKI	-57.6	-300.1	-242.5
12	TOMA	-35.3	-183.8	-148.5
13	ANCL	-33.7	-220.7	-187.0
14	BSKI	-32.0	-209.3	-177.4
15	CLCN	-37.7	-247.0	-209.2
16	CNDT	0.0	0.0	0.0
17	DNMG	-106.5	-697.4	-590.9
18	KAMR	-48.5	-317.7	-269.2
19	KLDR	-52.8	-345.9	-293.1
20	KLGD	-37.5	-245.6	-208.1
21	BMT1	-16.8	-124.9	-108.1
22	BMT2	-71.9	-534.2	-462.4
23	CEBA	-70.8	-526.5	-455.7
24	DADP	-40.9	-304.1	-263.2
25	PLGD	-81.7	-607.5	-525.8
26	CINB	-32.2	-239.5	-207.3

Table- A.2 Damage Coefficient applied to Buildings

Flood Level	Damage Rates
Less than 20cm	0.032
20-49cm	0.092
50-99cm	0.119
100-199cm	0.266
200-299cm	0.580
More than 300cm	0.834

Source: Based on Manual of Economic Study of Floods, MLIT Japan

Table- A.3 Damage Coefficient applied to Assets

Flood Level	Damage Rates (HH Goods)	Damage Rates *(Commerce/ Industry)
Less than 20cm	0.021	0.099 0.056
20-49cm	0.145	0.232 0.128
50-99cm	0.326	0.453 0.267
100-199cm	0.508	0.789 0.586
200-299cm	0.928	0.966 0.897
More than 300cm	0.991	0.995 0.982

Source: Based on Manual of Economic Study of Floods, MLIT Japan
*The Upper: Assets
The Lower: Inventories

Table- A.4 Percentage of Damage to Infrastructure against Damage Costs to General Assets

	Roads	Urban Sanitation	Public Services	Total
Percentage (%)	13.2	0.2	8.6	22.0

Source: Based on Manual of Economic Study of Floods, MLIT Japan

Table- A.5 Flood Duration

	Less than 20cm	20-49cm	50-99cm	100-199cm	200-299cm	More than 300cm
Suspension	3.0	4.4	6.3	10.3	16.8	22.6
Stagnation	6.0	8.8	12.6	20.6	33.6	45.2

Source: Based on Manual of Economic Study of Floods, MLIT Japan

Table- A.6 List of Kelurahan by Inundation and Slum Level

No	ID	Kelurahan	Poor	Inundation by	Slum Level
1	205	Wijaya Kusuma	151-450	HT_IW	3
2	212	Kedaung Kali Angke	151-450	HT_IW	4
3	215	Sunter Jaya	151-450	HT_IW	3
4	216	Pegangsaan Dua	151-450	HT_IW	3
5	219	Sukapura	151-450	HT_IW	3
6	227	Pademangan Barat	751-1050	HT_IW	4
7	228	Pademangn Timur	151-450	HT_IW	4
8	229	Cengkareng Timur	151-450	HT_IW	3
9	230	Sunter Agung	151-450	HT_IW	3
10	232	Cengakareng Barat	151-450	HT_IW	3
11	233	Pejagalan	451-750	HT_IW	3
12	235	Kapuk	751-1050	HT_IW	4
13	236	Tugu Utara	151-450	HT_IW	3
14	238	Warakas	151-450	HT_IW	3
15	239	Rawabadak Utara	151-450	HT_IW	3
16	241	Kebon Bawang	151-450	HT_IW	3
17	242	Lagoa	451-750	HT_IW	3
18	243	Semper Barat	451-750	HT_IW	3
19	244	Semper Timur	451-750	HT_IW	3
20	245	Ancol	451-750	HT_IW	4
21	247	Tegal Alur	151-450	HT_IW	4
22	246	Kapuk Muara	151-450	HT_IW	3
23	250	Kamal	451-750	HT_IW	4
24	248	Kalibaru	1051-3000	HT_IW	3
25	251	Koja	451-750	HT_IW	3
26	254	Marunda	451-750	HT_IW	3
27	255	Kamal Muara	151-450	HT_IW	3
28	256	Tanjung Priok	151-450	HT_IW	4
1	125	Pulo Gebang	451-750	RW_IW	3
2	127	Kebon Melati	151-450	RW_IW	4
3	131	Petamburan	151-450	RW_IW	3
4	171	Rawa Terate	151-450	RW_IW	3
5	172	Duri Kepa	151-450	RW_IW	3
6	179	Kedoya Utara	151-450	RW_IW	3
7	187	Rawa Buaya	151-450	RW_IW	3
8	195	Cakung Barat	151-450	RW_IW	3
9	199	Jembatan Besi	151-450	RW_IW	4
10	84	Semanan	n/a	RW_IW	Non slum
1	28	Kampung Tengah	151-450	RW_U	3
2	61	Kebon Pala	151-450	RW_U	3
3	63	Cipinang Melayu	151-450	RW_U	3
4	74	Pondok Kelapa	151-450	RW_U	3
5	78	Bidara Cina	151-450	RW_U	3
6	83	Pondok Bambu	151-450	RW_U	3
7	90	Cipinang Besar Selatan	451-750	RW_U	3
8	95	Cipinang Besar Utara	451-750	RW_U	3
9	97	Klender	451-750	RW_U	4
10	100	Kampung Melayu	151-450	RW_U	3
11	102	Rawa Bunga	151-450	RW_U	3

12	110	Cipinang	151-450	RW_U	3
13	120	Pal Meriam	151-450	RW_U	3
14	121	Pegangsaan	151-450	RW_U	3
15	124	Palmerah	151-450	RW_U	3
16	128	Jatinegara	451-750	RW_U	3
17	141	Kebon Jeruk	151-450	RW_U	3
18	151	Pulo Gadung	151-450	RW_U	3
19	165	Kayu Putih	751-1050	RW_U	3
20	260	Bukit Duri	151-450	RW_U	3
1	208	Angke	151-450	HT_U	3
2	209	Jembatan Lima	151-450	HT_U	3
3	221	Pekojan	151-450	HT_U	3
4	253	Penjaringan	1051-3000	HT_U	4

33 Kelurahan short list after second screening conducted

Table- A.7 Selected 15 Kelurahan

No	ID	Kelurahan	Poor	Inundation by	Slum Level	Kota	Remarks	Back up
1	253	Penjaringan	1051-3000	HT_U	4	North	Purely high tide	None
1	212	Kedaung Kali Angke	151-450	HT_IW	4	West	Cengkareng Canal Area	-Pejagalan -Simper Barat -Simper Timur -Kalibaru -Koja
2	227	Pademangan Barat	751-1050	HT_IW	4	North	Ancol Canal Area	
3	228	Pademangan Timur	151-450	HT_IW	4	North	Ancol Canal Area	
4	235	Kapuk	751-1050	HT_IW	4	West	West Canal Area	
5	245	Ancol	451-750	HT_IW	4	North	Ancol Canal Area	
6	247	Tegal Alur	151-450	HT_IW	4	West	Cengkareng Canal Area	
7	254	Marunda	451-750	HT_IW	3	North	Downstream of East Canal	
8	256	Tanjung Priok	151-450	HT_IW	4	North	Ancol Canal Area	
1	171	Rawa Terate	151-450	RW_IW	3	East	Stagnant of water	-Pulo Gebang -Kayu Putih -Sunter Jaya -Pegangsaan Dua
2	179	Kedoya Utara	151-450	RW_IW	3	West	West Canal Area	
3	131	Petamburan	151-450	RW_IW	3	Central	Ciliwung River Area	
1	78	Bidara Cina	151-450	RW_U	3	East	Ciliwung River area	-Cipinang Melayu
2	141	Kebon Jeruk	151-450	RW_U	3	West	West Canal Area	
3	260	Bukit Duri	151-450	RW_U	3	South	Ciliwung River Area	

The study on Impact of Climate-Change-Related Flood on the Urban Poverty in Jakarta, Indonesia

Final Report

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Japan International Cooperation Agency (JICA)

Yachiyo Engineering Co., Ltd.

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GLOSSARY

ADB	Asian Development Bank
Banjir Kanal Barat (BKB)	West Flood Canal
Banjir Kanal Timur (BKT):	East Flood Canal, one form of flood control: the planned canal since 1991 located in east Jakarta. BKT will cross the 13 kelurahan (2 kelurahan in North Jakarta and 11 kelurahan in East Jakarta) with a length of 23.5 kilometers
Beras Miskin (Raskin)	Rice for the Poor, as a program scheme of government to subsidize the consumption of the poor
Daerah Khusus Ibukota Jakarta (DKI Jakarta)	special capital area of Jakarta
GHG	Greenhouse Gases; a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect
IOD	Indian Ocean Dipole; an irregular oscillation of sea-surface temperatures in which the western Indian Ocean becomes alternately warmer and then colder than the eastern part of the ocean
IPCC	Intergovernmental Panel on Climate Change; the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts
ISDR	International Strategy for Disaster Reduction; the grant scenario for the reduction of disaster effect by United Nation
Jabodetabekpunjur	a greater Jakarta metropolitan area, Jakarta as core city which has Bogor, Depok, Tangerang, Puncak and Cianjur as satellite city
Jaminan Kesehatan Masyarakat (Jamkesmas)	Health Insurance for the Poor
JICA	Japan International Cooperation Agency
Kecamatan	sub district or political district administrated by a *camat*, sub division of K*otamadya*
Kelurahan	smaller political unit administered by the *lurah*
Kotamadya	municipality, sub division of a province. *Kotamadya* is led by *walikota*
Palang Merah Indonesia (PMI)	Indonesia Red Cross
Rukun Tetangga (RT)	neighborhood association which generally consists of 20 to 30 households based on the Jakarta Governor Decree
Rencana Tata Ruang Wilayah (RTRW)	Regional Spatial Plan
Rukun Warga (RW)	community association which generally consists of 8 to 18 RTs
UN HABITAT	the United Nations agency for human settlements
WB	World Bank

CHAPTER I INTRODUCTION

I.1 Introduction

This research is an integral part of "The Simulation Study on Climate Change in Jakarta, Indonesia" by JICA Study Team. The study aims to simulate and identify socio-economic impacts caused by climate change including temperature increase, sea level rise in Jakarta, and policy recommendations will be made for future infrastructure development based on the results of analysis. Thus, this research focuses on identifying socio-economic conditions related to the impacts caused by climate change.

This research is also implemented as the follow-up case study of WB-ADB-JICA Joint Study in 2010 "Climate Risks and Adaptation in Asian Coastal Megacities" which covers Manila, Bangkok, Kolkata and Ho Chi Minh City. Especially in Asia, since mega cities along the coasts are expected to increase in number and grow in size in accordance with the development of economy, implementation of global warming impact analysis and establishment of measures for mitigation and adaptation to the global warming influences in such mega cities are subjects of urgent. Therefore, Jakarta as mega city will be explored to be a case study.

I.2 Background

The concept of climate change in this millennium era is to be frequently mentioned and analyzed in the environmental assessment or development on the international and national level. Climate change components become one of the most important considerations with sustainability of human life in the construction of nation and state. The rapid change in climate, caused by the buildup of greenhouse gas (GHG) in the atmosphere, will leave ecosystems vulnerable and will affect lives and livelihoods through sea-level rise; increased intensity of storms, cyclones, drought, and flooding; greater frequency of heat and cold waves; more rapid spread of respiratory, vector, and water-borne diseases; greater population displacement; and more conflicts over scarce resources. (IPCC, *Climate Change 2007*: *Synthesis Report – Summary for Policymakers).*

As a result of global warming, frequency and intensity of extreme events, such as tropical cyclones (including hurricanes and typhoons), floods, droughts and heavy precipitation events, are expected to rise even with relatively small average temperature increases (see Table- I.2.1 and Figure- I.2.1). Changes in some types of extreme events have already been observed, for example, increases in the frequency and intensity of heat waves and heavy precipitation events (Meehl et al. 2007).

However, the magnificent impacts of the climate change force all sectors including government concern to deal with policies whose aims are to reduce the effects on societies. At the national and regional level, the mainstream shifts responsibility for implementing change-response strategies from single ministry or agency dealing with climate change (such as environmental departments) to all sectors of government, civil society, academia, and the private sector jointly. As shown in Figure- I.2.2, the cycle concerned with how the governments deals with climate change through their authority.

Figure- I.2.2 shows the cycle with three fronts: climate change, disaster risk management and development. Action on any front impacts the city on the other two fronts, and the impact may be either positive or negative. It, therefore, becomes imperative to ensure that the agenda on any one front does not increase the vulnerability on others. The climate change agenda needs to be viewed through the prism of the development agenda and should be embedded in the policies for disaster risk management. Forging links to citizen and volunteer groups is becoming an important part of disaster risk management in many cities and could play a role in a city's mitigation and adaptation programs as well (World Bank, 2009).

The impacts of climate change will influence not only government but also daily life of citizens. The impacts which are caused by climate change and could have influence on humans, the economy, infrastructure, and ecosystem will vary from one geographical region to the next, and will certainly be related to the degree of vulnerability associated with different communities and societies. The urgent things to be done are to identify the size of impacts and vulnerability of the people against hazards due to climate change.

Table- I.2.1 Examples of Major Projected Impacts

Projected change	Examples of major projected impacts		
	Water resources	Human health/mortality	Industry/settlement/ society
Warmer/fewer cold days/nights; warmer/ more hot days/nights over most land areas	Effects on water resources relying on snow melt	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced effects of snow, ice, etc,
Warm spells/heat waves; frequency increases over most land areas	Increased water demand; water quality problems, e.g., algal blooms	Increased risk of heat-related mortality	Reduction in quality of life for people in warm areas without air conditioning; impacts on elderly and very young; reduced thermoelectric power production efficiency
Heavy precipitation events; frequency increases over most areas	Adverse effects on quality of surface and groundwater; contamination of water supply	Increased risk of deaths, injuries, infectious diseases, allergies, and dermatitis	Disruption of settlements, commerce, transport, and societies due to landslides, subsidence, or flooding; pressures on urban and rural infrastructures
Area affected by drought increases	More widespread water stress	Increased risk of food and water shortage and wildfires; increased risk of water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potentials for population migration
Number of intense tropical cyclone activity increases	Power outages cause disruption of public water supply	Increased risk of deaths, injuries, water- and foodborne diseases	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers
Incidence of extreme high sea-level increases	Decreased freshwater availability due to saltwater intrusion	Increase in deaths by drowning in floods; increase in migration-related health effects	Costs of coastal protection versus costs of land-use relocation; also see tropical cyclone activity above

Source: Climate Resilient Cities, World Bank- 2009

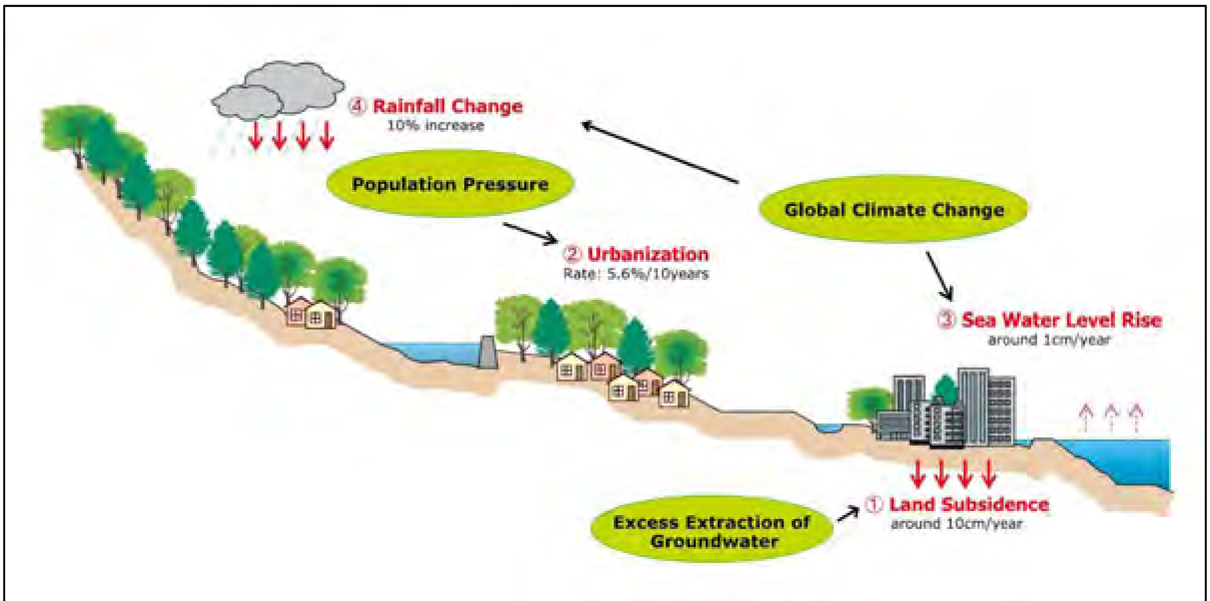
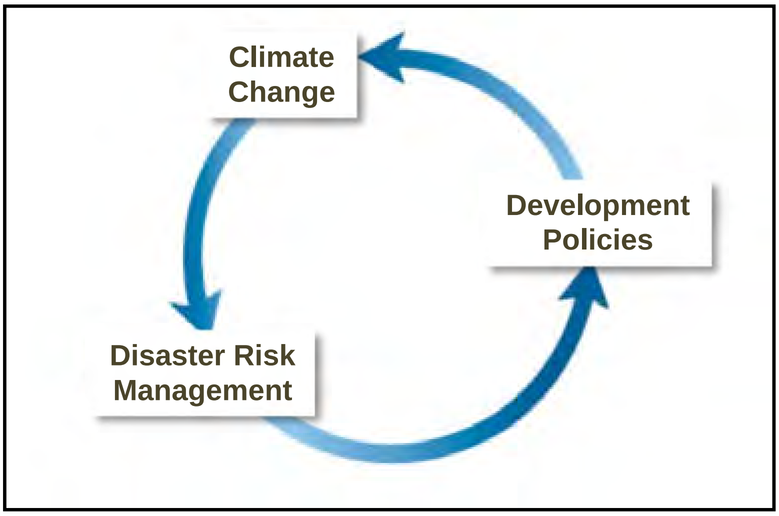


Figure- I.2.1 Image of Flood Risk



Source: Climate Resilient Cities, World Bank- 2009

Figure- I.2.2 Three Fronts in Climate Change Cycle

Within the United Nations International Strategy for Disaster Reduction Secretariat (UNISDR) (2004), vulnerability is defined as the set of conditions and processes resulting from physical, social, economic, and environmental factors, which increase the susceptibility of a community to the impact of hazards. According to Bogardi *et al.* (2005), the physical factors encompass susceptibilities of the built environment. The social factors are related to the social issues such as levels of literacy, education, social equity, traditional values, etc. Economic factors are related to issues of poverty, gender, level of debt and access to credit. Environmental factors include depletion and degradation of natural resources, and natural "vulnerability" towards climate change. Therefore, it is important to recognize the existence of vulnerability in coping capacity within disaster risk reduction.

The urban poor seem to be at high risks in the event of natural disasters partly because of the location of their settlements. Their settlements are, due to lack of purchasing power, inevitably on sites available with very low cost. Such sites are often vulnerable to floods and landslides; infrastructure is not well developed; and poor housing condition which are easily damaged or collapsed. The urban poor, thus, face threats against their lives, assets, and obstacles to future prosperity due to disastrous and worsening risks. Besides, the urban poor, often living in informal status, are also likely to face insufficient provision of public services, which hampers mitigation of these risks they are facing.

Environmental and climate change-related incidents affect the urban poor disproportionately because of overcrowded housing with poor quality, and inadequacies in provision of water, sanitation, drainage, health care, and garbage collection (World Bank, 2009). And recovering from disasters is also particularly difficult for the poor as they do not have resources or adequate safety nets, and public policies often prioritize rebuilding in other parts of the city (IPCC, *Climate Change 2007*: *Synthesis Report – Summary for Policymakers)*.

Therefore, this research focuses on exploring experiences of the urban poor in Jakarta[1] and the way they deal with inundation incidents due to floods through the household survey. The survey is trying to identify the socio-economic and environmental conditions of the poor who live in the vulnerable area in Jakarta.

As located in the tropical region, Jakarta has some climate phenomena, such as the phenomenon of IOD (Indian Ocean Dipole) centered in the Indian Ocean, sea level rise which potentially causes disappearing small islands and salt water intrusion, Ocean Warming which potentially causes declines

[1] Jakarta is the capital, global, and largest city of Indonesia. Located on the northwest coast of Java, it has an area of 661 square kilometers (255 sq mi) and a 2010 census count population of 9,580,000. It is the most populous city in Indonesia and in Southeast Asia, and is the tenth-largest city in the world. The urban area, Jabodetabekpunjur, is the second largest in the world.

in fisheries harvest and loss of biodiversity, increasing temperature which causes the increase of fire risk and disease risk range, and increasing rainfall which causes floods and landslides, etc. The climate phenomena have increased hazardous risk of Jakarta, especially in flood hazard. Floods have become annual events for people in Jakarta. They inevitably adapt to or cope with phenomena caused by climate change to prevent serious impacts for their lives.

In 2002 and 2007, floods hit Jakarta and had inundated the coastal area up to 10 meters above sea level. Increasingly rainfall and high tide were direct causes of inundation in Jakarta. Because of the high level of water, then since 2007, Government of Jakarta has built some flood infrastructures in the shore and river line, such as embankment, dikes, water pumps, etc. In fact, some of them have been successfully functioning and reducing impacts of flood on the lives of people in several areas, such as in the surrounding area of the East Canal (BKT) development, especially in the Ciliwung and the Cipinang river basins. However, there are still vast areas in Jakarta where people's livings are suffered from inundation due to floods. Therefore, it is significant to figure out how the poor dealt with those flood events, as well as what the impacts to them were.

I.3 Objectives of the Study

The objective of this study is to identify the impact of flood inundation on the poor in Jakarta through household survey which will be conducted along with the following objectives:

1. To identify the living status and the environment of the poverty group in Jakarta
2. To assess the direct effects of inundations on the poverty group
3. To identify the secondary and tertiary impacts of inundation on the poverty group
4. To specify the direct factors of the secondly and thirdly impacts of inundation on the poverty group

I.4 Limitation of the Study

- The Household survey was conducted only for 300 households which means apparently can't describe the total perception of the urban poor in Jakarta. But, at least, with proper sampling method based on geography and types of flood, the information from this survey can be drawn as representation of the urban poor.

- The survey activity was conducted in July 2011 when Jakarta is in the dry season, so it may seldom affect the respondents' perception against inundation.

- The household selection was based on data of the poor household registering a food subsidy programme in Indonesia, Beras untuk Rumah Tangga Miskin (which means "rice for poor households", RASKIN). Considering many poor households do not or cannot register the programme, those registered households may not represent the poor in Jakarta.

- The quality of statistical data which represent the number of poor households is not updated with the real condition in the year 2011. The lack of data and the accuracy of Head of Rukun Warga (community association: RW)/ Rukun Tetangga (neighborhood association: RT) can be seen as the limitation of making appropriate sample size for survey.

- Although the flood infrastructure development has reduced flooded areas in Jakarta significantly, no updated information about the flooded area in 2011 was available.

CHAPTER II METHODOLOGY

II.1 General Framework

The existence of rural to urban migration implies that urban areas have a substantive attraction, and in many countries the number of urban residents seems to exceed available land and capacity there. Jakarta is not an exceptional; based on the data of life time migration in DKI Jakarta shown in Table-II.1.1, net-migration figures since the year 1971 to 2005 still showed a positive value. According to 2010 census data, the population has reached 9,588,198 people with population density of 14,447 person/km^2. Population growth rate of Jakarta in the period 2000-2010 is about 1.41 percent; this figure is higher than that of 1990-2000 which was only 0.14 percent. Unless addressed by the policy that can significantly mitigate the current urbanization in Jakarta, the rate of population growth will continue to increase, and thereby population density will also increase.

Table- II.1.1 Life Time Migration: DKI Jakarta Province 1971 – 2005

	1971	1980	1985	1990	1995	2000	2005
In-migration	1,821,833	2,599,367	3,079,693	3,170,215	3,371,384	3,541,972	3,337,161
Out-migration	132,215	400,767	593,936	1,052,234	1,589,285	1,836,664	2,045,630
Net-migration	1,689,618	2,198,600	2,485,757	2,117,981	1,782,099	1,705,308	1,291,531

Source: Sensus Penduduk 1971, 1980, 1990, 2000 dan Survei Penduduk Antar Sensus (SUPAS) 1985, 1995, 2005

Urbanization put an impact on the population structure of Jakarta by ethnicity. According to 2000 population census data, Betawi, who originally have lived in Jakarta, reached only 27.86 percent and it is lower than Javanese that was 35.16 percent. As Betawi people marginalized geographically, they have been pushed out to the outskirt of Jakarta or even outside Jakarta such as Bogor, Bekasi, Tangerang, and Depok. Besides, some of them were not able to compete with the migrants; hence they were also marginalized economically and socially due to the progress of urbanization.

Similar to the other megacities in developing countries, in Jakarta, there is huge diversity in people's livelihood. On one hand, those who highly educated and can earn enough money enjoy well-being in the city. On the other hand, those who migrate with little money and Betawi people manage to live in Jakarta with limited land. Most of them live in poorly developed areas, so-called 'kumuh' which is the expression used by DKI Jakarta and means slum in Bahasa, Indonesian language. There are many poorly built temporary houses on places such as along the river bank and coastline with rudimentary materials such as cardboard and zinc. Some of them have improved the quality of housing to be semi-permanent or even permanent according to the improvement of welfare. Nevertheless, the layout of house building which is a mess, high density, and have dirty environment---salient features for "slum"--- seem almost impossible to be improved.

UN-HABITAT[1] defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following:

1. Durable housing of a permanent nature that protects against extreme climate conditions;
2. Sufficient living space which means not more than three people sharing the same room;
3. Easy access to safe water in sufficient amounts at an affordable price;
4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people; and
5. Security of tenure that prevents forced evictions.

Meanwhile, Housing Department of DKI Jakarta describes the characteristics of slum areas using eleven indicators as follows: 1) population density, 2) location close to economic activity, 3) inadequate road condition which four-wheeled vehicles cannot pass 4) inadequate drainage system, 5) inadequate air quality, 6) inadequate ventilation inside housing building, 7) no privacy inside house building, 8) lack of toilet facilities, 9) lack of clean water availability, 10) untidiness of building

[1] www.unhabitat.org

layout, 11) illegality of land ownership.

Overcrowding is one of the characteristics of urban poverty; the other dimensions of poverty are low income, poor health condition, low education attainment, individual and housing insecurity, and powerlessness (BPS, 2007)[2]. In terms of dimension of housing insecurity as mentioned above, the poor who reside in slum are vulnerable to the occurrence of eviction and to disaster risk by man-made disaster such as fire or natural disaster such as inundation. While disaster occurs, the poor suffer the most since they cannot afford the cost of repair or reconstruction of their assets.

The inundation is still occurring in Jakarta, although many efforts have already been conducted by government and other parties to overcome. Explanation related to inundation control infrastructure was obtained from secondary data, while public understanding of climate change issues, the impact of inundation, and counter measures which have been done within the framework to mitigate the disaster were obtained from primary data. In this study, inundation prone area was divided into 4 types:

- HT_U, means inundation mainly affected by high tide
- HT_IW, means inundation mainly affected by high tide and inland water
- RW_U, means inundation mainly affected by river water
- RW_IW, means inundation mainly affected by river water and inland water

This study focuses on the impact of climate change related to flood on the urban poor. Considering two criteria, i.e., characteristics of slum areas and typology of inundation, the analytical framework was created to provide a descriptive overview on characteristics of living status and environment based on typology of inundation. Figure- II.1.1 depicts the general framework for this study.

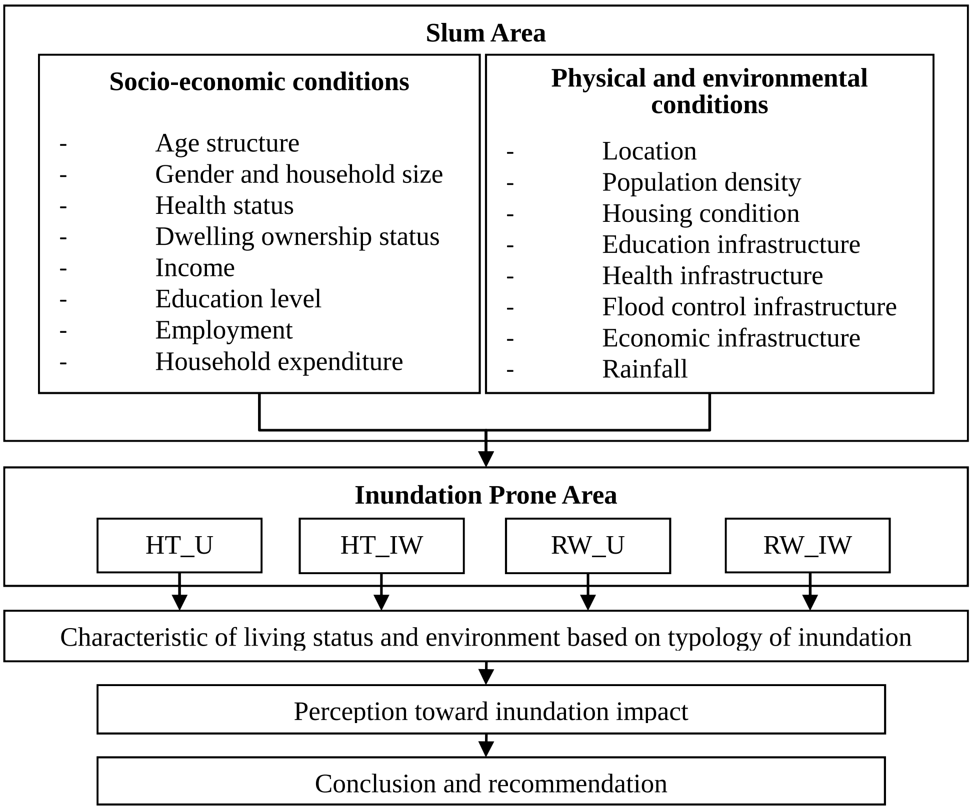


Figure- II.1.1 General Framework Flowchart

[2] "Analisis Tipologi Kemiskinan Perkotaan, Studi Kasus Jakarta Utara". 2007. Badan Pusat Statistik. Jakarta.

II.2 Type and Method of Data Collection

We use two categories of data in this study: primary and secondary data. The primary data, which is on socio-economic characteristics and inundation impacts at the household level, were collected through interviews conducted to the heads of household or household members considered most knowledgeable about the households. Besides, semi-structured interviews with some key informants, such as Kelurahan officers, the head of RW and RT, and government officials, who were considered knowledgeable about issues related to our study, were carried out to get general information.

The secondary data were gathered from relevant documents and literatures, such as the number of poor household and poor household members by Kelurahan from BPS, slum area by RW level from Housing Department of DKI Jakarta.

II.3 Survey Instrument

The survey was conducted using household questionnaires in July 2011. Prior to the full scale survey, pre-test was conducted in May 2011 in three Kelurahans: Penjaringan in North, Kampung Melayu in East, and Petamburan in Central Jakarta. Based on the pre-test result and internal discussion, the questionnaire was modified and finalized.

II.4 Sampling Frame Procedure

The study was conducted in poor and inundation prone areas in the mainland of Jakarta. The sample size is 300 households from 15 Kelurahans in which 20 households are selected.

II.4.1 Kelurahan Selection

We employed multi-stage sampling to select 15 Kelurahans for our survey based on two criteria: the poverty level and being areas affected by inundation. The first criterion on Kelurahan selection is poverty level; the data of poor and slum indicators in 2008 at RW level provided by Housing Department of DKI Jakarta were used in this research. Categorized as a slum if it met the following criteria:[3]

1. Population density: the number of people per hectare;
2. Layout of the building: considered if the layout of building is small and neatly arranged;
3. Construction of residential buildings: housing condition and whether it is permanent or not, indicated by percentage of building materials to be used: plywood, chamber (made from bamboo), woods-clay brick;
4. Ventilation: It can receive light from outside or air can spin out of the building;
5. Land used for building construction;
6. Road condition: percentage of soil or un-pavement road;
7. Drainage condition: duration of stagnant drainage per day;
8. Clean water availability: percentage of household using tap water;
9. Toilet facility: percentage of household using toilet in river or public/shared toilet; and
10. Waste/garbage transporting: frequency of garbage/waste pick up in a week.

Table- II.4.1 depicts the distribution of the number of RW with the slum level by Kotamadya. Comparing among Kotamadyas, South Jakarta is relatively better than others; there is no RW categorized as heavily slum (level 4). On the other hand, concentration of slum area at level 3 and 4 are mostly in West and North Jakarta. In line with the research objective, we only chose Kelurahans which were categorized as slum level 3 and 4.

[3] Then, based on the weight given to each indicator, 4 categories of slum level are respectively defined as follows: 0) non slum {>35}, 1) very lightly {31-35}, 2) slightly {29-30}, 3) continuously {21-28}; 4) heavily {<=20}

Table- II.4.1 Distribution of the Number of RW with the Slum Level by Kotamadya (2008)

Slum Level	Kotamadya					Total
	South	East	Central	West	North	
1	24	10	15	19	26	94
2	13	15	9	18	19	74
3	32	50	41	48	47	218
4	0	2	4	10	6	22
Total	69	77	69	95	98	408

Source: Housing Department of DKI Jakarta, 2008

The second criterion is inundation prone areas, which are identified based on the inundation maps on 2007 provided by YEC. The maps categorize inundation prone areas into four types of causes as mentioned in Section 2.1 above.

Based on these criteria, 61 Kelurahans were shortlisted (details are shown in Table A.1 in Appendix). Since judging only by the slum level allows some Kelurahans which have very small inundation-prone areas to be included, we additionally employed another criterion, the grade of the population of the poor[4]. Then, 24 Kelurahans were shortlisted which were graded as slum level 3 and populated with more than 450 poor people, or slum level 4.

This short list represented each group which was categorized by the combination of four causes of inundation: high tide, high tide and inland water, river water, river water and inland water. Since inundation data used for the selection was of 2007, there was some disparity between the current condition and the information. Because of that, we had to additionally select Kelurahans which were dropped from the long list but have severe inundation. At the first screening, there was no single Kelurahan in the South Jakarta included in the short list; there was only one Kelurahan which met the criteria as slum and inundation area, and there was very small chance of being selected since random sampling method was applied. South part of Jakarta gets inundation mainly by the river which cannot flow rain water properly any more. In this condition, pumping stations do not function since the volume of water is too huge. Hence, one Kelurahan was picked from South Jakarta.

Besides, 8 additional Kelurahans were taken from the lower reaches areas. The degree of inundation and quality of inundation water are worse in the lower reaches, so health risk is higher and in fact the poorer concentrated in the areas where people are not willing to choose as resident site normally. Therefore, it would be better to choose more Kelurahan from the lower reaches, which met a balance within current shortlist.

Through discussions and the screening process, a list of 33 Kelurahan was finally gained in which field verification would be carried out. Field verification was done with the aim of confirmation whether Kelurahan would be properly selected or not based on predetermined criteria. After all the information was gathered, the list of 15 Kelurahan for full scale survey was finalized (details are shown in Table A.2 in Appendix). Besides, the 15 Kelurahans selected, we selected several backups for each type of inundation.

II.4.2 RW and RT selection

Next phase was area selection within Kelurahan. Kelurahan is broken down into smaller units called RW (community association), and then further broken down into a number of RT (neighborhood association). In order to obtain appropriate RWs for each Kelurahan, two criteria were also applied as well. Information about slum gathered from Jakarta Housing Agency, and inundation from Kelurahan Officer. Table- II.4.2 depicts long list on RW selection.

[4]Second screening was choosing Kelurahans which had slum level 3 with grading of the population of the poor was 451-750 or 751 to 1050, while those which had 1-150 and 151-450 poor population were dropped. Hence, the shortlist were made up of poor population was more than 450 at slum level 3, and all the Kelurahans at slum level 4.

Table- II.4.2 Inundation and Slum Area within Kelurahan Selected

No	Code	Kelurahan	Based on Field Survey		Data from DKI Jakarta		Flood and Slum Area based on Survey and Data from DKI Jakarta			
			Inundation Area by RW		Slum Area by RW		By RW		Total RT within RW	
			Total	RW Number	Total	RW Number	Total	RW Number	Slum	Flood
1	78	Bidara Cina	6	3,5,6,7,11,14	2	6.15	1	6	4	8
2	131	Petamburan	2	2.3	4	3,4,8,9	1	3	2	6
3	141	Kebon Jeruk	3	1,4,9	1	5	1	4	n/a	n/a
4	171	Rawa Terate	2	4.5	2	2,6	2	4, 5	n/a	n/a
5	179	Kedoya Utara	3	1,2,8	2	2,8	2	2, 8	28	21
6	212	Kedaung Kali Angke	4	1,2,3,8	2	1,2	2	1, 2	10	17
7	227	Pademangan Barat	5	3,7,8,9,13	4	7,11,13,14	2	7,13	12	28
8	228	Pademangan Timur	4	1,2,3,10	2	1.1	2	1, 10	9	9
9	235	Kapuk	16	1 to 16	6	1,3,4,7,13,16	6	1,3,4,7,13,16	34	59
10	245	Ancol	1	2	2	2.4	1	2	7	6
11	247	Tegal Alur	5	1,3,8,9,11	1	8	1	8	8	8
12	253	Penjaringan	5	3,7,9,12,17	10	2,7,8,11,12,13,14,15,16,17	2	7,12	19	12
13	254	Marunda	2	1,7	2	1.2	1	1	5	1
14	256	Tanjung Priok	2	7, 6	4	6,7,11,13	4	6,7,11,13	18	18
15	260	Bukit Duri	3	10,11,12	3	10,11,12	3	10,11,12	25	25
Total			61	-	47	-	24	-	-	-

There were 61 RW categorized as inundation prone and 47 as slum RW. We picked up 24 RWs as short list which met with categories as slum and inundation prone area. If there was Kelurahan that had more than one RW, then random selection was conducted for main location and back up RW. Otherwise, there was no back up for Kelurahan that only had one RW. Table- II.4.3 depicts details of RW and RT selected.

Meanwhile at RT level, it was not selected randomly or purposely, but followed household sample selection (see Table- II.4.3 below for further details).

Table- II.4.3 RW and RT Selected

No	ID	Kelurahan	Main Location		Back up	
			RW	RT	RW	RT
1	253	Penjaringan	17	07,15	07	
1	212	Kedaung Kali Angke	01	03, 04	02	
2	227	Pademangan Barat	07	01, 14, 15	13	
3	228	Pademangan Timur	10	06, 09, 10, 15	01	
4	235	Kapuk	16	11, 12, 13	04	
5	245	Ancol	02	01, 03, 09, 10, 11, 12	None	
6	247	Tegal Alur	01	01, 06, 07, 11	None	
7	254	Marunda	01	02, 03	None	
8	256	Tanjung Priok	07	01, 03	06	
1	171	Rawa Terate	04	16	05	
2	179	Kedoya Utara	02	13, 14, 15	08	
3	131	Petamburan	03	16	None	
1	78	Bidara Cina	06	12, 13, 14, 15	None	
2	141	Kebon Jeruk	04	02	None	
3	260	Bukit Duri	10	10, 11, 12	12	

II.4.3 Household Sampling Frame

This household survey required 300 samples of poor household in slum and inundation area in Jakarta. A quota sample was distributed among selected Kelurahan that are 20 samples of household in each. Since there was no official list of poor household at Kelurahan level, the sampling frame as a basis for random sampling was developed by gathering information about RASKIN beneficiaries from RT head. This program is intended for the poor, and those who are the beneficiaries have to be met with the specified requirements set by government[5]. While the household meets with at least 9 or more of 14 requirements, it is entitled to become beneficiaries of RASKIN program. In practice, the authorities in the lower level such as RW and RT level, not all of them know these requirements, and even if they know, it seems to be ignored. Assessment for gathering data of poor household is more emphasized on field observation and their own understanding than to refer to the official documents.

Based on an interview with selected RT Head, their tasks at RT level are just to make a list of candidate beneficiaries enclosed copies of ID card and Family Card, and final decision is conducted by higher level after dispatching verification team. Therefore, the beneficiaries of this program are often biased when a formal referral is not applied.

The number of beneficiaries varies in each location, and the sample frame contains the list of names of RASKIN beneficiaries numbered from 1 to N. There were 20 names selected randomly, besides, 2 households in each RT were also provided as back up. Table- II.4.4 depicts the number of poor households in selected Kelurahans. Specifically for Kelurahan Kebon Jeruk had only 20 households, then all of them were picked up as sample households. To overcome the shortage of samples, back up were provided by selecting randomly from another Kelurahan which had the same type of inundation and was in the adjacent area that was Kelurahan Kedoya Utara.

Table- II.4.4 Population of Poor Household by RW and RT Selected

ID	Kelurahan	Main Location			Back up		
		RW Number	RT Number	Number of Poor	RW Number	RT Number	Number of Poor
253	Penjaringan	17	7,15	57	07		
212	Kedaung Kali Angke	01	03,04	21	02		
227	Pademangan Barat	07	01, 14, 15	36	13		
228	Pademangan Timur	10	06, 09, 10, 15	40	01		
235	Kapuk	16	11, 12, 13	34	04		
245	Ancol	02	01,03,07, 09,10,11,12	151	None		
247	Tegal Alur	01	01, 06, 07, 11	63	None		
254	Marunda	01	02, 03	78	None		
256	Tanjung Priok	07	01, 03	38	06		
171	Rawa Terate	04	16	38	05		
179	Kedoya Utara	02	13, 14, 15	34	08		
131	Petamburan	03	16	29	None		
78	Bidara Cina	06	12, 13, 14, 15	48	None		
141	Kebon Jeruk	04	02	20	None		
260	Bukit Duri	10	10, 11, 12	27	12		

II.5 Data Processing and Analysis

It began with data entry using Microsoft Excel program, then the data processing performed using SPSS statistical analysis program including descriptive analysis and tabulation.

[5] Poor household requirements: (1) size of floor less than 8 m^2, (2) main material of the floor is soil/bamboo/thick wood, (3) main material of wall is bamboo/rumbia/low quality wood/brick without plaster, (4) does not have own toilet, (5) does not have electricity for lighting, (6) only have access to water for drinking from well/uncovered spring/river/rain water, (7) main source energy for cooking from wood/charcoal/kerosene, (8) consume meat/milk only once a week, (9) buy only one piece of new cloth per year, (10) have meal once or twice a day, (11) cannot afford the fee for Puskesmas or private clinic, (12) monthly income of the household head is less than 600,000 Rupiah and her/his occupation is farmer with 500 m^2 land ownership/landless peasant/fisherman/construction labor/plantation labor, (13) education attainment of household head; no formal education/not graduated from elementary school/elementary school graduated, (14) saving or asset household value less than 500,000 Rupiah, including motorcycle, gold, livestock, and boat.

CHAPTER III GENERAL CONDITION OF JAKARTA

III.1 Physical Environment in Jakarta

III.1.1 Topographic Feature of Jakarta

DKI Jakarta, located on the north western coast of Java Island, lies in a low, flat basin averaged 7 meters above sea level. Particularly the northern areas are below sea level, while the southern areas are comparatively hilly. Main rivers such as the Ciliwung River and the Cipinang River, which flow from the mountainous Puncak highlands to the south of the city, go across the city northwards towards the Java Sea. A combination of low-lying areas and a river delta formed by those rivers drastically increases flood risk in Jakarta.

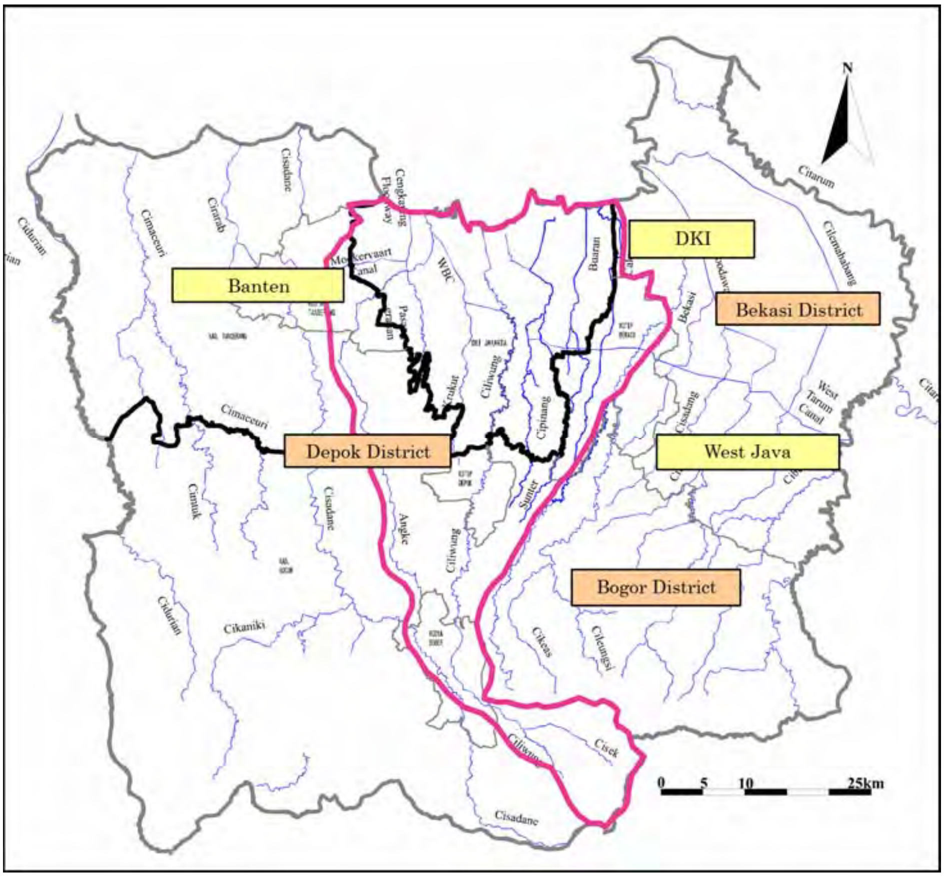


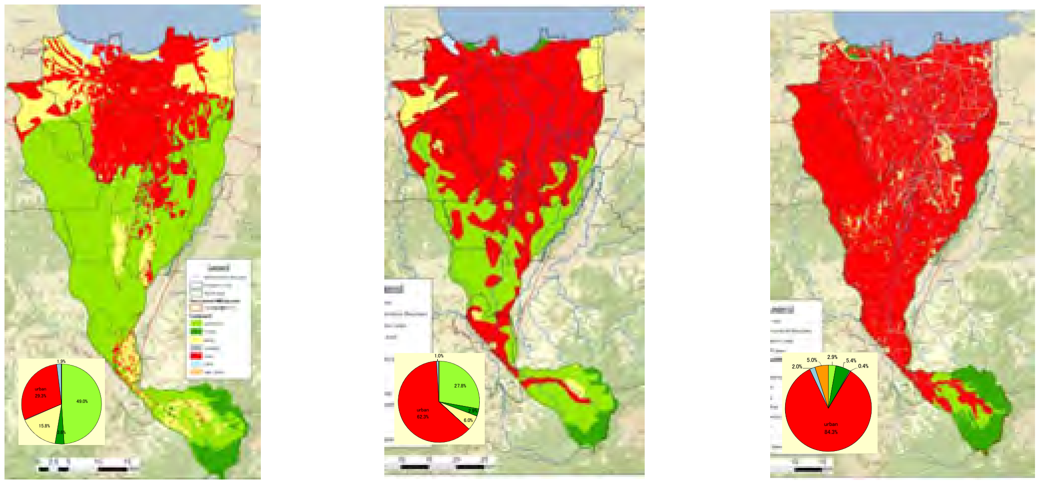
Figure- III.1.1 Location of Jakarta and Main Rivers

III.1.2 Land Use Transition and Increased Potential for Flood

In basin areas of the rivers flowing down in DKI Jakarta, the land development have been reached to the upper and middle stream areas owing to accelerating concentration of population and industries, and then it results in increased. The relation between outflow quantity of inundation and transitions of land use in the Ciliwung river basin, which is flowing down in the central area of Jakarta, is presented in the following. Similar developments are also advanced in the other river basin areas.

- Urbanization ratio of the Ciliwung river basin was raised from 29.3% in the 1980's to 62.3% in 2008, and expected to reach 75.8% in the future.
- Runoff coefficient is predicted to increase from f=0.74 in 2008 to 0.79 in the future according to urbanization ratio, and as a result the total flow amount of flood is expected to increase by approximately 10% in the future. It is attributed to reduction in the infiltration area of river basin due to development.
- Meanwhile, the results of flood simulation by "The Institutional Revitalization Project for Flood Management in JABODETABEK" suggested the possibility that peak discharge of

inundation would increase by approximately 220 m^3/s from $Q=520m^3/s$ in 2009 to $740m^3/s$ in the future in Depok because of the concentration of flowing water (resulting in shorten flood arrival time) due to land development associated with the construction and improvement of channels.



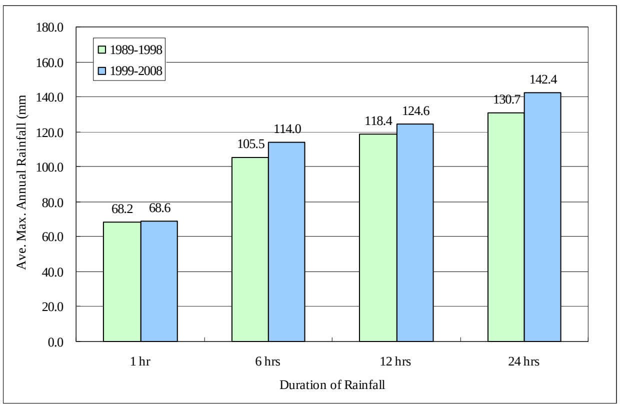
1980s Urbanization Rate: 29.3% Runoff Coefficient: f=0.69	2008 Urbanization Rate: 62.3% Runoff Coefficient: f=0.74	Future (2030) Urbanization Rate: 84.3% Runoff Coefficient: f=0.79

Figure- III.1.2 Land Use Transition of the Ciliwung River Basin

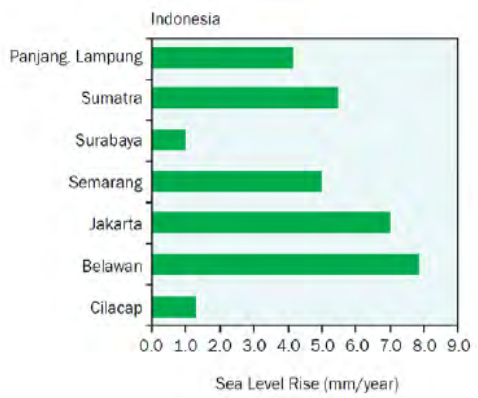
III.1.3 Climate Changes

(1) Rainfall Volume

In recent years, changes in annual rainfall patterns have become conspicuous, and it is forecasted that climate change risks such as prolonged dry seasons, reduced rainfall volume, and increase in concentrated downpours would be higher in the future. There is concern that escalation in seriousness and frequency of disasters arising from future climate change will trigger economic and social losses such as stagnation of economic activities and increasing poverty, etc., and it would be a critical risk factor for sustainable development of the country.



Trend Comparison of Maximum Annual Rainfall



Trend of Sea Level Rise

Source: The Economics of Climate Change in Southeast Asia: A Regional Review, April 2009, ADB

Figure- III.1.3 Trend of Annual Precipitation and Sea Level Rise in Indonesia

As for Jakarta Metropolitan area, Figure- III.1.3 indicates 1–9% increase in annual maximum rainfall comparing the last decade with more preceding decade.

(2) Sea Level Rise

Moreover, according to the official release by the Ministry of Environment in Indonesia, the sea level at Jakarta Bay is increasing at a rate of 7 mm per year. As a result, it is predicted that the rising sea level will force existing tide gates in low land areas to be permanently closed, then rendering them dysfunctional.

III.1.4 Groundwater Pumping and Land Subsidence in JABODETABEK

The Ciliwung-Cisadane river basin is experiencing extensive land subsidence with the development of JABODETABEK area in downstream areas (the northern metropolitan areas of Jakarta). The main factors behind this phenomenon are supposedly excessive pumping of groundwater in urbanized areas and decrease of the groundwater recharge volume owing to the residential development of the southern part of the metropolitan area. According to observations since 1978, maximum 177 centimeters of subsidence has already proved. The subsiding area expands to approximately 20 km inland from the coast, and judging from the trend of yearly changes, the subsidence doesn’t appear to be ceasing.

Under these circumstances, Pluit in the north of the metropolitan area was experienced dike break and inundation by high tide in May 2008. The dike originally designed with height of +2.1 meters, however, it had been lowering to +1.35–+1.55 meters as a result of land subsidence. Accordingly, due to the combination of extensively progressing land subsidence and rising sea level caused by climate change, flood prone areas in the lower reaches of the Ciliwung River are expanding and the damages caused by high tide and inundation have become more critical.

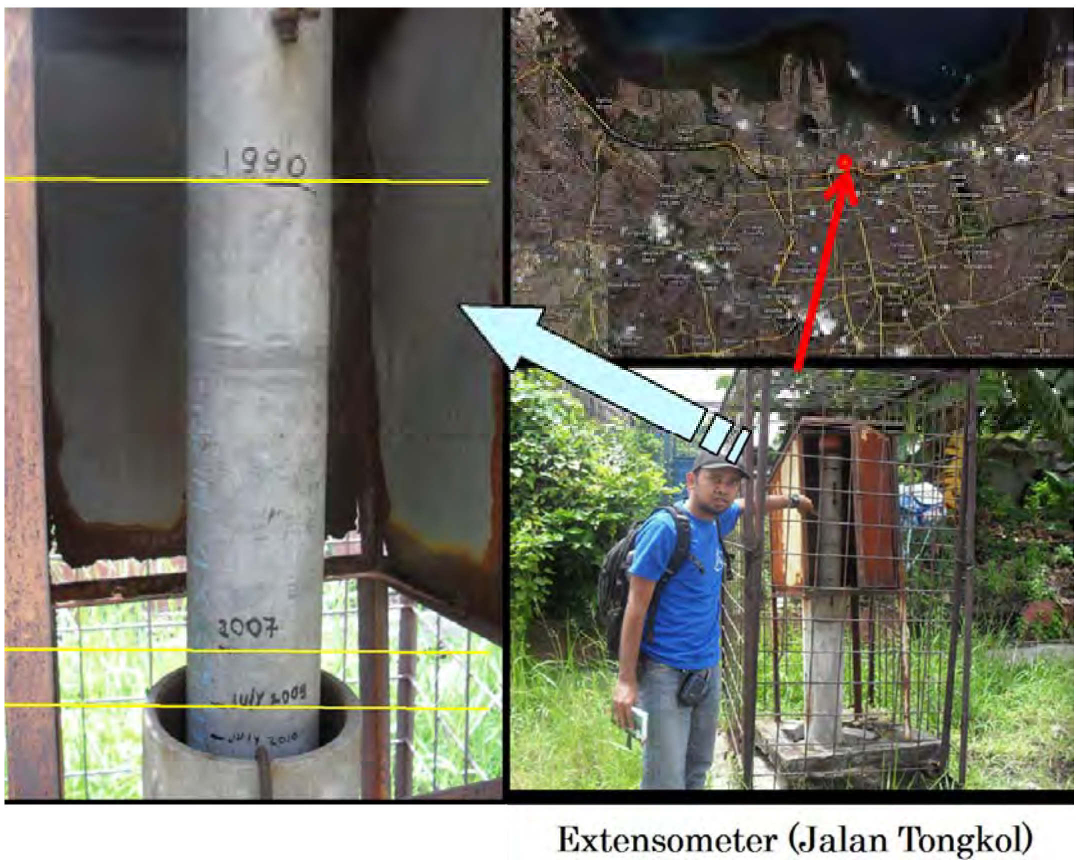


Figure- III.1.4 Condition of Land Subsidence in JABODETABEK

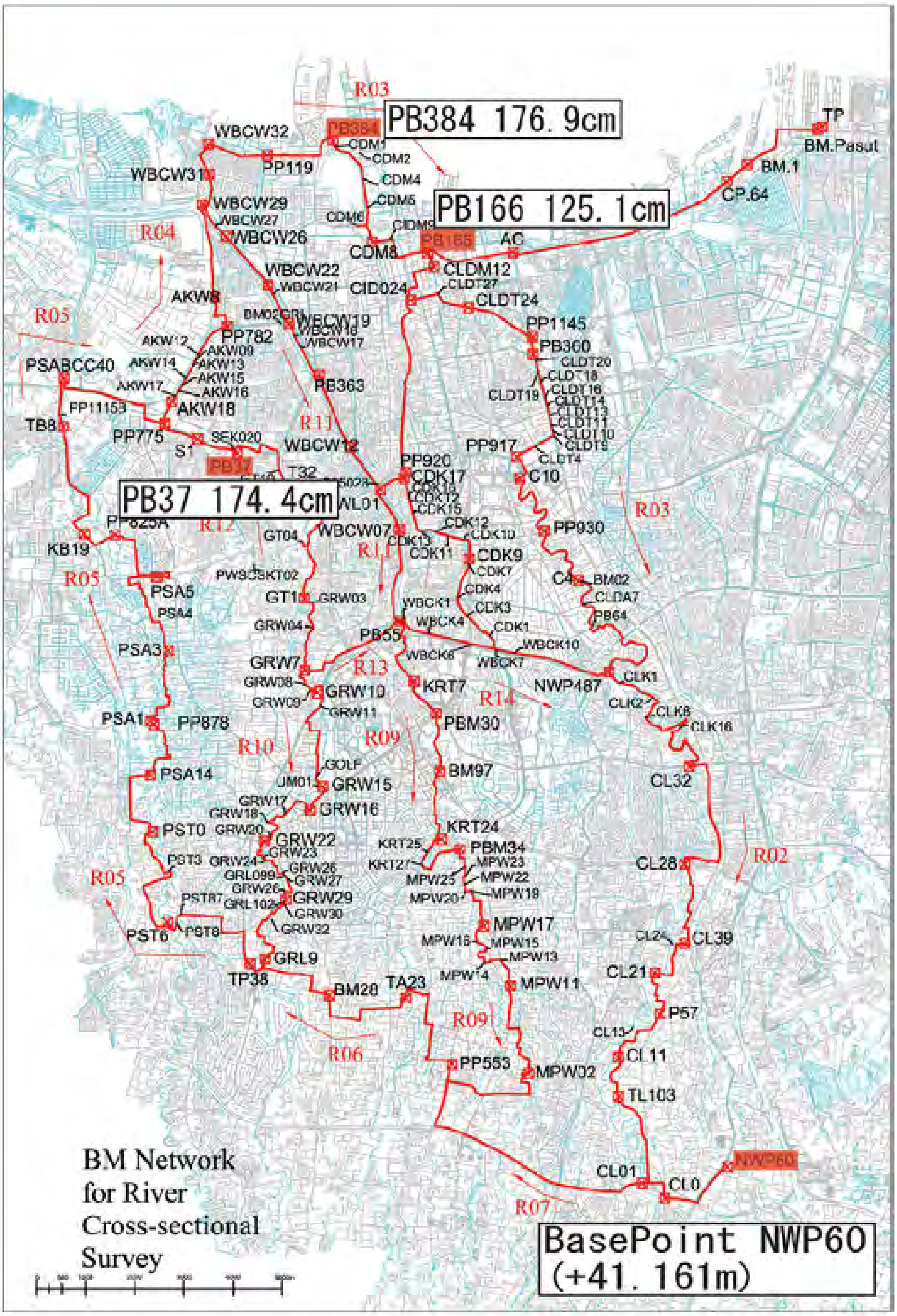
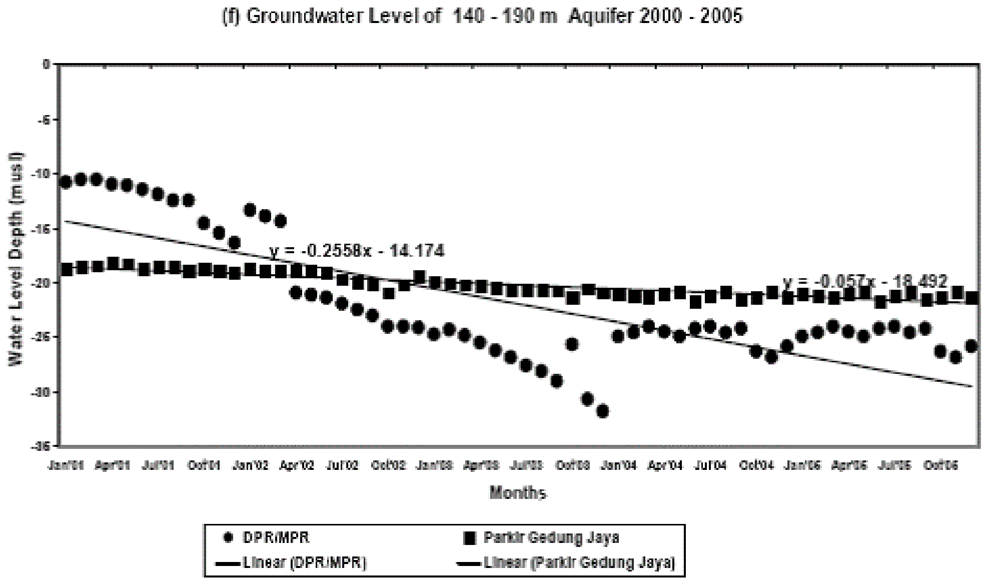


Figure- III.1.5 Land Subsidence in Jakarta

In JABODETABEK, since water demand is remarkably increasing along with population growth and development of industrial sectors, groundwater has been excessively pumped out in the whole coastal area where quality groundwater can be obtained. Meanwhile, penetration rate of tap water is only around 50%. Residents without water supply are depending on water from primitive wells or water sellers. So demand for water of both shallow and deep wells remains high, and interfusion of seawater occurs due to lowering of hydraulic head between seawater and groundwater. Excessive groundwater drawing results in the progress of ground consolidation and land subsidence.

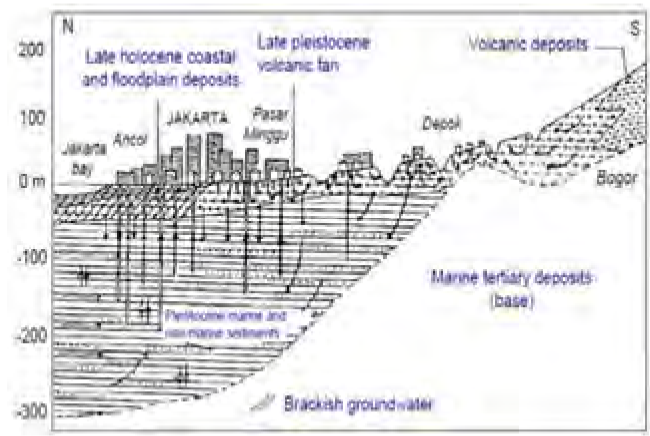
According to the results of observation, groundwater level in JABODETABEK is generally included in 6 aquifers: ①0–20m, ②20–40m, ③40–95m, ④95–140m, ⑤140–190m, ⑥190–250m. However, drawdown is occurred in all aquifers. ① belongs to alluvium and ②–⑥ belong to diluvium.

Figure- 3.1.6 shows changes in water level of 140–190m aquifer observed from 2000 to 2005. Judging from current situation of groundwater usage and coverage of water supply, drawing groundwater from alluvium and diluvium will be keeping on and extensive land subsidence caused by consolidation settlement is considered to be advanced.



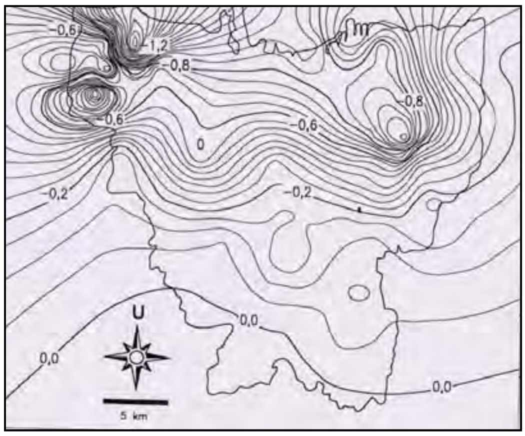
Source: Research Centre for Geotechnology, Indonesian Institute of Sciences (LIPI)

Figure- III.1.6 Changes in Water Level of 140–190m Aquifer (2000–2005)



Source: Hasanuddin Z. Abidin, 2001

Schematic Hydro-Geological Cross Section of Jakarta

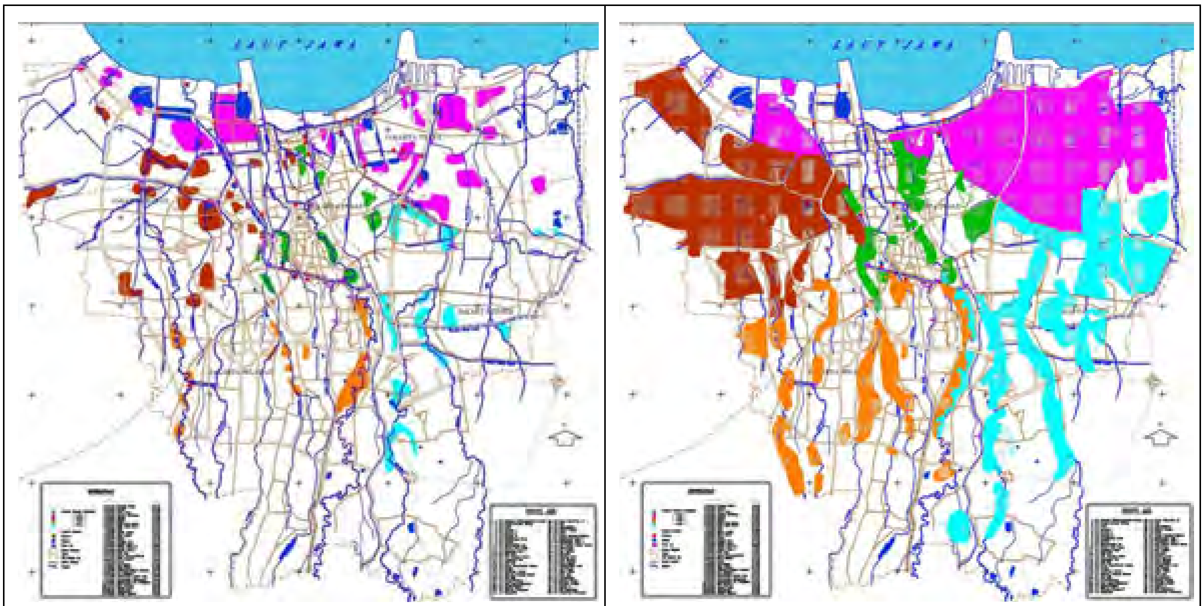


Ground Subsidence Level
(by Leveling, 1982–1997)

Figure- III.1.7 Land Subsidence in JABODETABEC

III.1.5 Flood and Inundation Status

In addition to 78 habitual flood prone areas in DKI Jakarta, flood risk maps were also developed in other areas. In 2002, from January to February, the JABODETABEK suffered from tremendous inundation damage not only by inland water but by river water. After the flood, JICA Study "Urgent Inventory Study on Damage of Flood in JABODETABEK, 2002" was intensively conducted to identify the flood damage and causes of flooding. According to the report, inundation area was 526 km^2, accounting for 8.6% of the total area of JABODETABEK, and disaster areas with flooding depth exceeding 0.5m for more than 1 week were 53 km^2. Total damage costs reached to 7.3 trillion rupiah.



Flood in Feb. 2002 | **Flood in Feb. 2007**

Figure- III.1.8 Inundated Areas in JABODETABEK

III.2 Social Environment

III.2.1 Demography

Regarding the population, Jakarta is the most populated city in Indonesia and likely continues to increase over time. According to population census data 1990, population of Jakarta has about 8.3 million people, within two decades the population reached the figure of 9.59 million in 2010. The average rate of Jakarta's population growth was about 2.42 percent in period 1980-1990, and in the 1990-2000 decreased to 0.14 percent. Decreasing of population growth rate was the impact of government policy in family control programs, as well as the development of growth centers in Jakarta buffer zones (BPS, 2010). However, in the following decade, 2000-2010, the rate increased to 1.40. The population rate was not evenly spread within regions; Kepulauan Seribu has the highest rate in over two decades. Meanwhile, Central Jakarta has the lowest rate; it had even experienced negative population growth during 1990-2000 (see Table- III.2.1 below).

As for the sex ratio, Jakarta's population is still dominated by man; according to the result of population census 1990, 2000 and 2010, the sex ratio was respectively 102, 102, and 103. This condition occurs in almost all regions except in West Jakarta which has about 100 in 1990 and 2010; it means there was an equal number between man and woman. Meanwhile sex ratio in 2000 was about 99, means the number of woman was greater one percent than man.

Table- III.2.1 Number of Population, Population Growth Rate, and Sex Ratio by Kabupaten / Kotamadya, 1990-2000

Kotamadya/ Kabupaten	Population			PGR* 1990-2000 (%)	PGR* 2000-2010 (%)	Sex Ratio		
	1990	2000	2010			1990	2000	2010
Kepulauan Seribu	14,826	17,245	21,071	1.52	2.02	112	104	103
South Jakarta	1,905,283	1,784,044	2,057,080	-0.66	1.43	103	104	102
East Jakarta	2,064,499	2,347,917	2,687,027	1.29	1.36	104	104	104
Central Jakarta	1,074,997	874,595	898,883	-2.04	0.27	101	102	102
West Jakarta	1,820,019	1,904,191	2,278,825	0.45	1.81	101	102	104
North Jakarta	1,348,122	1,419,091	1,645,312	0.51	1.49	100	99	100
DKI Jakarta	8,227,746	8,347,083	9,588,198	0.14	1.40	102	102	103

PGR=Population Growth Rate
Source: Data Strategis DKI Jakarta, 2010

Based on population distribution within region, Kepulauan Seribu has the least number of inhabitants and East Jakarta has the most in over 20 years. In line with the population growth, the population density also grew steadily. It was 12,422 person/km^2 in 1990 and increased to 14,476 person/km^2 in 2010. Comparing within region in mainland Jakarta, Central Jakarta has the least number of population, but the area only covered 48.13 km^2, then this region has the highest of population density. In 1990, 2000, and 2010, the population density was about 22,335, 18,172, and 18,676 respectively (see Table- III.2.2). Besides, there were land use conversion from residential to office buildings and central business development.

Table- III.2.2 Population Density of DKI Jakarta by Kabupaten/Kotamadya, 1990-2010

Kotamadya/Kabupaten	Area (Km^2)	Density		
		1990	2000	2010
Kepulauan Seribu	8.7	1,704	1,982	2,422
South Jakarta	141.27	13,487	12,629	14,561
East Jakarta	188.03	10,980	12,487	14,290
Central Jakarta	48.13	22,335	18,172	18,676
West Jakarta	146.66	12,410	12,984	15,538
North Jakarta	129.54	10,407	10,955	12,701
DKI Jakarta	662.33	12,422	12,603	14,476

Source: Jakarta dalam Angka, 2010

The declining of population growth rate resulted in the changes of population age structure that is characterized by a decrease proportion of population aged group 0-14 years and under accompanied by an increase in the productive age group (15-64 years) and elderly (65+). Figure 3.2-1 below shows the Jakarta population pyramid based on the result of Population Census 2010[1]that the number of young age group has begun to diminish, in contrast to the productive age group (15-64 years) become widen, particularly in 25-29 age group. The proportion of young age group (0-14) by 24 percent, while the elderly group (65+) only reached 3.1 percent. A population referred to young population structure if the proportion of young age group by 40 percent or more, while old population structure if the proportion of elderly people (65+)is more than 10 percent.

As for the composition of population by age group and sex, it seems that they are not much different except in the age group 15-19 years where the number of women is larger than men: 9.05 percent for women and 7.96 percent for men. By this age grouping, we can count dependency ratio defined as the ratio of young people (under 15 years old) plus elderly person (65 years and older) to the population of productive age group (15-64 year). The dependency ratio indicates the ratio of economically inactive compared to economically active. Dependency ratio of Jakarta in 2010 has about 37 percent, derived from young age group (33 percent) and elderly group (4 percent). This means that every 100 productive people have dependents by 37 non-productive people.

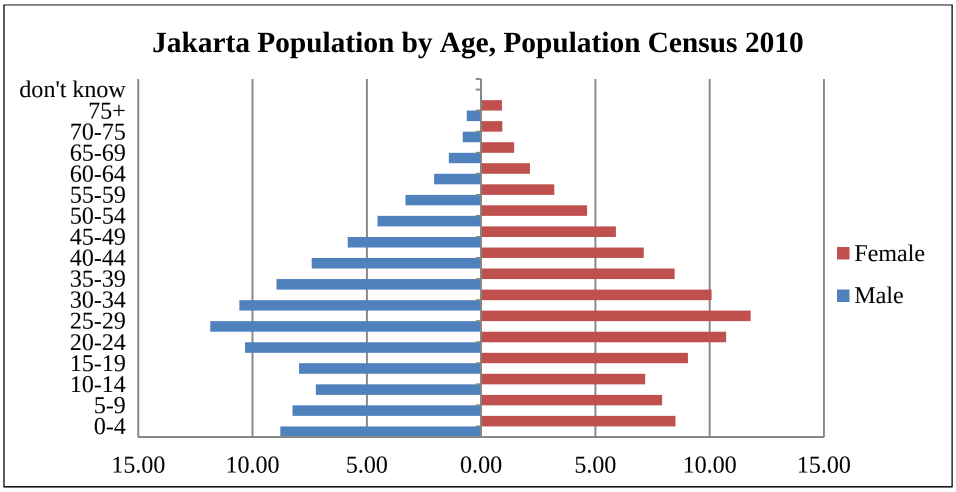


Figure- III.2.1 Population Pyramid 2010

The changes of age structure and dependency ratio should be accompanied by providing employment opportunities for the productive age group, and the provision of services and social security for non-productive people.

III.2.2 Poverty

Poverty is a situation where there is an inability to meet basic needs such as food, clothing, shelter, education, and health. Poverty can be caused by the scarcity of means of fulfilling basic needs, besides the difficulty of access to education, health and employment. Therefore, fulfillment to those basic needs is closely associated with the availability of basic infrastructure such as road, education facility, health facility, etc. Providing those basic infrastructures is decisive in reducing poverty.

Accesses to the education for example, people who have a good education have a lower chance of being poor, because the chance of getting a decent job is greater. Table A.3 and Table A.4 in Appendix show the distribution of social infrastructure related to the health and education facilities within regions in DKI Jakarta.

[1]http://www.bps.go.id/download_file/Data_SP2010_menurut_kelompok_umur.pdf

In determining the number of poor people, BPS DKI Jakarta refers to the 14 criteria and poverty line; size of house, main floor material, main wall material, sanitation facility, source of drinking water, main source of fuel for cooking, main source of lighting, consumption of meat/chicken/milk in a week, frequency of eating in a day, buying new cloths for each household member in a year, ability to pay medical expenses, the highest education attained by household head, the highest education attained by household member, ownership of assets/savings. Whereas, BPS DKI Jakarta also applies poverty line that is different among regions. The poor is defined as those whose expenditure per capita per month is below the poverty line.

The trend of the poverty level in Jakarta during 2000-2006 shows a fluctuating pattern. In 2000 was the culmination of a prolonged crisis that began in 1998, this condition raised the number of poor people from 2.48 percent in 1996 to 4.96 percent. The impact of various interventions by the government decreased population of the poor, in 2001 decreased to 3.61 percent, and relatively stable during 2002-2005. However, in 2006 the poor increased to 4.57 percent as the impact of rising of fuel price (BPS, 2010).

In addition, the poverty trend within 2007-2009 periods can be seen in Table- III.2.3. By using relative standard of poverty, Kepulauan Seribu that is located separately from mainland Jakarta, has the highest percentage of poor people, many dwellers live in poverty. And the second largest is North Jakarta, even figure of poverty in these two regions decreased but still above at provincial rate. On the contrary, remaining regions experienced to increase.

Table- III.2.3 Distribution and Percentage of Poor People and Poverty Line in DKI Jakarta by Kabupaten/Kotamadya, 2007-2009

Kabupaten/ Kotamadya	Number of Poor (000)			% of Poor People			Poverty Line*)		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
Kepulauan Seribu	3.4	2.6	2.4	14.64	13.56	12.66	270,071	314,358	345,933
South Jakarta	64.0	71.1	73.7	3.36	3.41	3.52	263,740	334,173	372,659
East Jakarta	71.2	79.8	81.2	2.85	3.39	3.42	220,855	303,390	305,674
Central Jakarta	28.5	31.0	32.1	3.17	3.58	3.68	209,929	262,251	322,184
North Jakarta	91.7	85.2	76.2	6.48	6.02	5.34	211,074	275,759	300,134
West Jakarta	57.4	72.9	74.0	2.84	3.41	3.44	212,490	292,656	296,947
DKI Jakarta	316.2	342.5	339.6	3.61	3.86	3.80	237,735	298,237	320,333

Source: Statistik Daerah Kota Jakarta Utara, 2010
*) Rupiah/Capita/Month

Beyond the standard in determining of poor people, there is other criterion used by the technical department in reducing poverty spatially, i.e. the level of slum area. And the slum is one of the characteristics of urban poverty, which is the poor usually live in undeveloped and risky areas, such as river banks and coastlines. A criterion of the slum has been described in Chapter 2. Table- III.2.4 shows the number of slum RW by Kabupaten / Kotamadya, whereas a number of poor people are concentrated in Kepulauan Seribu and North Jakarta, the distribution of slum RW is also clustered in these regions which have percentage of 29.2 and 22.7 respectively.

Table- III.2.4 Distribution of Slum RW by Type of Slum and Kabupaten/Kotamadya, 2008

Kabupaten/ Kotamadya	Total RW	Number of Slum RW					% Slum RW
		Very Slightly	Slightly	Continuously	Heavily	Total	
Kepulauan Seribu	24	1	1	5	0	7	29.2
Jakarta Selatan	576	24	13	32	0	69	12.0
Jakarta Timur	700	10	15	50	2	77	11.0
Jakarta Pusat	393	15	9	41	4	69	17.6
Jakarta Utara	432	26	19	47	6	98	22.7
Jakarta Barat	582	19	18	48	10	95	16.3
DKI Jakarta	2707	95	75	223	22	415	15.3

Source: Housing Department of DKI Jakarta, 2008; www.kependudukancapil.go.id

In an effort to reduce poverty, the government issued several assistance programs for the poor and near-poor (BPS, 2008) that are:

1. Package I: Assistance and Social Protection. The goal for the protection and compliance of the right to education, health, food, sanitation and clean water through program respectively BOS (school operational assistance), Jamkesmas (health insurance for poor), RASKIN (Rice for Poor), and PKH (hope Family Program).
2. Program II: Community Empowerment through PNPM Mandiri gives protection and fulfillment for the right to participate and employment.
3. Assistance Package III: Empowering micro and small enterprises (MSEs-KUR) aimed at the protection and fulfillment for the right to have opportunities.

III.2.3 Migration

There are three factors which directly affect population growth in certain area: fertility, mortality, and migration. Migration is defined as the movement of people across a specified boundary for the purpose of establishing a new or semi-permanent residence. Fertility and in-migration is a factor that causes population growth. In terms of migration, there are two factors that caused the migration known as push factor and pull factor. The push factor is such as limited job opportunities in the origin, while pull factor is such as rapid development in the destination area.

Jakarta is the center of government, business, education, and culture; these matters have been pull factor for the migrant into Jakarta. Based on the result of Jabotabek Migration Survey, the main reason of migration to Jakarta was looking for work (32.90 percent), and the kinship factor related to one's husband/wife/parents as much as 27.15 percent (BPS, 2001). Meanwhile, the results of research conducted by Khatijah (2008) stated that migration performed by migrant from Klaten (Central Java) to Jakarta mainly because of push factor that are limited ownership of agricultural land, slow economic growth and high rate of unemployment.

Table- III.2.5 depicts the trend of lifetime migration and recent migration in DKI Jakarta. Lifetime migrant means such a person that the provincial or regency/municipality where he/she was born is different from the provincial or regency/municipality where he/she lives now (at the time of enumeration). Meanwhile, recent migrant is those whose province of residence five years ago is different from current residential province (at the time of enumeration). Life time migration during the period 1971-2005 showed positive figures, meanwhile for recent migration shows a negative number during the last two decades. Contrary to statistical figures that the recent migration tends to decrease, the absolute number is still considerably high as reported by Government of DKI Jakarta that urbanization reached 138.000 persons per year[2].

Table- III.2.5 Life Time and Recent Migration DKI Jakarta 1971-2005

	1971	1980	1985	1990	1995	2000	2005
Life Time Migration							
In-migration	1,821,833	2,599,367	3,079,693	3,170,215	3,371,384	3,541,972	3,337,161
Out-migration	132,215	400,767	593,936	1,052,234	1,589,285	1,836,664	2,045,630
Net-migration	1,689,618	2,198,600	2,485,757	2,117,981	1,782,099	1,705,308	1,291,531
Recent Migration							
In-migration	-	766,363	684,001	833,029	594,542	702,202	575,173
Out-migration	-	382,326	398,737	993,377	823,045	850,343	734,584
Net-migration	-	383,037	285,264	-160,348	-228,503	-148,141	-159,411

Source: Statistics Indonesia, http://www.bps.go.id/tab_sub/view.php?tabel=1&daftar=1&id_subyek=12&notab=8Intercensal

The development of growth centers in Jakarta buffer zones and also other big cities outside Jakarta such as Bandung, Surabaya, Medan, and Semarang, causes in the declining of recent migration to

[2] http://www.beritajakarta.com/2008/id/berita_detail.asp?nNewsId=38786

Jakarta. In addition, residential development in the BODETABEK (Bogor-Depok-Tangerang-Bekasi) offers comfortable living environment as a pull factor for the Jakarta dwellers to move out. However, most of them are still performing their activity in Jakarta, as a commuter. Provincial Government of DKI Jakarta stated that nearly 2.7 million people travel to Jakarta, especially for work. Jakarta residents based on the population survey 2010 have about 9.6 million, but in the daytime population could reach to 12 million.

Associated with commuter, based on the results of Intercensal Population Survey (SUPAS) 2005, there were about 1.1 million commuters in Jakarta whose main objective is to work (886,154), then schooling (208,188), courses (2,056), and others (3,075), and the majority of commuters are in the productive age group (see Table- III.2.6).

Table- III.2.6 Population 5 Years of Age and Over Who Had Commuting Activity by Age group and Type of Main Activity

Age Group	Main Activity				Total
	Working	Schooling	Courses	Others	
5-9	-	35,632	150	167	35,949
10-14	10,425	49,604	-	-	60,029
15-19	37,871	59,012	1,165	-	98,048
20-24	146,182	49,859	268	327	196,636
25-29	168,385	10,677	473	875	180,410
30-34	148,546	1,208	-	229	149,983
35-39	136,606	1,618	-	447	138,671
40-44	88,358	-	-	241	88,599
45-49	61,151	578	-	318	62,047
50-54	54,978	-	-	86	55,064
55-59	23,452	-	-	385	23,837
60-64	5,227	-	-	-	5,227
65-69	3,488	-	-	-	3,488
70-74	1,012	-	-	-	1,012
75+	473	-	-	-	473
Total	886,154	208,188	2,056	3,075	1,099,473

Source: Intercensal Population Survey (SUPAS) 2005

III.3 Jakarta City Planning

III.3.1 Spatial Planning DKI Jakarta Province

Flood control infrastructure is being ultimate concern of the Government of DKI Jakarta Province; it is clearly detailed in the objectives, strategies and policies in the spatial plan (RTRW) 2030. Objectives and strategy of the government of DKI Jakarta Province in coping flood-related disaster are shown below.

Objectives:
Development of infrastructure and natural disaster risk reduction

↓

Strategy:

1. Develop infrastructure and facilities for flood control with the development of the polder system, recovery and development of lakes and reservoirs, improvement of dam safety, and the development of river and sea dikes;
2. Developing the North Coast region as an effort to anticipate climate change;
3. Improve and enhance the city drainage system;
4. Developing pathways, regions and disaster evacuation chamber;
5. Improving the provision of open space for the anticipated high rainfall intensity; and
6. Creating harmonious living side by side with water.

The spatial plan consists of spatial structure and spatial use plan. Being conducted by participative method, the spatial plan in Jakarta is developed as more comprehensive plan covered by many stakeholder of the city. Forms of participation can be realized through various means such as exhibitions, sectoral discussions, territorial discussions, websites, and mass media. The spatial plan has considered flood control policies and strategies in establishing sustainable urban systems of Jakarta. Therefore, flood control strategy is inseparable from the spatial structure and land use planning which are planned by and for Jakarta's stakeholders.

(1) Spatial Structures of DKI Jakarta

Spatial structure plan is the arrangement of residential centers and network system infrastructures and facilities that serve as supporting social and economic activities in a hierarchical society that has a functional relationship. In the Spatial Structure Plan of 2030, the policy covers as stated below (see Figure A.4 in Appendix):

1) System Economic Center;
   a. Primary Activity Center, and
   b. Secondary Activity Center.

2) Systems and transportation networks;
   a. Land transport systems and networks;
   b. Sea transport systems and networks;
   c. System and air transportation network.

3) System of water resources infrastructure;
   a. Conservation of Water Resources Systems;
   b. Utilization of Water Resources Systems;
   c. Damaged Water Resources Control Systems.

4) Urban Systems and Network Utilities
   a. System and Clean Water Network;
   b. Sanitation Infrastructure;
   c. Drainage Infrastructure;

d. Solid Waste Facility;
e. Systems and Energy Network; and
f. Systems and Networks Telecommunications and Informatics.

(2) Spatial Use Plan

Spatial Use Plan is the distribution of allotment space in a region. The Jakarta Provincial Plan is manifested as the distribution of allotment of space that includes:

a) Allocation of space for protection and/or conservation
b) The allotment of space for the function of cultivation and/or production.

Allotment of space for functions Protected Area is directed to:

a) Increase the function of protection of an area either locally or against an object or the wider region;
b) Maintain and restore the condition of the area or object that must be protected;
c) Protect areas which are prone to be affected by natural disasters.

Allotment of space for aquaculture functions directed to:

a) Optimize existing urban potential in boosting economic growth,
b) Develop social community and achieve sustainable development;
c) Provide a balanced need for space for various community activities; and
d) Accommodate a variety of activities in order to increase the role and function as a city services on an international scale, national and regional levels.

(3) Flood Control Plan

Government of DKI Jakarta Province has put Flood control plan as part of a system of water resources infrastructure plan. The plan consists of 3 (three) main systems: Conservation System of Water Resources, Utilization System of Water Resources, and Controlling System for Destructive Power of Water. In relation to flood events, this section only explains the Controlling System for Destructive Power of Water. The step-by-step strategies set out in RTRW 2030 are as follows:

1) The Infrastructure Development of Controlling System for Destructive Power of Water directed to minimize the environmental problems arising from flooding and inundation;

2) Consideration for current and future condition of land subsidence and negative impact of global warming in the Infrastructure Development of Controlling System for Destructive Power of Water;

3) The Infrastructure Development for Controlling System of Destructive Power of Water is conducted through mitigation and adaptation measures that can reduce the risk of potential disaster;

4) Mitigation measures aimed to prevent flooding and inundation caused by:
   a. Sea water runoff (rob);
   b. Water runoff that carries water from the river downstream, and
   c. Rain fall.

5) The action of adaptation directed to provide additional space for water and create a harmonious living side by side with water;

6) Development of flood control and drainage infrastructure intended to enhance the capacity of the rivers/big canals for 100 year floods, canals/rivers for 25 year floods, and the system of sub-macro (polders) for 25 year floods;

7) Development of flood control infrastructure through:
   a. Construction of infiltration wells and bio pore;
   b. Construction of reservoirs/lakes in the precise area in the Ciliwung watershed and other watersheds to reduce water flow in rivers.
   c. Normalization of the river, channel, reservoir and lakes;

d. Construction and road maintenance for river inspections and increase the collector roads to support the Riverfront Development;
e. Implementation and expansion of the polder system in low areas prone to flooding and inundation
f. Increased community participation in flood control by developing a polder system based on community participation
g. Synchronize the development of new reclamation area in North Jakarta waterworks system
h. Construct sea dike at a depth of -8 m to the west and central regions of reclamation and construction of levees on the east coast to existing
i. Increase flow capacity of the West Flood Canal and Cengkareng Drain and develop Cengkareng Drain II for the region to the west;
j. Increase flow capacity Cakung Drain, Sunter River, and construct the East Flood Canal to central and eastern regions; and
k. Widen and deepen the river estuary in Jakarta Bay

8) Establish and restructure the trace and demarcation line with the arrangement of rivers, channels, reservoirs and lakes according to their function as flood control, drainage, flushing, water resources conservation, and river transportation infrastructure.

9) Increase the ratio of water bodies which include the channels, rivers, flood canals, and reservoirs where are to cover areas accounting for 5% of the total area of Jakarta in the year 2030.

10) Develop legal systems to enforce protection of water body in the form of channels, times, rivers, flood canals, and reservoirs. The use and design cannot be changed.

11) Maintain territory border of rivers and flood canals as green open space for flood control.

III.3.2 Floods and Their Infrastructure

(1) Flood Area at Jakarta

According to data from the Jakarta Public Works Agency, in Jakarta area there are 78 areas prone to inundation based on the flood events in Jakarta in 2002 (see Figure- III.3.1) and 2007 (see Figure-III.3.2). Based on these data, within 5 (five) years there has been expansion of areas prone to inundation in Jakarta.

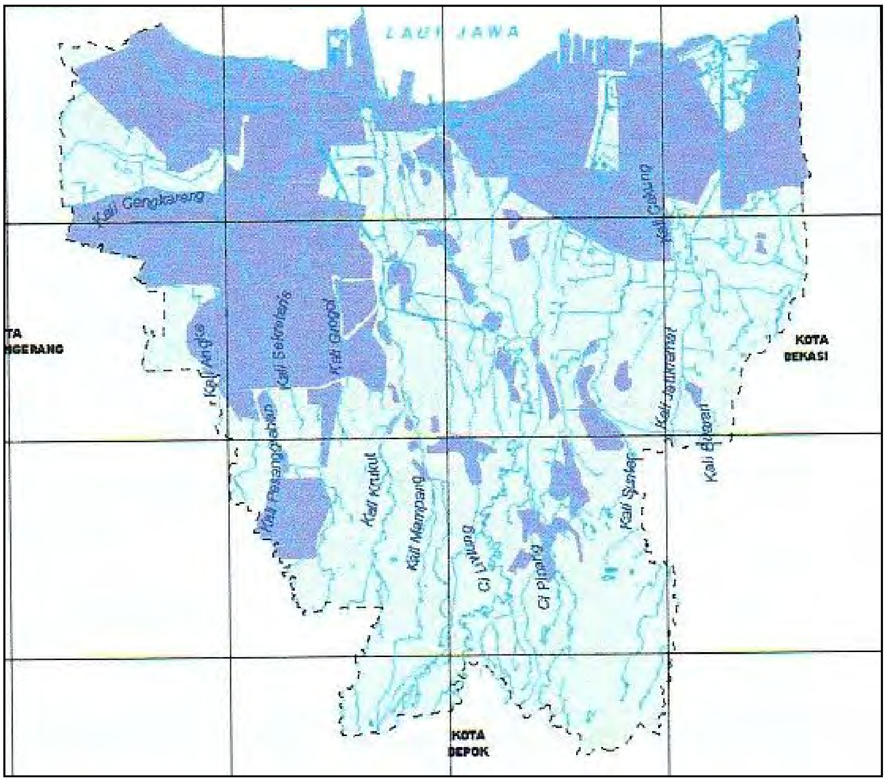


Figure- III.3.1 Inundation Areas in Jakarta 2002

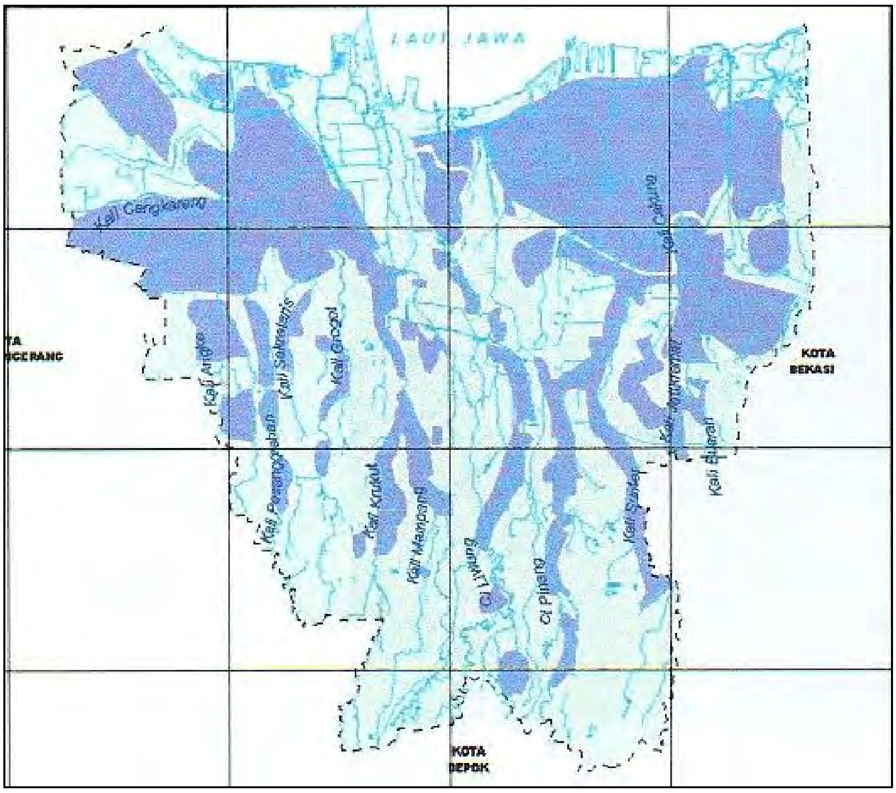


Figure- III.3.2 Inundation Areas in Jakarta 2007

(Source: Esther, 2007)

There is also flooding due to sea level rise. Based on Esther (2007), another impact of climate change is sea level rise (sea-level rise). Rising sea level threatens low flat areas or towns located in the Coast region. Jakarta, located on the coast of Jakarta Bay, is potentially affected by flooding due to the phenomenon of this sea level rise. During 2007, floods which were caused by sea water (flooding rob) resulted in submerging thousands of homes, and disrupting the activities of people. Susandi (2006) and Lobo (2008) state the trend of sea level rise in Jakarta Bay reaches approximately 5.7 mm per year.

The other cause is the increasing rain fall. One of the most important factors in catastrophic flooding is rainfall. Climate change has resulted in an increase in rainfall about 3-5 percent; the potential for flooding will also increase. In 2010, direct Run-off (DRO) in southern Jakarta is greater than that in the northern region. It is associated with the fact that the intensity of rainfall in southern Jakarta is greater than that in the north.

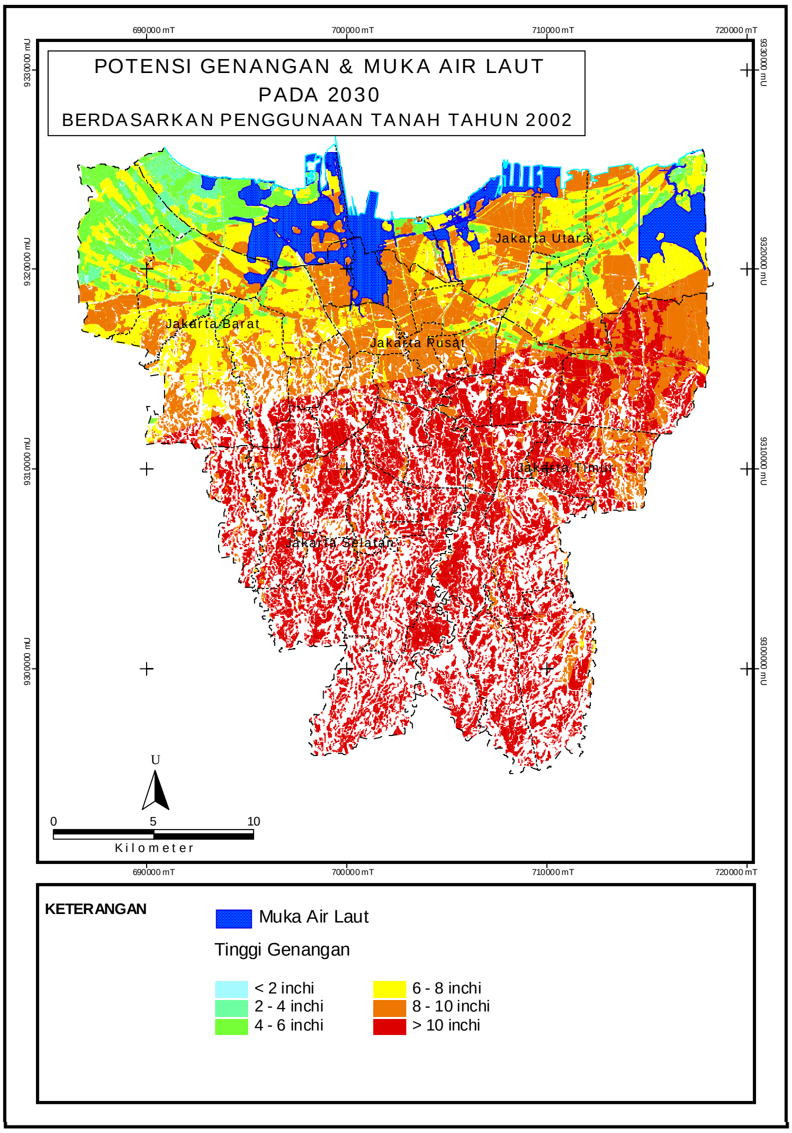


Figure- III.3.3 Projected potential Inundation areas at 2030

(Source: Lobo, 2008)

(2) Control of Floods in DKI Jakarta

According to Esther (2007), the problems of flooding in Jakarta stated in the Spatial Plan of DKI Jakarta are as follows:

1. Flow caused by rainfall in the upstream (Bogor and its surrounding area) will flow to Jakarta via the rivers. Prior to flow through the river in the downtown area Jakarta, diverted into canals so that flood the channel can be directly into the sea.
2. In the southern part of Jakarta with a surface area that is high enough, the water diverted by gravity through the channel, micro-channel (drainage), and macro (river) to the sea.
3. Low area on the north coast where gravity drainage to the sea is not possible, it should be with the polder system reservoirs in advance and then just flow the water through the east and west channel network to the sea.

Based on the condition, The Government of DKI Jakarta Province has made Jakarta flood control schemes principle as shown in Figure- III.3.4 and polder system at Jakarta as shown in Figure- III.3.5.

Source: Esther, 2007

Figure- III.3.4 Jakarta Flood Control Schemes Principle

Source: Esther, 2007

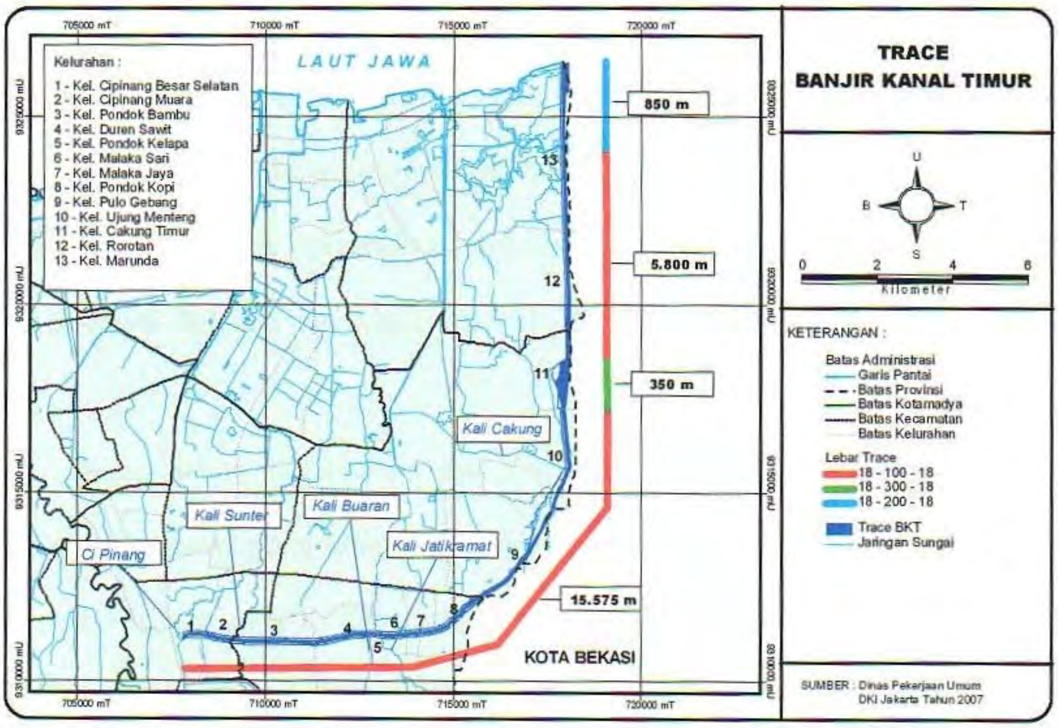
Figure- III.3.5 Polder System at Jakarta

(3) Regional Flood Control Facility in Jakarta

DKI Jakarta has a flood control facilities including 110 units of sluice gates in 39 locations, 16 reservoirs, 216 pumping units which spread in 5 areas of Jakarta. In eastern and northern Jakarta, was built East Flood Canal (BKT). Objectives of the development of BKT are;

1) Supporting the handling of flood control in the north and east of Jakarta, by controlling the flow of the five of the 13 rivers that pass through the area of Jakarta;
2) Reducing the 13 flood inundation area in eastern Jakarta;
Protecting the industrial park, warehouse, and settlements located in East Jakarta and North Jakarta as a water conservation infrastructure to recharge water energy and raw water sources;
3) Developing water transport infrastructure and recreation as an engine of growth of east and north of Jakarta with the concept of water front city.

Trace map of BKT plan can be seen in Figure- III.3.6.



Source: Public Work Department, DKI Jakarta Province; in Esther, 2007

Figure- III.3.6 Trace Map of BKT plan

(4) Floods Infrastructure Development in Jakarta 2030

The flood infrastructure development policies have been described in each municipality as stated in Table- III.3.1.

Table- III.3.1 Flood Infrastructure Development Policies

No	Municipality	Floods Infrastructure Development policy
1	North Jakarta	a. Normalization of the river and times: Cakung Drain, Old Cakung river, Cipinang river, Sunter, Ciliwung river, Jati Kramat river, West Flood Canal, and Baru river; b. Supporting development of East Flood Canal, especially in terms of land acquisition; c. Development and improvement of drainage capacity to address the problem of water inundation, especially in the area of highway Sediyatmo, region Pluit, Kelapa Gading, Tugu Utara, Kebon Bawang, Rawa Badak, and Pademangan; d. The arrangement along the river through the control of illegal buildings in Kamal river, West Flood Canal, Sunter, Cakung river, and Ciliwung river; e. Directed physical development overlooking the river (river front development) f. Construction of a new polder system and restoration of existing polder system (making embankments retaining runoff, procurement of pumps, additional capacities of reservoirs) especially in the polder system III East Sunter, Kelapa Gading, Tanjungan, Yos Sudarso, Muara Angke, Pluit, Sunter Selatan, Sunter East I, Sunter Utara, Teluk Gong, Bimoli, Gaya Motor, and Kapuk Muara; g. Development and recovery Situ Rawa Kendal
2	West Jakarta	a. Referral development of flood control and drainage infrastructure to improve the capability area: West Flood Canal, Cengkareng Drain, and construction of Cengkareng Drain II (sodetan River Angke-Mookervart-sea); b. Development and improvement of channel capacity to address the problem of stagnant water, especially in the area Palmerah, Jelambar, Pekojan, Sentra West Primary Kapuk Muara, Kamal Tegal Alur, Kedaung Angke, Kalideres and Rawa Buaya; c. Supporting development Cengkareng Drain II, especially in terms of land

No	Municipality	Floods Infrastructure Development policy
		acquisition; d. Normalization of rivers and channels: Mookervart river, Angke river, Pesanggrahan river, Sepak river, Jelangkeng river, Bandengan River, River Duri, River Concrete, Castle River, River Citegal Alur, River Maja, once the Secretary, once Krukut, West Flood Canal, Cengkareng Drain, and River Grogol; e. Development and capacity building in the polder and pumping: Pinangsia, Tomang, Bojong, Srengseng, Grogol, macan street, Jelambar Wijaya Kusuma, Rawa Kepa, and Slipi Hankam, Kyai Tapa, Kapok, Pedongkelan Semanan, Pondok Jakarta, Mangga Raya, Kedoya and Cengkareng and at other locations prone to inundation; and f. Control of ground water withdrawal symptoms to avoid land subsidence and the inundation potential
3	South Jakarta	a. Development and improvement of drainage capacity to address the problem of water inundation, especially in the area of Tebet, Mampang, Pondok Pinang, Bintaro, Kalibata, Pasar Jum'at. b. Increased capacity of the reservoir, especially in Ragunan, Mangga Bolong, Jewel, Siguragura, Ulujami, Agriculture Lebak Bulus, Setiabudi, Babakan, UI, Heroes Park. c. Normalization of water flow: Pesanggrahan River, River Grogol, River Krukut, New River, River Mampang, Cideng River, and River Ciliwung, d. Development and recovery capacities in the polder and pumping: Setiabudi West, East Setiabudi, Bintaro, Kebon Baru, Tunnel Manggarai, IKPN Bintaro and Petogogan; e. Construction and development of drainage networks systematically in areas prone to inundation.
4	East Jakarta	a. Recovery capacity of steady flow Ciliwung River, Cakung river, Sunter river, Cipinang river, Buaran river, and Jati Kramat river; b. Recovery and increased channel capacity to address the problem of stagnant water, especially in the area of Kampung Rambutan, Kampung Makassar, Kebon Pala, Dewi Sartika, Otista Raya, Kebon Nanas, Cipinang Jaya, Cipinang Muara, and Pondok Bambu; c. The arrangement along the river through the control of illegal buildings of Ciliwung River, Baru river, Cipinang river, Sunter, and Jati Kramat river; and d. Development and recovery capacities polder and pumping at UPP, Cibubur, Pulomas, Bidara Cina, and tunnels DI Panjaitan.
5	Central Jakarta	a. Normalization of the river/canal, especially Ciliwung river, Sentiong river, Kali Malang, Item River, Kali Mati, West Flood Canal, and Duri river; b. Development and improvement of drainage capacity to address the problem of water inundation, especially in Sawah Besar district, Mangga Besar, and Jati Pinggir; c. The arrangement along the river through the control of illegal buildings in Flood Canal, Duri river and Ciliwung river; d. Directed physical development overlooking the river (river front development) e. Increasing the capacity of rivers, canals, conduits, and channels through dredging environment; f. Development and recovery capacities in the Cideng polder, Istana Merdeka, Item river, reservoirs, Motel, Industrial, Jatipinggir, Kartini, Manggadua Abdad, Rajawali, Sumur Batu, and Duku Atas g. Development and situ-situ recovery of Taman Ria Senayan and Situ Lembang; h. Control of disposal of waste into the rivers and canals by involving community participation; i. Construction of a channel/tunnel water (sewage) and ducting systems in a large scale.

CHAPTER IV KEY FINDINGS

This chapter will describe some key findings about the environmental and social conditions of survey sites, perception of the urban poor community in the survey sites about their vulnerability and adaptation mechanism to flood events.

IV.1 Survey Sites

Our survey areas belong to the neighborhood scale which is called *Rukun Tetangga* (RT), the smallest neighborhood unit in Jakarta. We selected 15 RTs based on the condition of Kelurahans affected by floods and dominated by poor households in DKI Jakarta province as described in Chapter II above. They spread diversely in entire Jakarta but are mostly located in north Jakarta. Figure- IV.1.1 shows the location of survey sites.

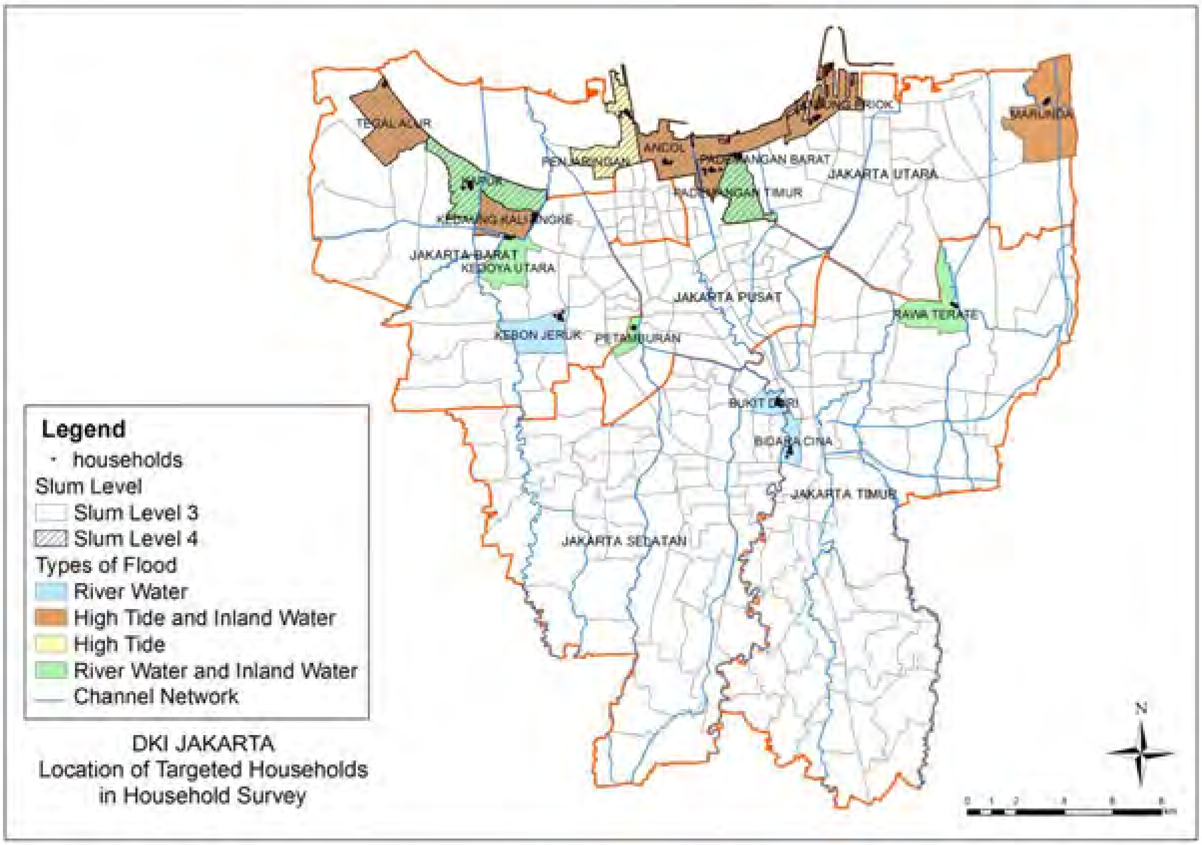


Figure- IV.1.1 Location of Survey Sites

IV.1.1 Kelurahan Kebon Jeruk (RT 12)

Brief profile of Kebon Jeruk located in West Jakarta is shown in Table- IV.1.1.

Table- IV.1.1 Brief Profile of Kelurahan Kebon Jeruk

Kelurahan	Area (km^2)	Population	Household	Number of RW	Number of RT
Kebon Jeruk	369.15	52,295	8,838	11	131

This area is often inundated, but it is just temporary. Usually, the inundation is caused by heavy rainfall or a river overflow. According to the respondents in this Kelurahan, areas which experienced inundation were RT 04 and RT 02. Inundation that occurred in RT 04 was only momentary inundation. It was caused by the small trench on the side of Jalan Arjuna which could not have enough capacity to accommodate rainfall water. Time duration of inundation is around 1 hour on average. RT 02, in which most of houses are categorized as slums, also has quite frequent experiences of inundation because of their location in the river banks of Kali Sekretaris.

When it has heavy rain and river overflowing, highway safety wall of Tomang-Kebon Jeruk embanks water to the other side of the highway and inundate South Arjuna Road. The Inundation often hit not only RW 04 but also RW 12 because their location is under the highway and the parent tract of Kebon Jeruk territory was disconnected. Inundation water level in this area usually reaches about 0.5 meter.

IV.1.2 Kelurahan Bidara Cina (RT 12, 13, and 14)

Brief profile of Bidara Cina located in East Jakarta is shown in Table- IV.1.2.

Table- IV.1.2 Brief Profile of Kelurahan Bidara Cina

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Bidara Cina	126	32,281	16,150	16	189

Kelurahan Bidara Cina directly abut to the riverside, so many settlements are located on the river bank. Heavy rainfall in the rainy season, the shallowness of the river due to waste, and lack of water infiltration are the factors that trigger the occurrence of catastrophic floods in this region (PMI, 2005). Last year, Bidara Cina was still experiencing inundations, especially in the Ciliwung River bank. Inundation usually comes from flooding posts from upstream and poor local drainage. According to Banpol PP and Tramtib officers, flood prone areas in this Kelurahan is RW 3, 5, 6, 7, 11, and 14. The most severely affected by inundation is RW 05 and 07. The height of inundation could reach an adult's chest (1.5 meters) and the duration of flood is usually just a day and/or night at low tide.

IV.1.3 Kelurahan Kapuk (RT 11, 12, and 13)

Brief profile of Kapuk located in West Jakarta is shown in Table- IV.1.3.

Table- IV.1.3 Brief Profile of Kelurahan Kapuk

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Kapuk	562.68	92,099	22,688	16	222

Kelurahan Kapuk is part of the northern coastal area of Jakarta which experienced significant land subsidence for about 0.87 cm/year. Kampung Apung is one of the areas in Kapuk which has the evidence of land subsidence. A pool of water used to cut off traffic to Soekarno Hatta Airport, which shows that the Jakarta area is slowly sinking. This declining process was caused by a variety of impacts which reduced water catchment areas, unstable soil conditions, and the exploitation of ground water.

Under these circumstances, Kelurahan Kapuk is a flood-prone area. Inundation often occurs because of heavy rain, poor drainage, and flooding river. Based on the information gathered from interview with staff in Kelurahan Kapuk, all of RW in this Kelurahan are often hit by inundation in which water level is ranging from 0.2 to 0.5 meter.

IV.1.4 Kelurahan Kedoya Utara (RT 13, 14, and 15)

Brief profile of Kedoya Utara located in West Jakarta is shown in Table- IV.1.4.

Table- IV.1.4 Brief Profile of Kelurahan Kedoya Utara

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Kedoya Utara	314.78	40,535	19,152	11	131

In this Kelurahan, especially RW 01, 02 and 08 are flood prone areas. Poor and stagnant drainage channels cause the flood. The water level sometimes reaches 1 meter.

IV.1.5 Kelurahan Penjaringan (RT 07 and 15)

Brief profile of Penjaringan located in North Jakarta is shown in Table- IV.1.5.

Table- IV.1.5 Brief Profile of Kelurahan Penjaringan

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Penjaringan	395.43	82,564	16,528	17	165

The position of Kelurahan Penjaringan is lower than sea level (approximately one meter below sea level) and crossed by three rivers (Ciliwung, Angke and Kali Krukut) that flow into the sea. These conditions have caused some RW settlements in some beaches around, including RW 01, 02, 03 and 17, flooding in the rain or high tide season. Inundation caused by high tide is now happening all the time due to levee breaches.

Based on data from the Office of Housing Government of DKI Jakarta in 2009, RW 12 is categorized by heavily slummed area. There are 45 poor households in 5 RTs are being flood prone area. Some of them are generally immigrants. Although most people have decades of living in this area, most of them still occupy a rented house or build a temporary house on land along the river. Their livelihood is dependent on odd jobs or jobs in the informal sector.

IV.1.6 Kelurahan Petamburan (RT 16)

Brief profile of Petamburan located in Central Jakarta is shown in Table- IV.1.6.

Table- IV.1.6 Brief Profile of Kelurahan Petamburan

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Petamburan	90	26,428	12,904	11	119

Kelurahan Petamburan is traversed by the West Flood Canal as well as railroads Serpong - Jakarta, between stations Palmerah and Tanah Abang. In general, this Kelurahan is a fairly dense neighborhood called *kampung* bordering the Flood Canal. Based on data from the Office of Housing Government of DKI Jakarta in 2009, RW 03 is categorized as heavily slummed area.

RW 03 is located in a river basin where all the streams in Petamburan lead to. Therefore, type of inundation was the seasonal flooding due to heavy rainfall from October to February. The level of water can reach 2 meters; it is still complained that the water level sometimes exceeds the height of Flood Canal levee due to water flow from upstream.

IV.1.7 Kelurahan Bukit Duri (RT 10, 11, and 12)

Brief profile of Bukit Duri located in South Jakarta is shown in Table- IV.1.7.

Table- IV.1.7 Brief Profile of Kelurahan Bukit Duri

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Bukit Duri	107	42 337	20,868	12	152

Based on the height from sea level, Kelurahan Bukit Duri area is divided into two; namely the high land area that lies along the road Bukit Duri Grade, and low land area on which mainly RW 10, 12, 14 are located and lie along the Ciliwung river banks.

In the rainy season, Kelurahan Bukit Duri area always submerges in floods caused by an overflow from Ciliwung River, especially in the lower mainland. Besides located in inundation-prone areas, the low-lying areas in Bukit Duri are also a densely populated area formed by narrow alleyways and dominated by small and thick houses with poor sanitation.

IV.1.8 Kelurahan Ancol (RT 01, 03, 09, 10, 11, and 12)

Brief profile of Ancol located in North Jakarta is shown in Table- IV.1.8.

Table- IV.1.8 Brief Profile of Kelurahan Ancol

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Ancol	377.28	17,387	5,249	7	64

Our survey site is RW 02 which covers 3 poor households in RT 09, 5 households in RT 10, 2 households in RT 11, 4 households in RT 12, 4 households in RT 01, and 2 households in RT 03. RW 02 is located in coastal areas impacted by high tidal flood (rob flood) due to the arrival of the rainy season instead. This RW has also been impacted by land subsidence which occurs continually.

IV.1.9 Kelurahan Kedaung Kali Angke (RT 01, 03, and 04)

Brief profile of Kedaung Kali Angke located in West Jakarta is shown in Table- IV.1.9.

Table- IV.1.9 Brief Profile of Kelurahan Kedaung Kali Angke

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Kedaung Kali Angke	281.35	26,816	7,021	8	81

Our survey area is RW 01 which covers 8 poor households in RT 01, 8 households in RT 03, and 4 households in RT 04. This area is also prone to flood because of the location in the coastal area and local poor drainage.

IV.1.10 Kelurahan Marunda (RT 02 and 03)

Brief profile of Marunda located in North Jakarta is shown in Table- IV.1.10.

Table- IV.1.10 Brief Profile of Kelurahan Marunda

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Marunda	791.69	18,084	5,320	9	80

Kelurahan Marunda is a coastal area in which tidal flood occurs frequently. The maximum height of water level in the event of tidal flooding caused by high tide is 1.1 meters.

Specifically, inundation prone areas are RW 01, 02 and 07.

IV.1.11 Kelurahan Pademangan Barat (RT 01, 14, and 15)

Brief profile of Pademangan Barat located in North Jakarta is shown in Table- IV.1.11.

Table- IV.1.11 Brief Profile of Kelurahan Pademangan Barat

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Pademangan Barat	353.35	61,507	20,758	16	211

Our survey area is RW 07 which covers 5 poor households in RT 01, 8 households in RT 14, and 7 households in RT 15. This Kelurahan is very dense and even shabby because the location is very strategic next to the commercial trade center where people in the Kelurahan come to find a job. Nearly 70% of the population is urban migrants, and Kelurahan Pademangan Barat is one of the typical slum areas in Jakarta.

IV.1.12 Kelurahan Pademangan Timur (RT 06, 09, 10, and 15)

Brief profile of Pademangan Timur located in North Jakarta is shown in Table- IV.1.12.

Table- IV.1.12 Brief Profile of Kelurahan Pademangan Timur

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Pademangan Timur	261.24	40,474	11,907	10	145

Our survey area is RW 10 which covers 7 poor households in RT 06, 9 households in RT 09, 2 households in RT 10, and 2 households in RT 15. In general, Kelurahan Pademangan Timur is lowland area. Floods caused by local rainfall are frequent in this Kelurahan. In addition, the condition of drainage filled with garbage and mud also causes the flood in RW 05 and 07. Most of incidents are accompanied by a little rain, and the water level reaches up to 0.5 meters.

IV.1.13 Kelurahan Rawa Terate

Brief profile of Pademangan Timur located in East Jakarta is shown in Table- IV.1.13.

Table- IV.1.13 Brief Profile of Kelurahan Rawa Terate

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Rawa Terate	330	15,425	8,157	6	60

Our survey area is in RW 16 which covers 20 poor households in RT 16. This area is prone to inundation if heavy rainfall flushed Jakarta, especially from five-year cycle of flooding. This Kelurahan has specific characteristics of the morphology which is concave and formerly was a swamp. Therefore, when heavy rainfall occurs, it is mostly flooded. The Kelurahan is lowland and most of the area is located on the riverbank Cakung; on the edge of the river is prone to inundation during the rainy season.

IV.1.14 Kelurahan Tegal Alur (RT 01, 06, 07, and 11)

Brief profile of Tegal Alur located in West Jakarta is shown in Table- IV.1.14.

Table- IV.1.14 Brief Profile of Kelurahan Tegal Alur

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Tegal Alur	496.69	65,699	24,310	16	159

Our survey area is RW 10 which covers 5 poor household in RT 07, 6 households in RT 06, and 9 households in RT 01 and RT 11. Kelurahan Tegal Alur is on a coastal region and adjacent to the sea. Conditions as a flood prone area are further exacerbated by the existence of two streams of Semonggol River and Tanjungan River which currently run through the Kelurahan and the streams are becoming shallow by the sedimentation of sludge.

Semonggol River reaching 2 km in length located in this village became shallow and narrow due to temporally occupied buildings over a long period, therefore water overflows when it has heavy rain. Water level in the event of inundation can reach 0.5 meters in RW 1, 3, 9, 11 and 15.

IV.1.15 Kelurahan Tanjung Priok (RT 01 and 03)

Brief profile of Tanjung Priok located in North Jakarta is shown in Table- IV.1.15.

Table- IV.1.15 Brief Profile of Kelurahan Tanjung Priok

Kelurahan	Area (ha)	Population	Household	Number of RW	Number of RT
Tanjung Priok	554	25,174	6,547	16	157

Kelurahan Tanjung Priok is a coastal region bordering the sea north of Java. Because of the location on the coast, the Kelurahan suffered from flood particularly caused by high tide. The location near the harbor and dense housing make the Kelurahan flood prone area.

IV.2 Physical and Socio-Economic Condition

IV.2.1 Settlement Status

According to the interview with 300 Households in 15 Kelurahans, the average household size is 4-5 members. Since our survey area is poor settlement, it can be argued that the living standard of our respondents refers to the condition of the poor. One of the indicators is the fulfillment of modest healthy house criteria.

According to the regulation of “Rumah Sehat Sederhana” which means modest healthy house by Ministry of Public Works, the standard of threshold area for modest healthy house occupied by four people is 28.8m^2 (7.2m^2 per one person). Our survey shows that all of the houses did not have front yard or back yard. Of the households who have five or more members live in a house, 21% occupy a house with an area less than 19m^2, and 78.9% occupy a house with an area of 20-49m^2; they have been forced to live in fairly narrow house compared to the regulation. .

So, it can be shown that one of the typical characteristics of poor settlement in Jakarta is high density of both population and houses. The population increase in Jakarta is not accompanied by the expansion of intensive settlements. Meanwhile, every year the population in Jakarta has been added primarily as a result of migration into Jakarta. Jakarta as the capital city of the State has a strong appeal for residents in other provinces to move to Jakarta. This becomes an aggravating factor for untidy density of population.

IV.2.2 Migration Pattern

The problem of services for housing and settlement facilities is very pronounced. It is caused by the rapid increase of urban population due to migration and the limitation of land for an adequate settlement. As for the migration, the data show that 54.3% of the head of the family were born in Jakarta and 45.7% were not. In addition, 49% of the head of household came from their home town and 51% had lived in Jakarta since they were born; those whose original hometown is West Java (*Jawa Barat*) account for 27.6% and Central Java (*Jawa Tengah*) account for 23% of all (see Figure-IV.2.1).

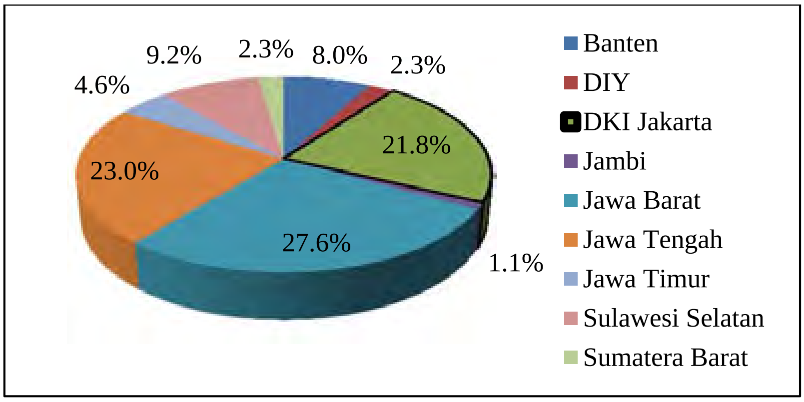


Figure- IV.2.1 Original Hometown of Head of Households

The main reason of migration is to rely on their relatives and/or friends (39.8%), to get better job though had job (11.7%), and to get job because lost job (11.7%). But in reality, their expectation for better income is not always realized. The data show that the average income before moving to Jakarta is not much different from that of the present. The average income in Jakarta ranges from zero to five hundred thousand rupiahs per month, meanwhile 46% of them had average income only in the range zero until three hundred thousand rupiahs before moving.

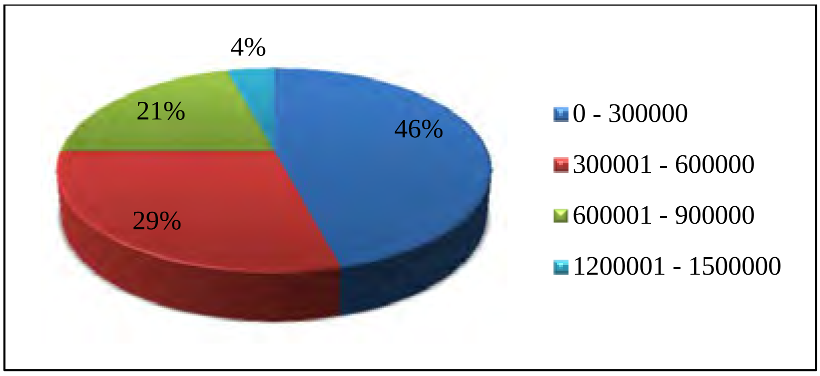


Figure- IV.2.2 Range of Head of Households Income before Moving

The other characteristic of the migrated poor is their relationships to their original community. Although settled in Jakarta, 95% of them still have access to community in the original village and 93% of them have relationships through ethnic and religious relations; the form of relationships is the bond of friendship (called *silahturahmi in Bahasa*). Such relationships are fostered very well though many of the households which have no assets or liabilities there; 98% of respondents answer that they have no any dependents who live separately and 99.7% of them answer that they have no assets at their hometown.

IV.2.3 Health Status

The health status of respondents seems to be in good condition; only 4% of household members are currently ill and 9.3% of household members suffered from pain in the last 12 months. If pained, 63% of household members choose to seek medical treatment. But if their conditions are not serious, 53% of them do not seek the medical treatment. The types of health facilities are physician practices (47%) and clinics (31%). On the other hand, 63% of them do not visit doctors or medical facilities because of financial reasons. It needs to be noted that even though their health status is not bad at this moment the possibility of becoming ill is not low considering sanitary conditions in such vulnerable areas.

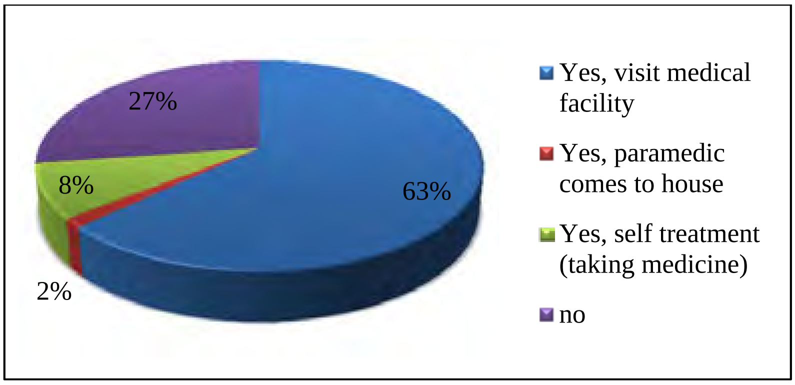


Figure- IV.2.3 Type of Illness Treatment

IV.2.4 Education Level

In general, the educational status of household members is not so bad in the sense that 81.9% of them have ever attended school; 46.9% of them are at elementary school and 25.6% of them are at junior high school. On the other hand, almost 61% of household members that have ever attended school have not completed 1st level.

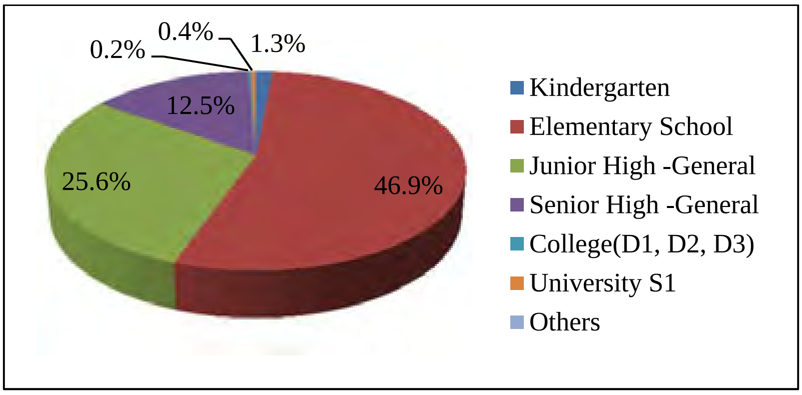


Figure- IV.2.4 Level of Highest Education ever Attended by Household Members

The data also show that 39% of household members are in a school age, but only 41% of them are enrolled in academic year 2010/2011. Focusing on how the household pay for school, 61.7% of them do not spend money for school. It is possible because the primary education system as the 9-year compulsory education program in Indonesia is free. The other 29.5% of them are students receiving scholarships.

Focusing on the reason to quit school and work for living, it is mainly financial limitation. Therefore, due to inadequate educational background, many of the head of households are part-time worker or casual job (12.6%) and housework servant (18.1%) as shown in Figure- IV.2.5. Details about jobs and income are discussed further at Section 4.2.5 Financial Status below.

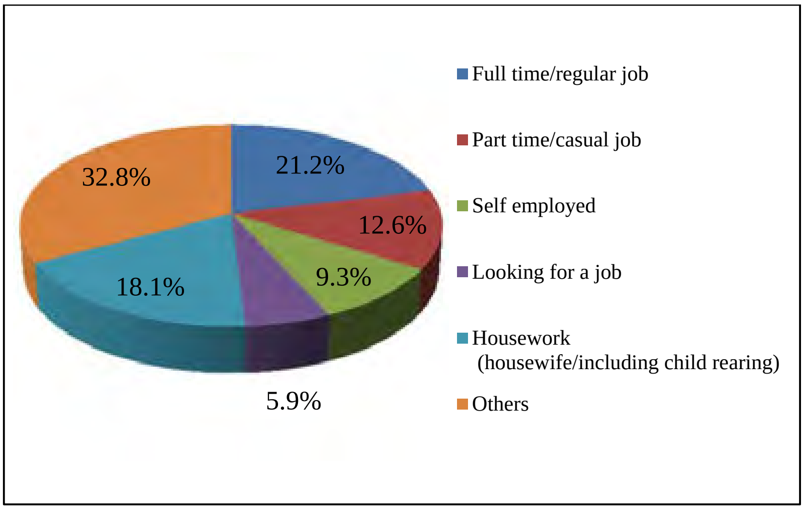


Figure- IV.2.5 Main Activity of Head of Household

IV.2.5 Financial Status

Parsudi Suparlan (2007) states that slum dwellers are not socially and economically homogeneous, and the livelihood of its citizens has diverse income levels, as well as their origins. Most slum dwellers are those who work in the informal sector or have additional livelihood in the informal sector. The condition was also seen from our respondents. There is no dominant livelihood based on survey results. In addition, most of our respondents are classified as low income.

Figure- IV.2.6 shows that 34.2% of respondents have monthly income of five hundred thousand or less and 40.8% have monthly income above five hundred thousand to one million rupiahs. While the Jakarta regional minimum labor wage in year 2011 is one million two hundred thousand rupiah (Rp 1.200.000,-), 83.0% of them have monthly income of less than the minimum labor wage. Income can be defined as the consumption and savings opportunity gained individual within a specified time frame, which is generally expressed in monetary terms (Barr, 2004). Meanwhile, except income there is the source of economics from their savings. It is defined as income not spent, or deferred consumption (Random House, 2006). 96 % of them are not saving their money; only 0.33% of them save the maximum value 14,000,000 – 15,000,000 rupiahs. Therefore, it can be interpreted that households do not have a reserve fund in the form of savings or the other.

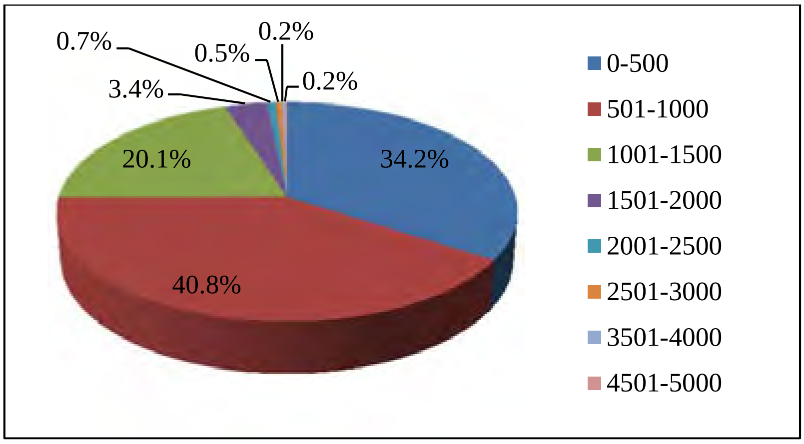


Figure- IV.2.6 Monthly salary of Head of Households per Month (in 1,000 rupiah)

The types of job which they engage in are largely classified as informal activities; it is difficult for them to get financial assistance from formal financial institutions. According to the survey, 65% of them did not have a loan. As for those who have a loan, borrowing from relatives, friends, or neighbors is still the main choice for 40% of them (see Figure- IV.2.7).

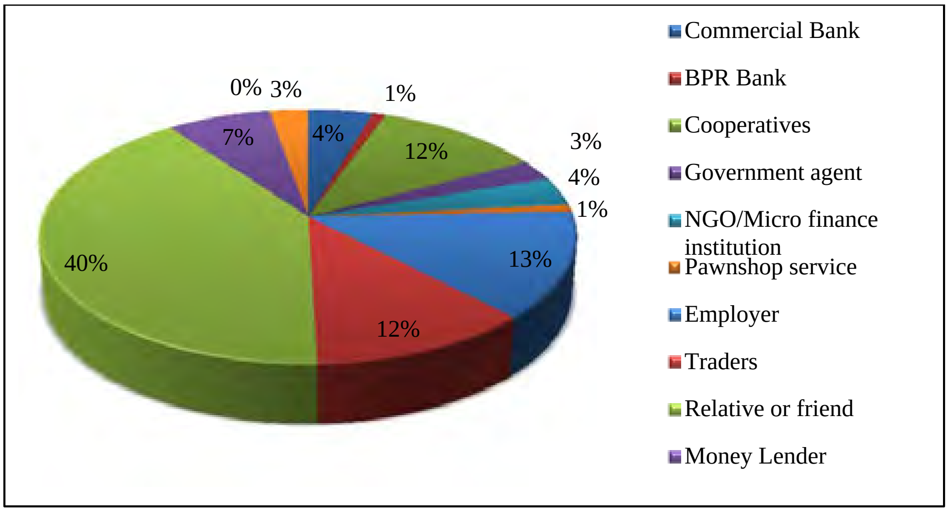


Figure- IV.2.7 Types of Lenders

The nominal of debt value is dispersed. 84.7% of households have average debt rate 0 – 250.000 rupiahs. In addition to money, 28% of households also have a loan in the form of goods. In general, the amount of loans in kind with a value range of 0 - 5,000,000 rupiah reached 62.1%. More details of the amount of debt can be seen in Figure- IV.2.8.

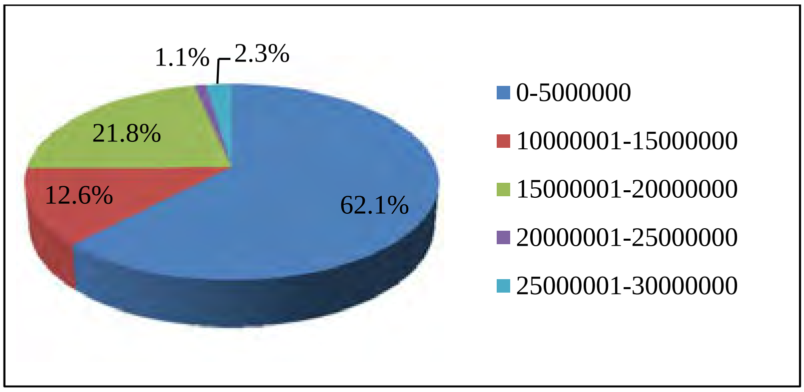


Figure- IV.2.8 Total Amount Borrowed

As for asset value, 62% of respondents have land and housing with area of 1-50 m^2. According to the respondents, the approximate prices of house and residential land owned by households are under 10 million rupiahs. It can be seen in Figure- IV.2.9.

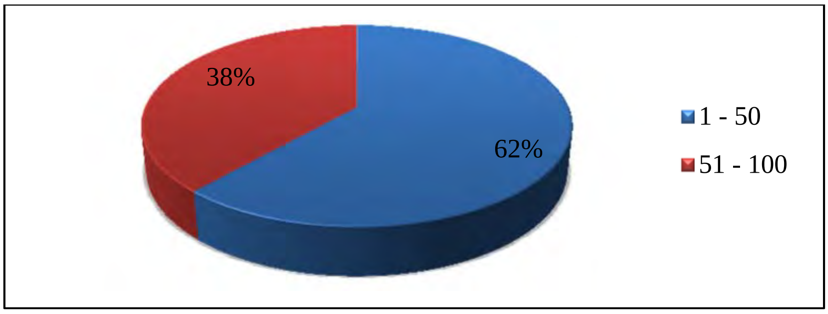


Figure- IV.2.9 Area of Residential

IV.2.6 Housing and its Facilities

Housing and its facilities are basic needs for human welfare. The urban people who have low income will have difficulties to fulfill the need of feasible housing and its facilities.

(1) Housing Structure Condition

In terms of housing, there are several factors that can be described from the survey: ownership, structure conditions, and basic infrastructures. As for the ownership, there are three types of poor housing ownership that belong to the conditions of Jakarta, which are:

a. The poor households which have their own house and land
b. The poor households which have their own house, but temporally occupy the land
c. The poor households rent the house and has no right on the land

According to our study, it is found that 68.7% of them had their own house and 23.3% of them rent the house. As for house size, according to Ministry of Public Works, the criteria of the modest healthy house can be seen in Table- IV.2.1.

Table- IV.2.1 Standards of Modest Healthy House

Standard /people (m^2)	House units	Total Area (m^2) for 3 people			House units	Total Area (m^2) for 4 people		
		Land (L)				Land (L)		
		Minimal	Effective	Ideal		Minimal	Effective	Ideal
threshold (7.2)	21.6	60	72-90	200	28.8	60	72-90	200
Indonesia (9)	27.0	60	72-90	200	36.0	60	72-90	200
International (12)	36.0	60	----	200	48.0	60	----	200

Source: www.pu.go.id

The majority (47.3%) households have a house with an area of 20-49 m^2; 31% of households have a house with an area less than 19 m^2, and 20% of household have a house with an area of 50-100 m^2. Referring to house health standards by the Ministry of Public Works, the majority households did not meet criteria for modest healthy house.

As for house building, the type of houses in the study area can also be classified by the number of floor level related to conditions of frequent flooding. According to our survey, 49% of the households still live in a house which is not terraced nor has storage, 44.3% of households live in single-story house (see Table- IV.2.2).

Table- IV.2.2 Size of Floor Number

1 story house

Type of house	Proportion
Not terraced house	49.0%
1 story house	44.3%
2 story house	5.7%
1 story apartment	0.3%
3 story apartment	0.3%
Other	
boat	0.3%

Landed house

Based on our survey, we can also describe the condition of building structure of houses through the material of wall, roof, and floor.

- Wall is generally made by brick (55%) and the rest 22% made by mortar, and 16% made by wood. However, there are also made by bamboo, plastic, plywood, and mix material but in a little percentage (see also Figure- IV.2.10).

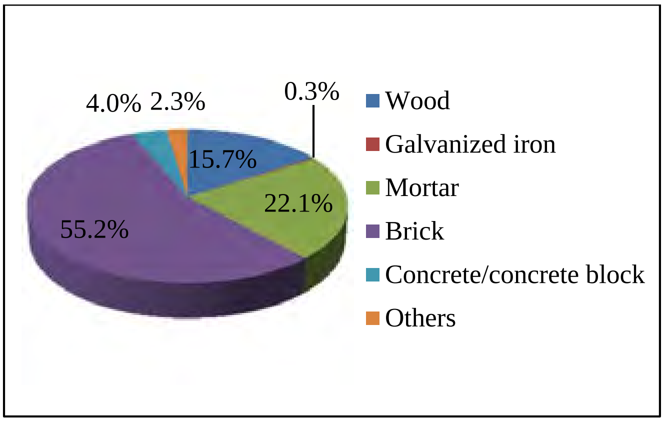


Figure- IV.2.10 Material of House Wall

- The majority of households having the house with the roof of asbestos are 58% and tile-roofed houses are 31.4% (see Figure- IV.2.11).

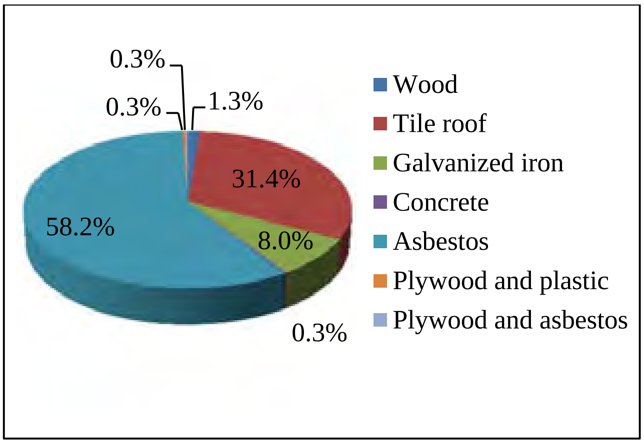


Figure- IV.2.11 Material of House Roof

- In general the house with floor of marble / ceramic are 54.5% and with floor tile are 38.8% (see also Figure- IV.2.12)

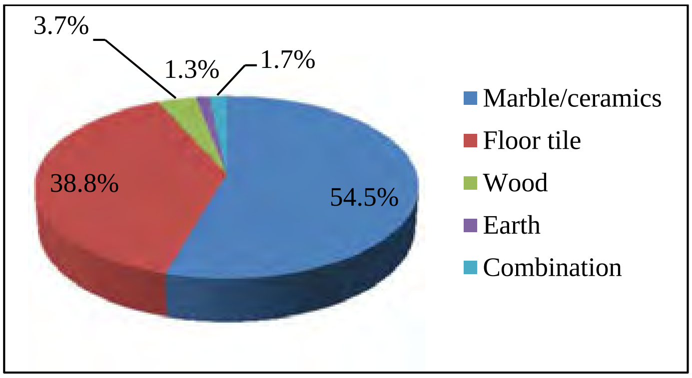


Figure- IV.2.12 Material of House Floor

(2) Electricity and Energy

92.2% of respondents dominantly use electricity for lighting, and the rest is for television/radio (1.0%) and cooking (0.7%). Their consumption in electricity can be categorized high in a matter of usage duration because 45.9% of the households can use electricity for 24 hours/day and 45.7% of them can use electricity for 10-18 hours/day. However, 49.5% of them only pay below 50,000 rupiahs/month.

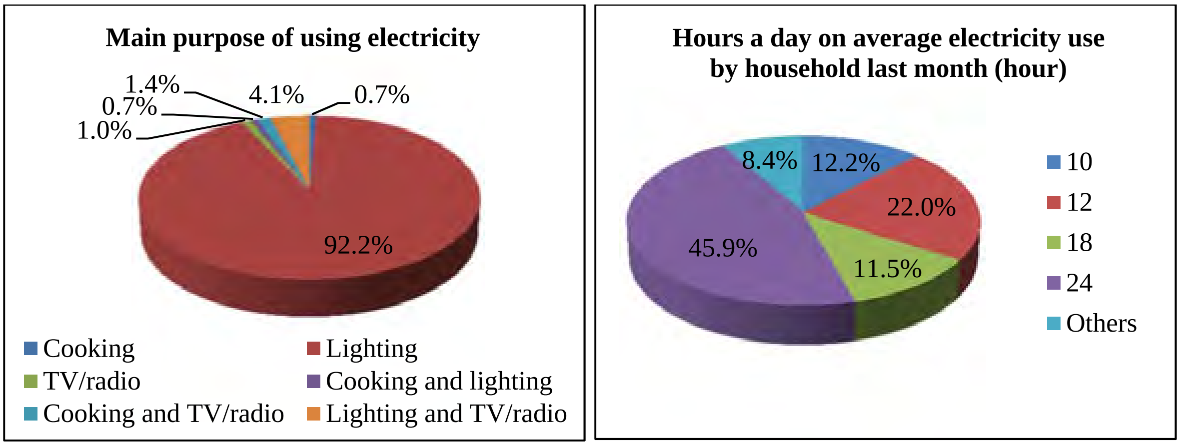


Figure- IV.2.13 Electricity Use of Households

The reason for low percentage of using electricity for cooking is that 78.5% of households use fire wood as an energy source for cooking. In addition, the electrical cooking equipment is expensive.

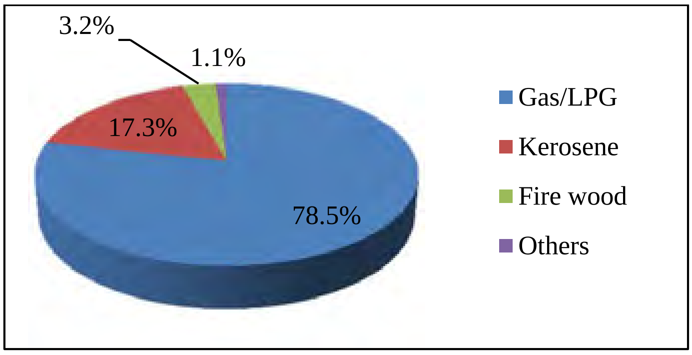


Figure- IV.2.14 Source Energy for Cooking

(3) Clean water

There are four main sources of clean water used by poor households: water pipes, drilled water (deep well), bottled water, and water from encircling water sellers. For daily consumption, the households choose pipe water both in dry and rainy season. But for drinking, the majority chooses bottled water in dry season; only 10.3% of them still use the well (see Figure- IV.2.15).

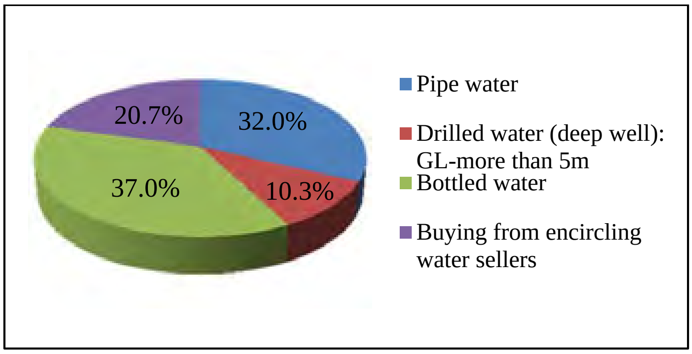


Figure- IV.2.15 Sources of Clean Water in Dry Season

As for water storage, 81.0% of households choose to save in containers (buckets and jerry can) and 7.9% save in Roof tank / cistern, but 11.1% of households have no stored water (see Figure- IV.2.16). As for the main water sources for them, 61.7% of them say that they buy it from water seller, so only 15.3% of them use tap water or water from well. .

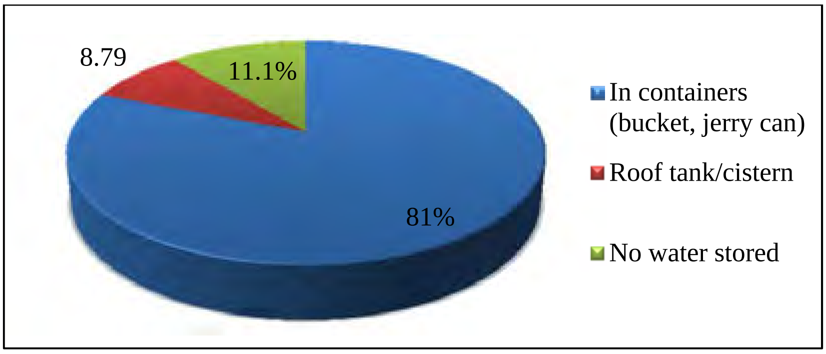


Figure- IV.2.16 Storage Drinking Water

(4) Waste water management

The waste water management usually becomes last priority of poor communities. According to our survey, waste water is generally managed in the local neighborhood scale, which is RT or RW with percentage of 73.2% and rest by other parties such as government body, private institution, and household as seen in Figure- IV.2.17 below.

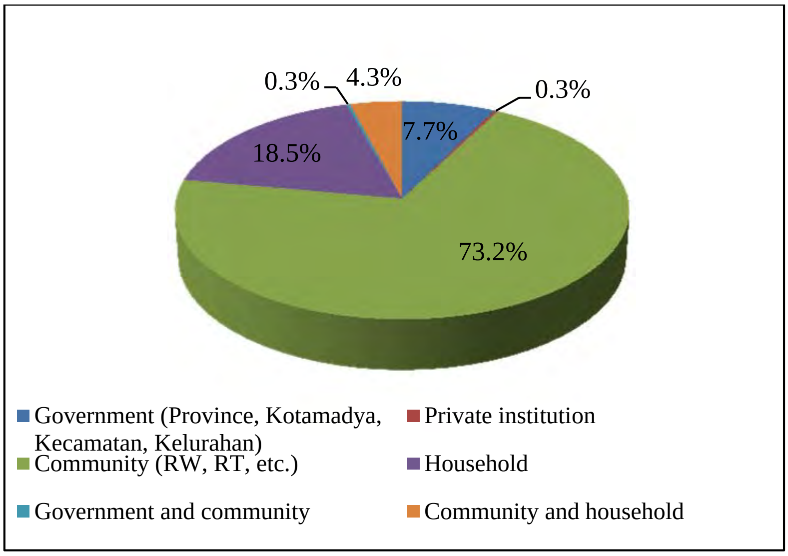


Figure- IV.2.17 Waste Water Management Parties

The participation rate of households in maintaining drainage is quite good as it reaches about 77.3%. They generally use maintenance method such as working together to clean clogged drainage systems (72.6%), but there are still 22% of them who choose to clean by themselves when clogged. As for frequency, 56.5% of them do the maintenance once a month and 26.1% of them once a week.

(5) Sanitation

It is important to identify sanitation facilities since most of the urban poor settlements lack them. According to our survey, 81.3% of households drain their sewage at drainage ditch (flowing) and only 11.3% at drainage ditch (stagnant).

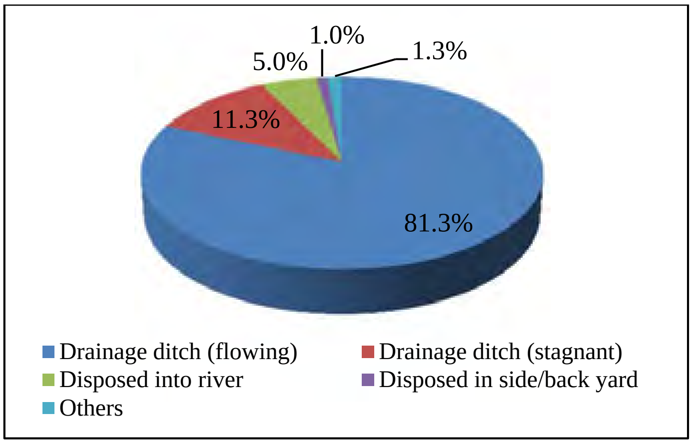


Figure- IV.2.18 Household Sewage Pattern

As for other aspects such as shower and toilet place, 75.7% of respondents said that the majority of household members take a shower at their own bathroom, 12.7% of them use public bathroom, and 11% of them use shared bathroom with other households. As for the frequency of bathing, around 93% of them bathe twice a day in normal condition, but not all of households have a toilet with good standard. Only 42% of household members go to own toilet with septic tank and 33.3% of them go to public toilet.

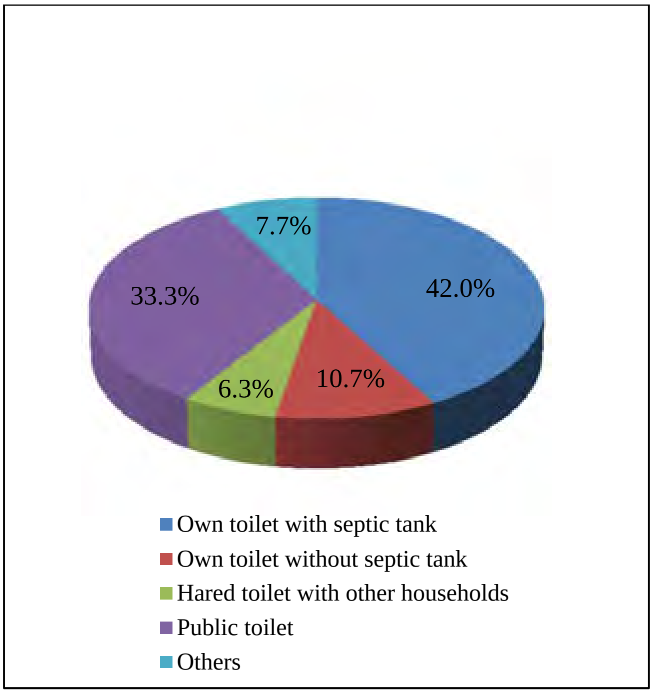


Figure- IV.2.19 Toilet Access

IV.3 Experiences with Inundations

As one of the biggest urban area in South East Asia, Jakarta is a megacity facing many kinds of problems related to demographical and environmental pressures. The problems are generally combination of natural and manmade disasters. As a megacity and the capital city of Indonesia, Jakarta has complex disorders particularly to sustain its environment from hazards include caused by climate change effect.

Five municipalities in DKI Jakarta are considered one of top 10 cities vulnerable to climate change together with other 530 urban areas in seven ASEAN countries, namely Indonesia, Thailand, Cambodia, Laos, Vietnam, Malaysia, and the Philippines (Yusuf et al (2009)). One of the worst hazards in Jakarta is flood or inundation at several critical points. In 2002 and 2007 were the severe conditions in which the level of inundation hit 7 meters depth. However, people get used to be familiar with the five years flood cycle. In this section, we describe the inundation incidents and respondent's perceptions particularly in responding floods or inundation as a part of climate change impact.

IV.3.1 Inundation Incidents

Yusuf et al (2009) stated that there are 3 municipalities in DKI Jakarta which were the three worst inundations in South East Asia: Jakarta Pusat (Central Jakarta), Jakarta Utara (North Jakarta) and Jakarta Barat (West Jakarta). Joga (2011) said that floods usually hit Jakarta in January-February based on experiences of severe inundation in some point of location.

In the past 15 years, the two worst inundations were in 2002 and 2007. In 2002, during one week in February, several main rivers including Ciliwung overflowed and Jakarta were inundated with a height of 0.5 - 2.0 meters (Lobo, 2008). In 2007, during three days, almost 70% of total area in Jakarta was hit by flood with a height of 0.3 - 6 meter. In that year total loss of asset is 8.8 trillion rupiahs which consist of 5.2 trillion losses in state's infrastructure and 3.6 trillion for lost income (Lobo, 2008).

This study captures inundation incident based on the perception of respondents through quantitative indicators. There are several aspects that can be drawn through their experiences last year, which are:

1. Occurrence time of flood, 21.5% of them said that February was the worst month of inundation that happened in the past twelve months
2. Duration time of flood, 25.6% of them stated the inundation lasted for less than 6 hours and only 4.7 % of respondents stated that inundation lasted for a month at their settlement.
3. Frequency of flood, 4.7% of them said that inundation incident often hit their settlement area once a month (see Figure- IV.3.1).

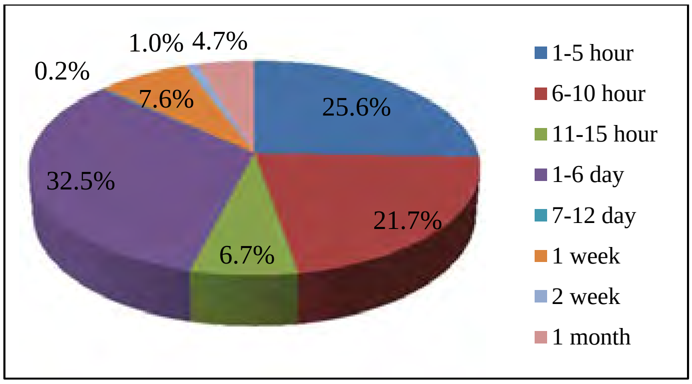


Figure- IV.3.1 Frequency of Flood in the Past 12 Months

4. Scale of Flood, both inside the house and in the street
   a. Inside the house, 53.4% of them said that the maximum height of water due to the inundation occurred in the past 12 months was under the ankle and 37.8% said that the depth was under the hip (0.2 – 0.5 meter) (see Figure- IV.3.2)

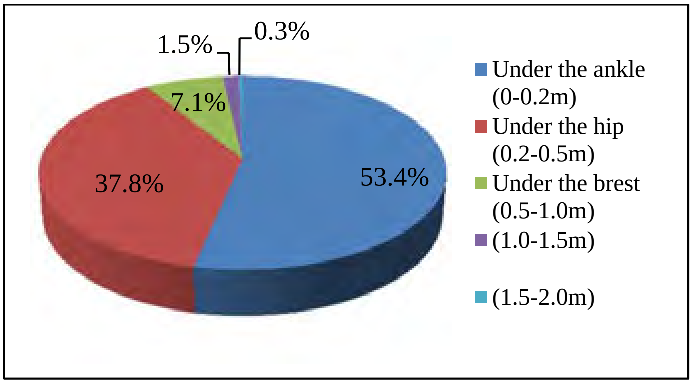


Figure- IV.3.2 Maximum Depth of Inundation inside the House in the Past 12 Months

b. As shown in Figure- IV.3.2, the maximum depth of inundation on the street (in front of the house), 26.7% of them said that the maximum depth on the street is under the hip (0.2 – 0.5m). If we compare the depth of inundation between inside and outside the house, it is clear that each of houses had prepared for inundation in many ways. Some of them were equipped with simple dike or the door attached above the ground level so that the inundation did not overflow into inside the house.

Besides respondents' experiences last year, this study can also provide the information about their experiences during past five years. 89.1% of them stated that the most severe inundation occurred in 2007. At that time, the inundation lasted in a week and 24.6% of them stated that the depth of the inundation is around 0.2-0.5 meters in the street.

IV.3.2 Perception of Inundation and Climate Change

One of the perceptions of inundation that can be seen from this survey is about the impact of inundation on the households. The most serious disruption that they suffered from inundation in daily life was external activity. 24.9% of respondents stated that working and attending to school are significantly disturbed by inundation (see Figure- IV.3.3). However, the local residents do not think it is a serious problem because they have got used to deal with that condition. The other additional effect considered by respondents is related to healthy status of them. Skin disease was the most common illness that occurred after inundation.

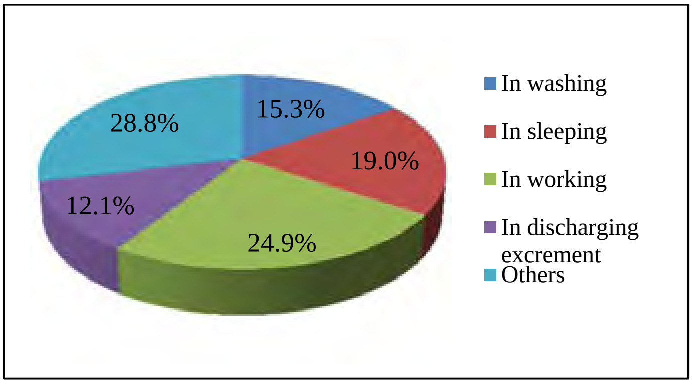


Figure- IV.3.3 Difficulties Caused by Inundation

In understanding perception of respondents to climate change, each individual has an opinion about the impact based on not only his/her experiences but also his/her feeling to the conditions. Therefore, climate change issues cannot be enforced as scientific understanding to poor people which are the vulnerable ones, but adjusting to their own perception as dysfunctional system of environment.

One of the climatic factors asked to respondents is rainfall changes. 57% of them said that they get the information from television. The interesting one is the high percentage of those who "do not know the weather prediction". It means that weather itself is not so important among the poor to practice daily life, evidenced from the percentage of ignorance to the weather information is quite large. Therefore, there are 35.7% of respondents who do not really aware of weather changes.

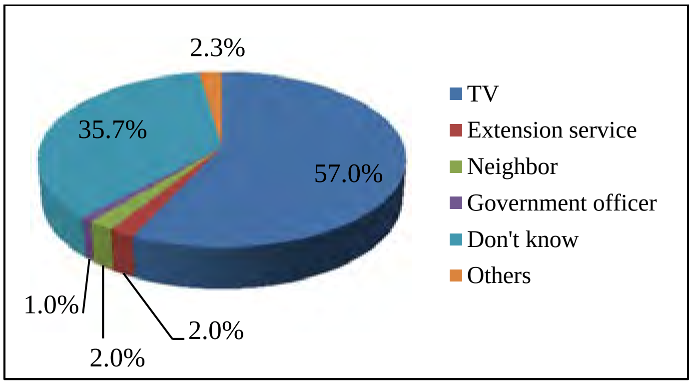


Figure- IV.3.4 Source of Weather Prediction

But compare to the condition of 20 years ago, 63.3% of them believe that the rainy season starts more erratic nowadays and 26.7% of them stated that it is more difficult to determine when the rainy season starts. It means that according to their perception, there are some changes related to climate pattern especially on the rainy season in recent 20 years.

Table- IV.3.1 Determining of Starting Date for Rainy Season Compare to 20 Years Ago

Determining of Starting date For Rainy Season Compared to 20 years ago	
More difficult	26,7%
Same	3,3%
Easier	2,0%
More steady	0,3%
More erratic	63,3%
Don't know	4,3%

As for rainfall patterns according to their perceptions in the last 3 years (2009, 2010 and 2011) compared to the past 20 years, most of them (88.3%) said that the pattern of rainfall is steadier in the last 3 years than that of 20 years ago.

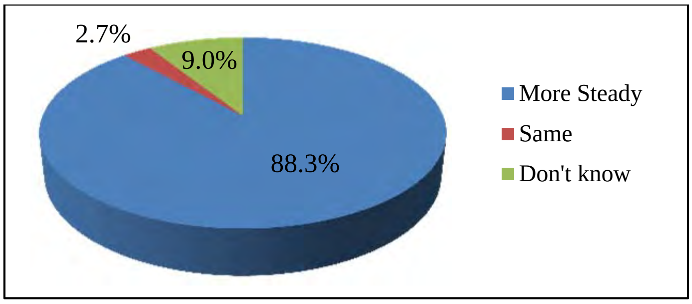


Figure- IV.3.5 Change of Rainfall Pattern Compare to the Past 20 Years

As for the situation in their residential areas, they say that there is no change on the condition of a pool. And most of them stated that there is also no change on the impact of inundation in residential areas over the last 3 years.

Table- IV.3.2 Changes on the Impact of Inundation in the Past 3 Years

Level of changes	Percentage of perception
Decrease	34,3%
Same	37,7%
Increase	12,3%
Don't know	15,7%

Seeing the results of a survey on perceptions of the poor on climate change, they did not notice for every detail on changing. They already adapt to the situation, so they are not aware of the change as a serious problem for their daily life. Meanwhile, they are aware of the change of weather which becomes more erratic in the long term.

IV.4 Defining Vulnerability of the Poor in Jakarta

People have to face the frequent inundation or flood depending on their social, economic, or even environmental resources. The resources are various in different part of society identified by people's livelihood. It becomes an integral part seen in daily life and related to each other. On one hand, overpopulated cities can provide their residents with more livelihoods, but on the other hand, they increase vulnerabilities against natural hazards, civil strife, and climate change impacts.

Most of the survey area has severe and frequent inundations. It can be seen from the infrastructure of houses they have, social capital that they built as indirect impact such as *gotong royong* in Bahasa or cooperative attitude which was nurtured from the experience of facing the flood together, and economic activities for the poor. In urban areas, where disaster becomes more severe partially due to overpopulation, the poor tend to be vulnerable. Limited access to infrastructure and public services are the reason why the risks of disaster are getting worse. Moser *et al.* (1994) highlight the contemporary vulnerability of the urban poor to changes caused by structural adjustments.

Three aspects which make the urban poor more susceptible are as follows: 1) Urban life is more commodified than that of rural areas, which means obtaining goods in urban economy nearly always requires money with only limited scope of households. 2) Complexity of environmental risk in urban areas is greater than that of rural area because of so many overlapping risks associated with the household, workplace or neighborhood and with the decreasing environment because of industry waste. 3) Social fragmentation makes the urban poor more vulnerable since high residential mobility and the loss of supportive social network. These three aspects are also identified in our survey area as environmental, social and economic aspects of vulnerability.

As described previously, BPS DKI Jakarta refers to the 14 criteria of poor and poverty line. The 14 criteria are as follows: size of house, main floor material, main wall material, sanitation facility, source of drinking water, main source of fuel for cooking, main source of lighting, consumption of meat/chicken/milk in a week, frequency of eating in a day, buying new clothes for each household member in a year, ability to pay medical expenses, the highest education attained by household head, the highest education attained by household members, ownership of assets/savings. Meanwhile, BPS DKI Jakarta also applies poverty line that is different among regions. Poor is defined as the state of people whose expenditure per capita per month is below the poverty line.

According to Bogardi *et al.* (2005), <u>physical factors</u> encompass susceptibilities of the built environment. <u>Social factors</u> are related to the social issues such as levels of literacy, educations, social equity, traditional values, etc. <u>Economic factors</u> are related to issues of poverty, gender, level of debt and access to credit. <u>Environmental factors</u> include depletion and degradation of natural resources, and natural "vulnerability" towards climate change. Therefore, it is important to recognize the existence of vulnerability in coping capacity within disaster risk reduction.

IV.4.1 Environmental and Physical Vulnerability against Inundation

Our survey area is flood-prone and slum[1] according to the Government of DKI Jakarta. We assume that the surrounding environment of our survey area is not feasible for sustainability of resident's life. It means that the slum area could increase the vulnerability against disaster, including inundations.

88% of respondents are aware that they live in one of the inundation prone area, and only 12% of them are not aware of it. It means they have already known and noticed about the environmental vulnerability, but they are still obliged to choose to live and stay at this inundation prone area.

[1] The criteria of slum are determined by 10 indicators : 1) density, 2) housing lay out, 3) construction of house, 4) ventilation, 5)land use, 6) road condition, 7)drainage, 8) freshwater availability, 9) toilet, 10) waste transporting. The slum area is mapped by the Housing Agency, Government of DKI Jakarta Province.

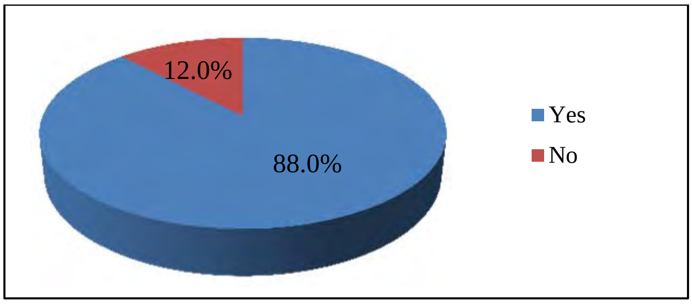


Figure- IV.4.1 Awareness of Inundation Prone Area

Physical risks are also identified from the condition of their houses. As mentioned above, the housing condition does not meet the standard of modest healthy houses, including the water scarcity in most of the houses and the usage of electricity in a long duration for a day.

IV.4.2 Social Vulnerability

As stated above, the average number of household member who live in each house is 5 persons, meanwhile the area of house is only 19 m^2. It could be identifying that each house is dense, and if a house denser, it will be more vulnerable against the adverse impact of disaster for people inside. The other factor is their education level. In this study, we can identify respondent's experiences of formal education. 81.9% of the entire household members have attended for school and the rest 18% have not. But, most of them only attended for elementary school and junior high school (72.5%). In addition, as stated above, 61% of household members who attended school only completed at the first grade of each stage. That is one of the main reason why we can categorize the vulnerability of the poor identified from respondents is enough high.

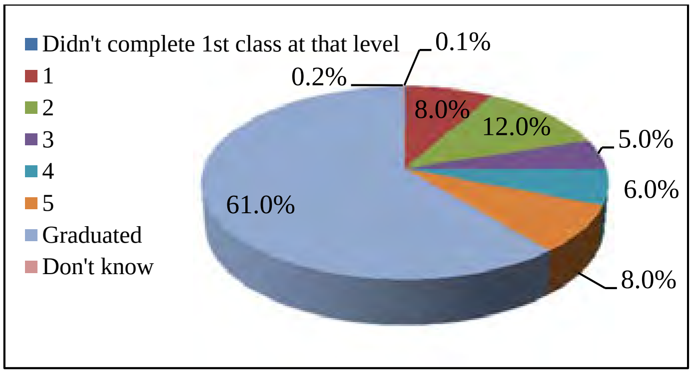
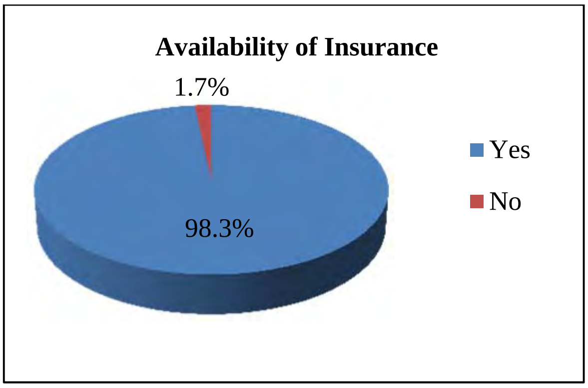


Figure- IV.4.2 Education Level of Household Member

Health status is also determining factors of social vulnerability. As for health status such as the number of unhealthy people and belonging status of health insurance, only 4 % of entire household members are injured or sick and the rest 96% are in healthy condition. This percentage may encourage them not to use insurance for their security; 98.3% of respondents have no insurance as shown in Figure- IV.4.3. The small proportions (1.7%) of them primarily use health insurance, secondarily use life insurance, and the rest use both.

Government of Indonesia has provided health insurance for the poor called JAMKESMAS. But practically, JAMKESMAS is widely used by people with limitation including the poor. According to the respondents, only 9% of the household members are JAMKESMAS beneficiaries, and the rest have never been. It can be said that the household members have little interest in insurance, and it will make them more vulnerable if they got adverse impact of disaster including inundation.



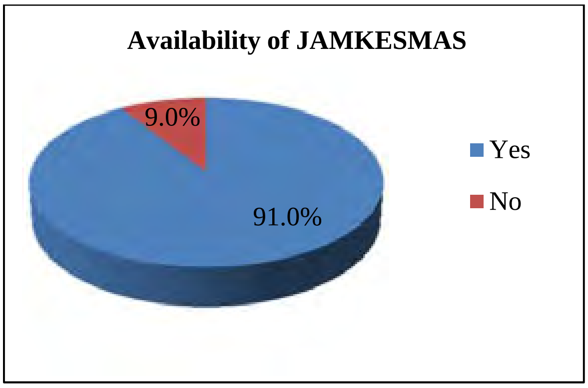


Figure- IV.4.3 Availability of Insurance

IV.4.3 Financial Vulnerability

The assumption is that the more economic capital increases, the less vulnerable the poor are in coping disaster. They have a capability to improve their condition, so they could adapt or mitigate for better condition. In detailed scale, economic vulnerability is measured by household assets and income per period of time. Consistency of income is important to maintain the sustainability of life cycle.

According to our survey, only 25.3 % of respondents do not own a house or residential land asset. The rest 74.7 % have a house and/or residential land asset. The asset that belongs to the respondent is mostly residential land of not more than 50 m^2 and a house. So, even though they live in small house, most of them already own their house as their asset. It could decrease their vulnerability against the adverse impact of disasters.

The other factor is availability of saving. If people have savings, they could cope with events which may damage their welfare. In this study, most of the respondents (96%) do not have savings. The rest 4% have savings in range from Rp.600.000 to 1.000.000. The lack of savings can be one of the significant factors representing their high vulnerability.

Then, if we look further about their income per month or monthly salary, most of respondents (almost 80% of them) earn less than the minimum regional income as described above (see Figure- IV.4.4). It is stated that the financial condition of respondents is more vulnerable during the inundation because the income becomes too low to accommodate the daily necessities.

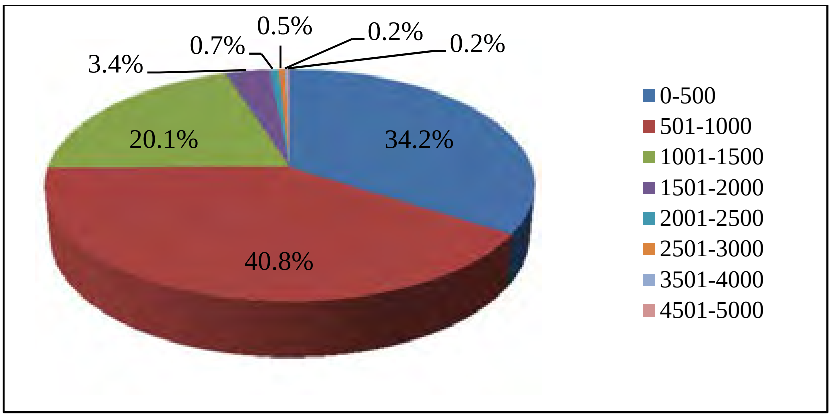


Figure- IV.4.4 Monthly Salary/Income (in 1,000 rupiah)

In the light of the salary of respondents, we could find out that most of them are too vulnerable to reduce the impact of inundation. Crosschecking with the coping action that they do, it convinces become vulnerable because most of them do nothing even if they have medium-high salary (500,000 – 3,000,000 rupiahs). On the other hand, it was shown that those who have the highest salary (4,000,000-5,000,000 rupiahs) use their savings to reduce the impact of inundation.

IV.5 Adaptation and Mitigation Condition

As for cultural backgrounds of respondents, some of those are from Jakarta and others are from outside Jakarta or even outside Java Island such as Sulawesi or Sumatra Island. Although they came from different regions, they need to adapt themselves to community at the settlement area and also to surrounding environment, including the experience of inundation that happens frequently in their area.

The adaptation process must be based on economic and social capabilities of households. But as mentioned above, few households use insurance to protect their assets and activities to prevent financial losses from occurring. There are many households which are not aware of the necessity of, or cannot afford, insurance, and government contribution is insufficient to run the subsidized insurance for the poor as a vulnerable group.

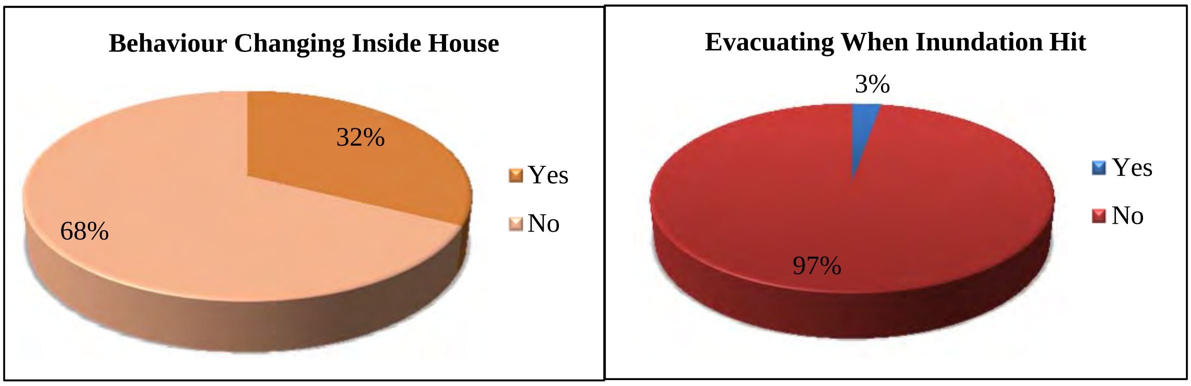


Figure- IV.5.1 Adapting to Inundation

Adaptation activities are also characterized by how people cope with the threat of disaster such as inundation. As for the hazard which threatened 15 Kelurahans, February 2011 is the month when inundation hit those Kelurahans for 6 hours. Those Kelurahans suffered from inundation once a month in average. Most of the household members (97%) just stayed at home during the inundation and the rest was evacuated to their relatives. It is also stated that 68% of respondents did not change their behaviors inside house facing the inundation; they had already accustomed to that condition. Although they have to deal with many difficulties caused by inundations, it does not seem to be a big deal for them to live side by side with water run-off.

There are some changes of behavior in daily life related to food consumption and sanitation inside house. 57 % of respondents stated that during the inundation, they satisfy their need to drink bottled freshwater brought by one of household member. Sometimes they buy the bottled water from peddlers or at a shop. Meanwhile they felt that there were no big problems in accessing food outside during inundation. 43.1% of them cooked by themselves and were not necessary for buying food outside.

Related to their adaptation measurements, we should know about the scale of inundation impact. According to the survey, the impact of inundation has caused many things: firstly, 42% of them said that there were some damages in their houses; secondly, 10% of them said that their assets were lost; and thirdly, they were in bad health (see Figure- IV.5.2).

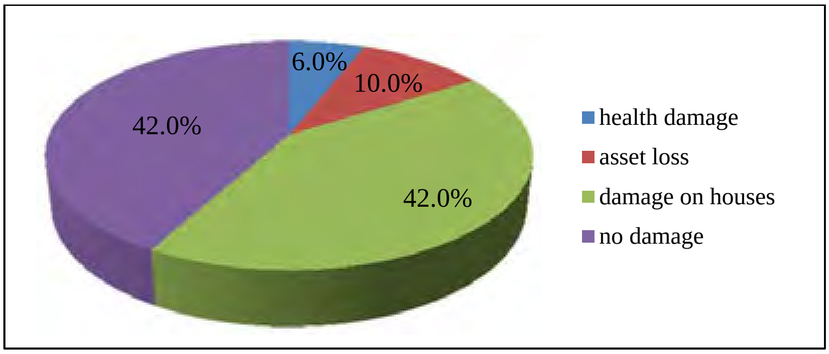


Figure- IV.5.2 Types of Damages of Inundation

In relation to that impact, however, 83% of them do nothing for replacing or changing the losses of income and assets; they rarely have actions for rebuilding or repairing their houses or assets. Only 10% of them use their savings to renovate their houses, and the rest is supported by any institution to rebuild or renewal their assets.

Related to mitigation, only 36% of them do nothing for preventing their assets from suffering from inundation. Others prepare for mitigation, such as raising the floor level, keeping ditch and drain clean, and preparing safer place for their assets (see Figure- IV.5.3)

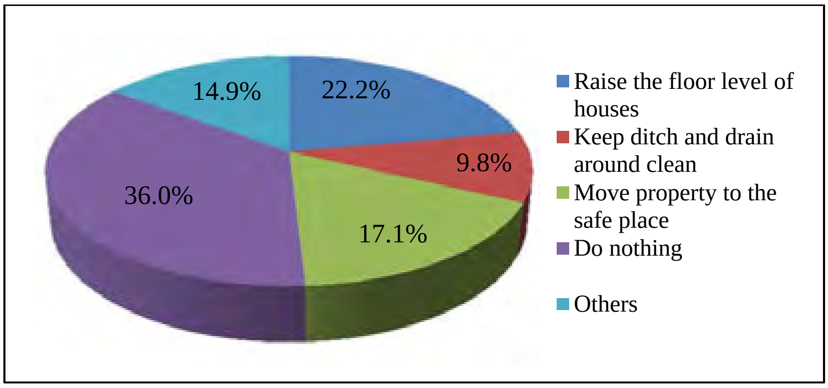


Figure- IV.5.3 Mitigation Measurement for Inundation

Meanwhile from the previous observation and interview in Kelurahan, we also found several statements about how flood warning system functioned in their RW. The RW in Kelurahan at South Jakarta along the Ciliwung riverside (such as Bukit Duri and Bidara Cina) has a systematic flood warning mechanism in the rainy season. The RW staffs have the information of flood from the Kelurahan staffs and dam keepers by radio communication to share what they experienced.

CHAPTER V CONCLUSION

V.1 Summary

Analysis on their past experiences in responding inundation shows that the poor in Jakarta are vulnerable in many ways. The vulnerability includes physical factors such as small and fragile structure of their houses and limited basic infrastructures, economic factors such as lack of savings, lack of insurance for their private assets, and low income, social factors such as high population density, low education levels, and no insurance. These vulnerable conditions need to be addressed in order to formulate appropriate and effective policies for the poor.

Poverty is one of the significant and contributing factors to increase their risk to the inundation impact, or in short, exacerbate vulnerabilities.

As argued in Murdoch (1994), as for the causalities between poverty and vulnerability, the following three factors can be emphasized to be contributing poverty. First and income fluctuation caused by price variability of agriculture products, which does not seem to be applicable in the analysis of the urban poor. Second is poorly developed financial institutions. And the third is weak social institutions.

Based on our study, we can disaggregate the causalities between poverty and vulnerability into the following factors.

Considering possible access to financial services, one of the crucial factor is the status of asset holding. The assets of the urban poor, most of them have no land ownership and have limited movable assets, and all they can afford is just to find places where they can live temporally. Although formal or micro finance tools has been modestly introduced, it seems quite difficult to private sector to provide them with financial measures, as the poor often give the appearance of borrower with high risk under information asymmetric situation. Public sector also faces difficulty to support them, as their policy tools are basically designed for nations in formal sector, with proper registration as tax payers.

Turning eyes to social insurance issues, public support can be hardly expected by the same reason as above. Thus those urban poor have to depend on non-public or spontaneous social capital. Our analysis shows that half of the people in poor community are migrants who do not have reliable connections to Jakarta, therefore it is very unlikely that they can obtain any support through spontaneous networks based on territorial bonding or blood relative.

The poor households, however, have strong relationships with their relatives or friends who came from the same originated village, but they have not been able to transform it into solid social capital which can support them in the long run. One of the reasons may be the circumstances they are facing, which always force them to focus only on how they can survive in the short run..

Weak social capital also leads to their weak awareness and capabilities to take care of their environment and their responsiveness to environmental changes such as climate change. Their adaptive capacity should be enhanced, especially in maintaining their settlement in order to achieve sustainable environment for a long period by at least using their social assets.

One of the striking implications of our study result is that, the reason why the poor households do not prepare for floods in a proper manner is that they assume that inundation is not their priority issues to be managed and inundation incidents do not interfere their daily or main activities fundamentally. In general, respondents who are supposed to represent the poor mostly prefer to adapt to the situation rather than prevent the impact of inundation. Therefore, we found that they consider it better just to do nothing and waiting for support from other institution instead of spending their own capital to do prevention. This may reflect the urban poor’s utility perception, in which, estimating their poor assets and expected losses in case of encountering inundation, preventive actions are far more costly than adaptation.

According to the perception of the poor households in the coastal area, inundation incident is mainly caused by rainfall and high tide. But, the survey answers also claims that poor local drainage to be another determinant factor. Based on their experiences, the worst inundation event was the flood in the year 2007 and the month of February was the worst time. It is also shown that several RTs have no longer been inundated significantly because of flood control infrastructure development such as flood canals (BKT), water pumps, polders, and dikes (for example RW 07 in Kelurahan Marunda).

V.2 Policy Implication

Based on the survey, there are some policy implications that can be proposed to be considered by government both in national and local level in order to respond to the impact of climate change on urban poor settlement as follows:

Issues to be addressed at the national level:

1. The urbanization process which occurred in metropolitan area such as Jakarta should be controlled by consistent and continuous policies considering social, demographic, and employment sectors; consistency is crucial, as threat of eviction may deteriorate the urban poor’s behavior, as well as their potential social capital.
2. To try to incubate social capital by announcing acceptance of status quo, prompt the poor to think and behave on the long run basis. Such long run based behavior may contribute to the field such as spontaneous environmental protection, mutual provision of informal financing/insurance, by enhancing their welfare with very limited fiscal expenditure.
3. To conduct thorough survey on the status social capital accumulation. The criteria of the poor clearly suited in conceptual framework, but it was liable to be inconsistent in the implementation phases. Some data from the field survey show that the poor households were not identified very well. It means that references used for the identification of the poor (Program RASKIN) was not fully in accordance with local facts; some are listed as the poor, but in reality some are not categorized as the poor. While there are some households which should receive assistance, not all of those are registered. A monitoring and supervision program by the central government need to be implemented to ensure that the data of the poor are suitable to the facts;
4. Based on the above survey, to plan resettlement to geographically non-vulnerable area. Key is to preserve the existing social capital/networks in the process of resettlement. Participatory process in the planning (and partially in financing) may be expected.
5. To consolidate the physical infrastructure in geographically vulnerable area, in order not to allow migrants flow in. The areas where the poor consequently continue to occupy tend to be vulnerable areas. Such areas are originally vulnerable against inundation and the vulnerability is increasing due to climate change. Therefore, it is suggested to construct land use control mechanism in spatial management by monitoring and evaluating conditions of vulnerable areas.

Issues to be addressed at the local government level:

1. The flood infrastructure has reduced some inundated area, but according to the survey, the impact of inundation is still observed because of their location which is prone to inundation and has poor drainage. Because of the lack of connection bond with any external sources caused by the limitation of the poor, they are forced to have strong internal bond such as good cooperation with others in the community. Therefore, the socialization and internalization of local environmental management by community should be enlarged and enhanced in order to decrease the vulnerability of the poor.
2. The land use planning and zoning regulation are the instruments that can manage the environmental degradation continuously and long term phases. But in the short term, the law enforcement of building code and land use permit will be effective.
3. The vulnerability and adaptation assessment, especially for urban poor area, needs to be incorporated in the development and spatial plan, so as especially to introduce mitigation and adaptation aspects in planning policy programs.

4. Encouraging the activities of microfinance may have favorable effects. Unlike rural areas, however, under high mobility in urban life (especially for seasonal workers), high cost for monitoring borrowers can hamper incentives for the lenders. One possibility is incentivizing residents to settle down (to become permanent residents with proper registration), by prioritizing them to access the financial tools.

V.3 Recommendation for Next Study

- The matters of land subsidence are not sufficiently discussed in this study. So, it is recommended to study on land subsidence and its impacts which exacerbates climate change impact to the national vital infrastructures, poor community, and daily life of the poor especially in the north coastal Jakarta.
- The cause and system of urbanization, i.e., migration inflow to urban area, are not covered in this study. Therefore, it is recommended to study on migration pattern of poor settlement and informal sector in Jakarta. As we know, Jakarta is one of the densest cities and highly urbanized. The denser city becomes, the more vulnerable the city becomes to disaster as climate change impacts. Hence it will be useful to enrich the study on climate change impact on vulnerable group.
- It is recommended to study flood events and potential insurability of flood impact to the poor community according to the increase of adaptive capacity. This recommending study will define the main causes of flood as one of the climate change impacts and then will be assessed in relation to the insurability.

APPENDIX

Figures

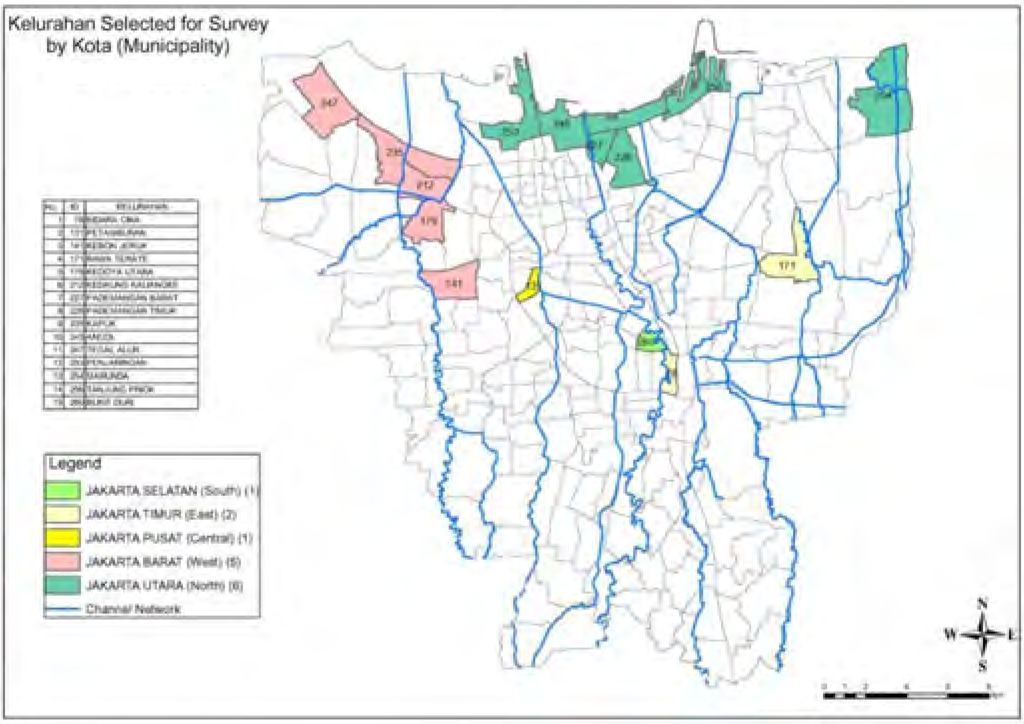


Figure- A.1 Selected 15 Kelurahans by Municipality

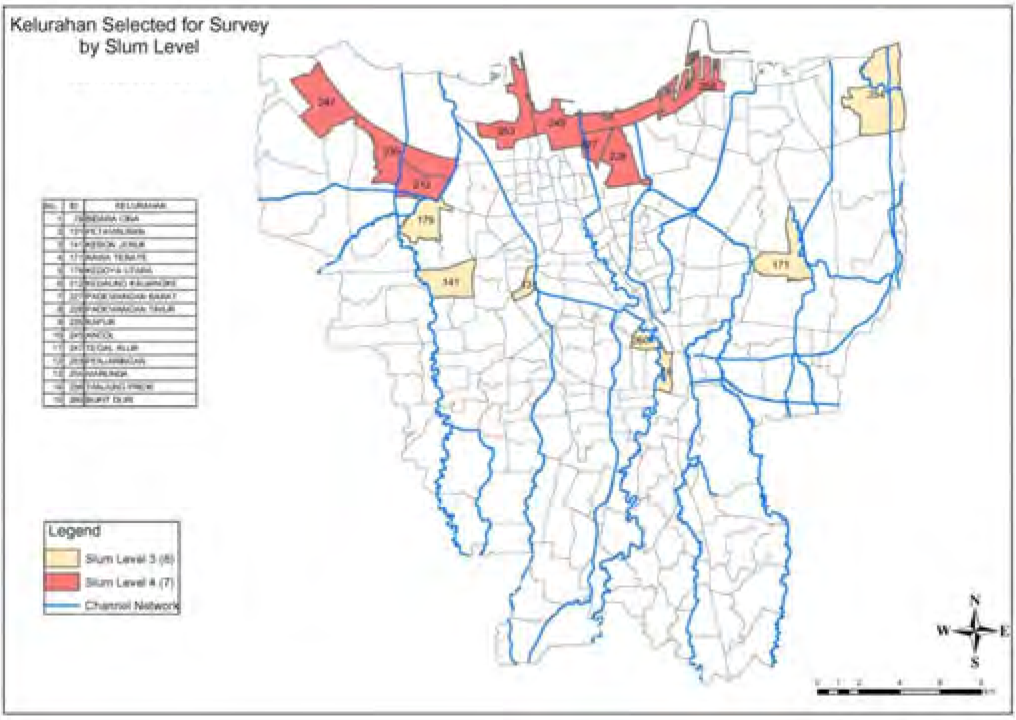


Figure- A.2 Selected 15 Kelurahans by Slum Level

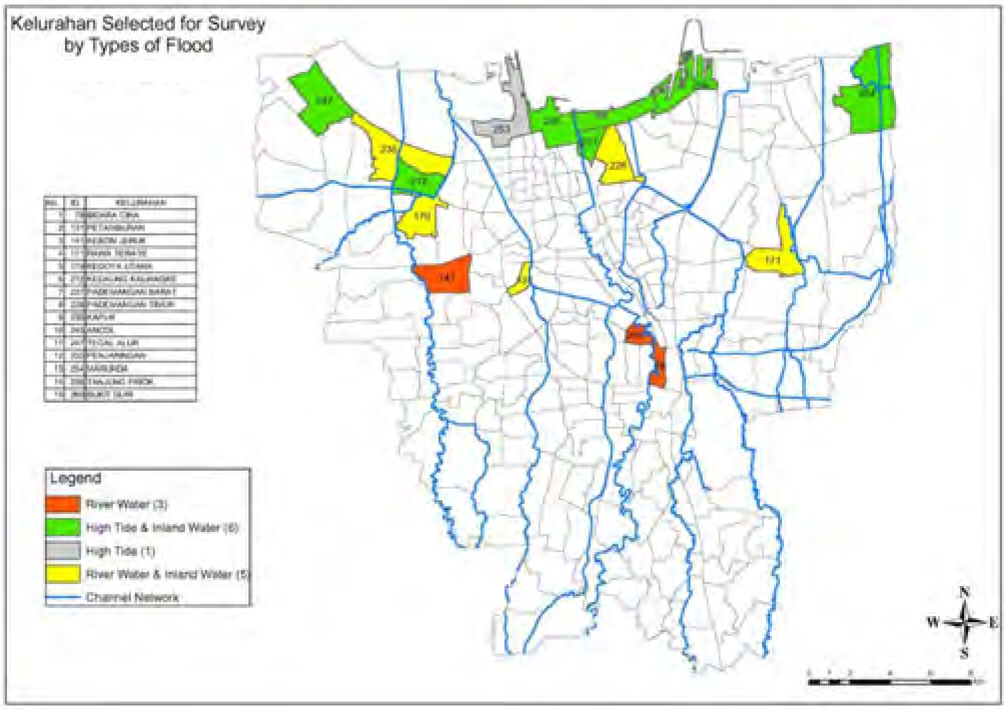
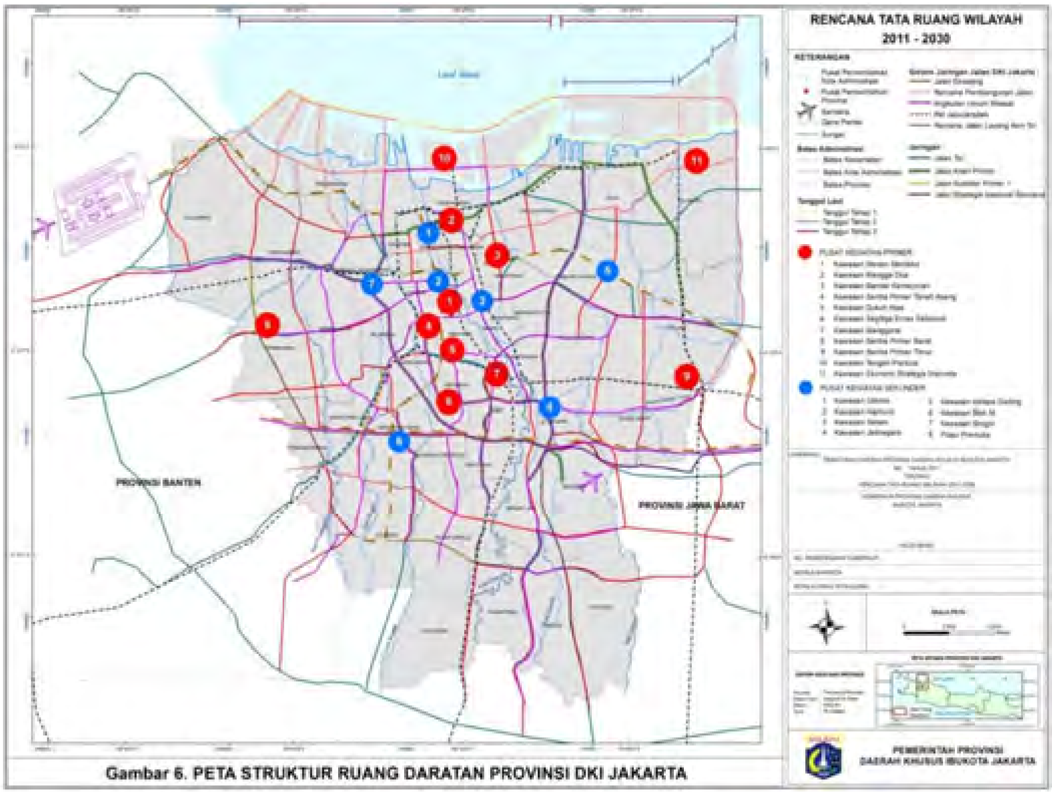


Figure- A.3 Selected 15 Kelurahans by Types of Flood



Source: Spatial Planning Agency of Jakarta

Figure- A.4 Spatial Structure Plan of Jakarta 2030

Tables

Table- A.1 List of Kelurahan by Inundation and Slum Level

No	ID	Kelurahan	Poor	Inundation by	Slum Level
1	205	Wijaya Kusuma	151-450	HT_IW	3
2	212	Kedaung Kali Angke	151-450	HT_IW	4
3	215	Sunter Jaya	151-450	HT_IW	3
4	216	Pegangsaan Dua	151-450	HT_IW	3
5	219	Sukapura	151-450	HT_IW	3
6	227	Pademangan Barat	751-1050	HT_IW	4
7	228	Pademangn Timur	151-450	HT_IW	4
8	229	Cengkareng Timur	151-450	HT_IW	3
9	230	Sunter Agung	151-450	HT_IW	3
10	232	Cengakareng Barat	151-450	HT_IW	3
11	233	Pejagalan	451-750	HT_IW	3
12	235	Kapuk	751-1050	HT_IW	4
13	236	Tugu Utara	151-450	HT_IW	3
14	238	Warakas	151-450	HT_IW	3
15	239	Rawabadak Utara	151-450	HT_IW	3
16	241	Kebon Bawang	151-450	HT_IW	3
17	242	Lagoa	451-750	HT_IW	3
18	243	Semper Barat	451-750	HT_IW	3
19	244	Semper Timur	451-750	HT_IW	3
20	245	Ancol	451-750	HT_IW	4
21	247	Tegal Alur	151-450	HT_IW	4
22	246	Kapuk Muara	151-450	HT_IW	3
23	250	Kamal	451-750	HT_IW	4
24	248	Kalibaru	1051-3000	HT_IW	3
25	251	Koja	451-750	HT_IW	3
26	254	Marunda	451-750	HT_IW	3
27	255	Kamal Muara	151-450	HT_IW	3
28	256	Tanjung Priok	151-450	HT_IW	4
1	125	Pulo Gebang	451-750	RW_IW	3
2	127	Kebon Melati	151-450	RW_IW	4
3	131	Petamburan	151-450	RW_IW	3
4	171	Rawa Terate	151-450	RW_IW	3
5	172	Duri Kepa	151-450	RW_IW	3
6	179	Kedoya Utara	151-450	RW_IW	3
7	187	Rawa Buaya	151-450	RW_IW	3
8	195	Cakung Barat	151-450	RW_IW	3
9	199	Jembatan Besi	151-450	RW_IW	4
10	84	Semanan	n/a	RW_IW	Non slum
1	28	Kampung Tengah	151-450	RW_U	3
2	61	Kebon Pala	151-450	RW_U	3
3	63	Cipinang Melayu	151-450	RW_U	3
4	74	Pondok Kelapa	151-450	RW_U	3
5	78	Bidara Cina	151-450	RW_U	3
6	83	Pondok Bambu	151-450	RW_U	3
7	90	Cipinang Besar Selatan	451-750	RW_U	3
8	95	Cipinang Besar Utara	451-750	RW_U	3
9	97	Klender	451-750	RW_U	4
10	100	Kampung Melayu	151-450	RW_U	3

11	102	Rawa Bunga	151-450	RW_U	3
12	110	Cipinang	151-450	RW_U	3
13	120	Pal Meriam	151-450	RW_U	3
14	121	Pegangsaan	151-450	RW_U	3
15	124	Palmerah	151-450	RW_U	3
16	128	Jatinegara	451-750	RW_U	3
17	141	Kebon Jeruk	151-450	RW_U	3
18	151	Pulo Gadung	151-450	RW_U	3
19	165	Kayu Putih	751-1050	RW_U	3
20	260	Bukit Duri	151-450	RW_U	3
1	208	Angke	151-450	HT_U	3
2	209	Jembatan Lima	151-450	HT_U	3
3	221	Pekojan	151-450	HT_U	3
4	253	Penjaringan	1051-3000	HT_U	4

33 Kelurahan short list after second screening conducted

Table- A.2 Selected 15 Kelurahan

No	ID	Kelurahan	Poor	Inundation by	Slum Level	Kota	Remarks	Back up
1	253	Penjaringan	1051-3000	HT_U	4	North	Purely high tide	None
1	212	Kedaung Kali Angke	151-450	HT_IW	4	West	Cengkareng Canal Area	-Pejagalan -Simper Barat -Simper Timur -Kalibaru -Koja
2	227	Pademangan Barat	751-1050	HT_IW	4	North	Ancol Canal Area	
3	228	Pademangan Timur	151-450	HT_IW	4	North	Ancol Canal Area	
4	235	Kapuk	751-1050	HT_IW	4	West	West Canal Area	
5	245	Ancol	451-750	HT_IW	4	North	Ancol Canal Area	
6	247	Tegal Alur	151-450	HT_IW	4	West	Cengkareng Canal Area	
7	254	Marunda	451-750	HT_IW	3	North	Downstream of East Canal	
8	256	Tanjung Priok	151-450	HT_IW	4	North	Ancol Canal Area	
1	171	Rawa Terate	151-450	RW_IW	3	East	Stagnant of water	-Pulo Gebang -Kayu Putih -Sunter Jaya -Pegangsaan Dua
2	179	Kedoya Utara	151-450	RW_IW	3	West	West Canal Area	
3	131	Petamburan	151-450	RW_IW	3	Central	Ciliwung River Area	
1	78	Bidara Cina	151-450	RW_U	3	East	Ciliwung River area	Cipinang Melayu
2	141	Kebon Jeruk	151-450	RW_U	3	West	West Canal Area	
3	260	Bukit Duri	151-450	RW_U	3	South	Ciliwung River Area	

Table- A.3 Number of Schools by Kabupaten/Kotamadya, 2009/2010

Kabupaten/ Kotamadya	Education Level				Total
	Kindergarten	Primary School	Junior High School	Senior High School	
Kepulauan Seribu	2	15	6	4	27
South Jakarta	208	799	255	248	1,510
East Jakarta	344	954	338	330	1,966
Central Jakarta	136	410	127	137	810
West Jakarta	160	774	275	235	1,444
North Jakarta	150	495	206	168	1,019
DKI Jakarta	1,000	3,447	1,207	1,122	6,776

Source: Jakarta dalam Angka 2010

Table- A.4 Number of Health Facilities by Kabupaten/Kotamadya, 2009

Health facility	Kepulauan Seribu	South Jakarta	East Jakarta	Central Jakarta	West Jakarta	North Jakarta	DKI Jakarta
Hospital	1	36	31	31	20	17	136
Maternity Hospital	0	27	13	18	22	24	104
Puskesmas	2	10	10	8	8	6	44
Pustu	6	68	78	33	67	43	295
Medical Clinics	0	51	152	175	248	153	779
Dental Health Center	0	23	9	42	29	22	125
Laboratories	0	31	20	44	49	31	175
Dispensaries	0	323	396	54	437	298	1508
	9	569	709	405	880	594	3,166

Source: Jakarta dalam Angka 2010

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