

IMPACTS OF SEA LEVEL RISE in Bangkok, Thailand

Hiroaki KAKIUCHI

Chuo Mapping Co., Ltd

Takekazu AKAGIRI, Takahito KUROKI, Tohru NAGAYAMA

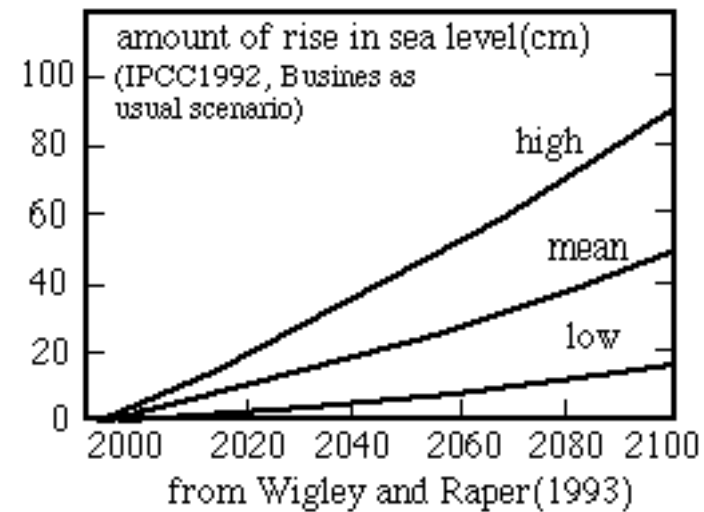
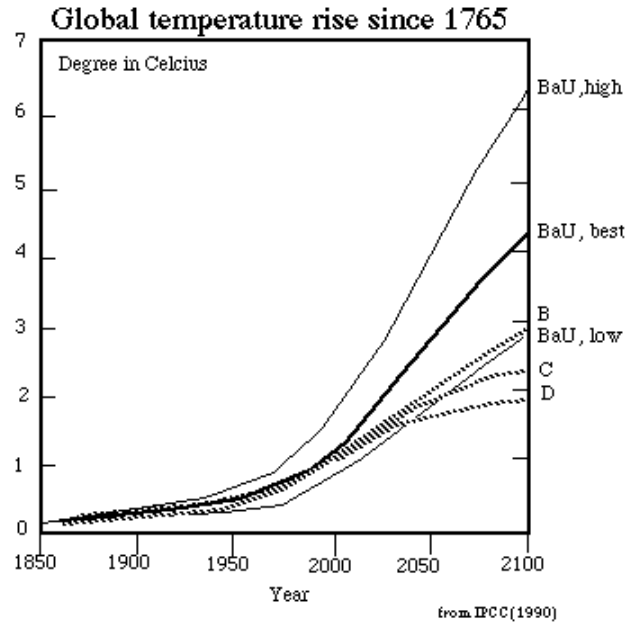
Geographic Survey Institute, Min. of Construction, JAPAN

Shunji MURAI, Ryosuke SHIBASAKI, Masataka TAKAGI

Institute of Industrial Science, Univ. of TOKYO

Course of Sea Level Rise

- ◆ Global Warming by Green House Gas Emission
 - ◆ Ice-melting
 - ◆ Increasing Precipitation



Related Factors of Sea Level Rise

- ◆ Ground Subsidence
 - ◆ Pumping Ground Water

- ◆ Poor Drainage
 - ◆ Construction of Artificial Structure

- ◆ Beach Erosion
 - ◆ Reclamation of Mangrove Forest

Objectives

- ◆ Estimation of Submergence Area from DEM
- ◆ Prediction of Damage by using R/S data and GIS
 - ◆ Population
 - ◆ Property Loss
- ◆ Evaluation of Land Use Suitability using GIS

Materials

Test Area: Bangkok, Thailand

◆ Digital Elevation Model

- ◆ Contour Maps and LANDSAT TM
- ◆ Field Measurement using GPS

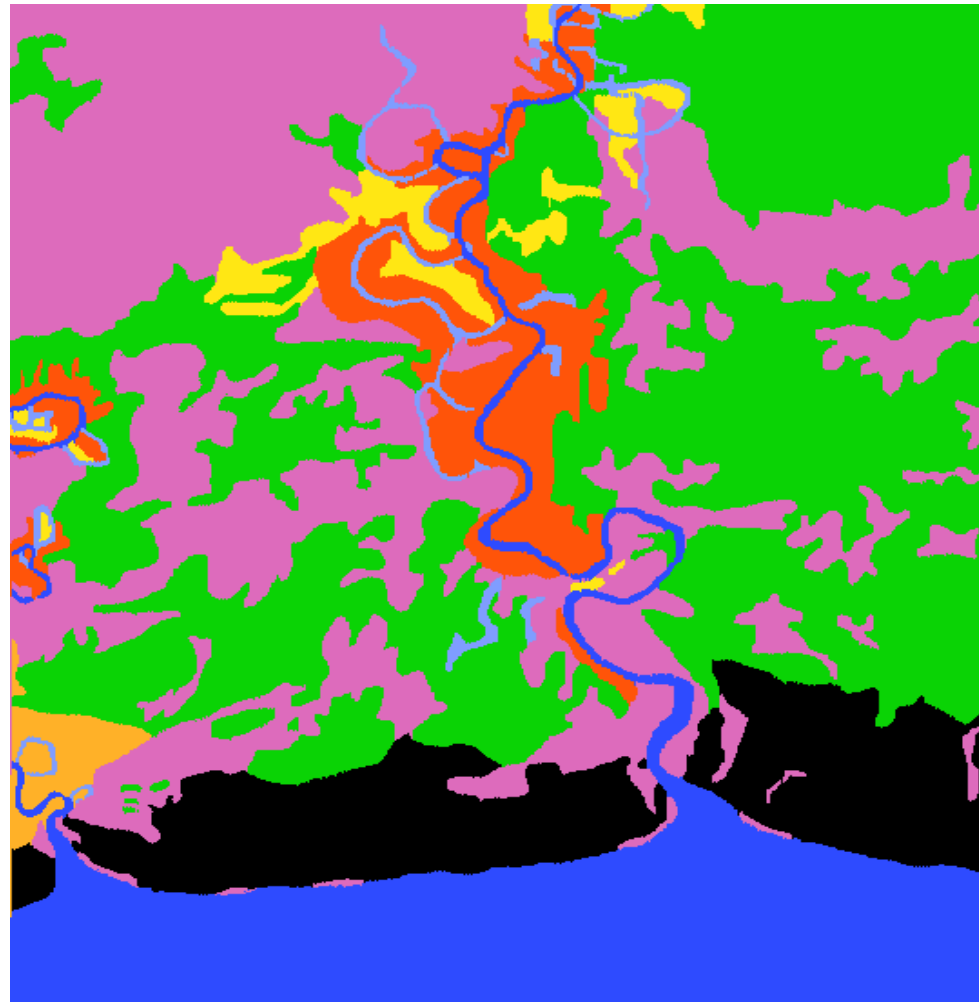
◆ Land Use Map using LANDSAT TM

- ◆ Visual Interpretation by Expert
- ◆ Automated Classification by Maximum Likelihood Method

◆ Socio-Economic Data

- ◆ Population
- ◆ Land Productivity
- ◆ Land Price

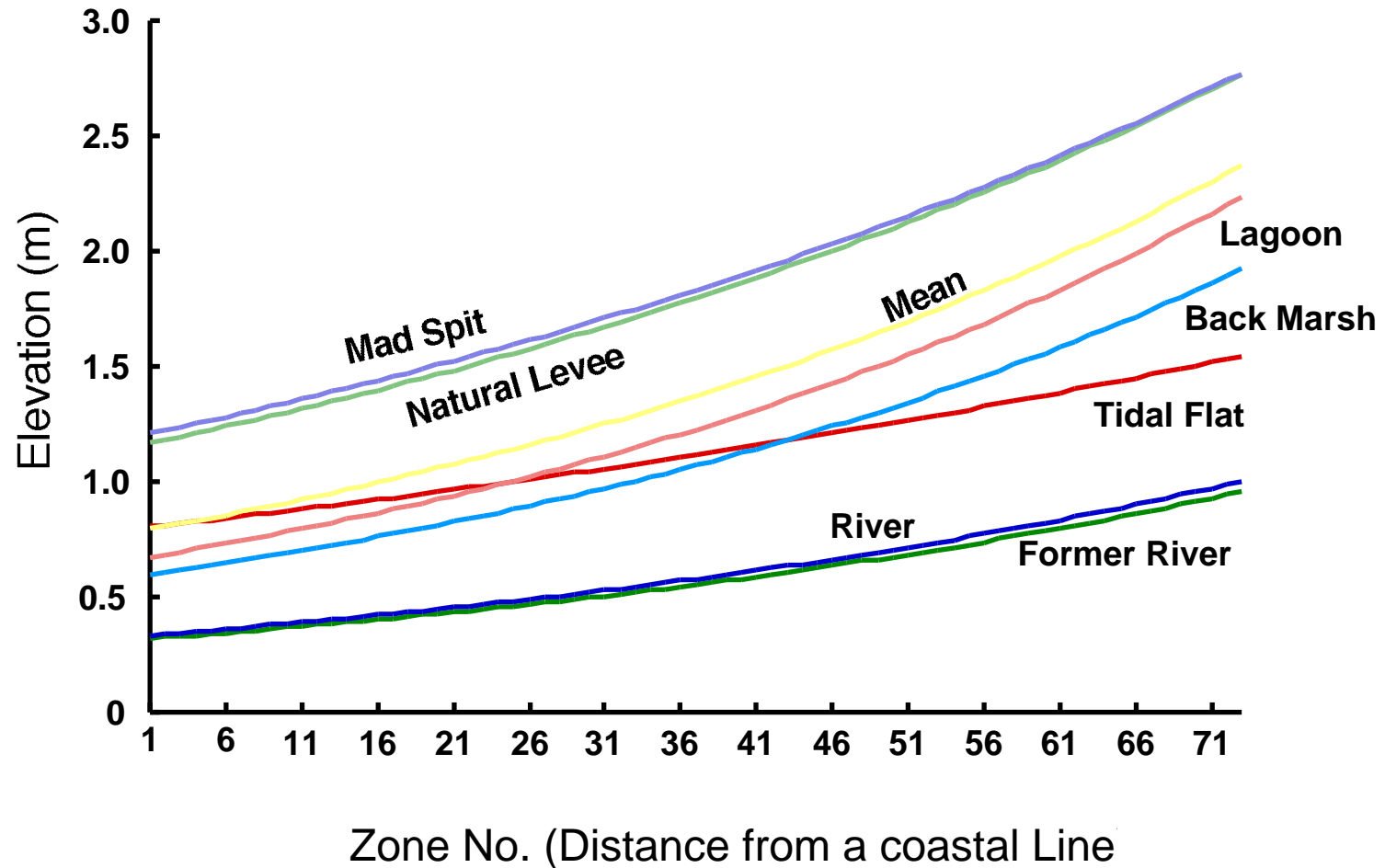
Geomorphological Map from LANDSAT TM



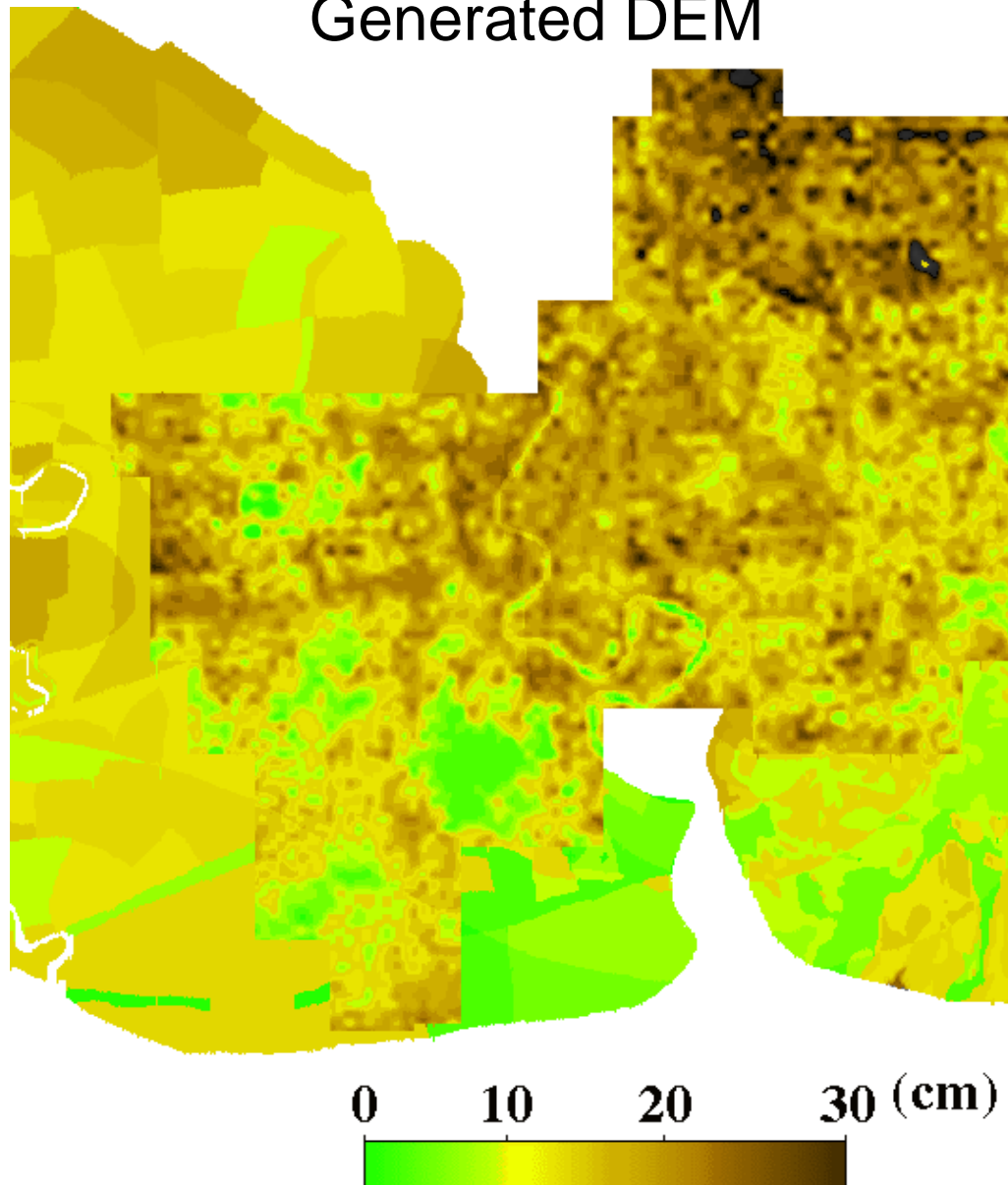
0 5 10km



Averaged Profile in Each Geomorphological Classes



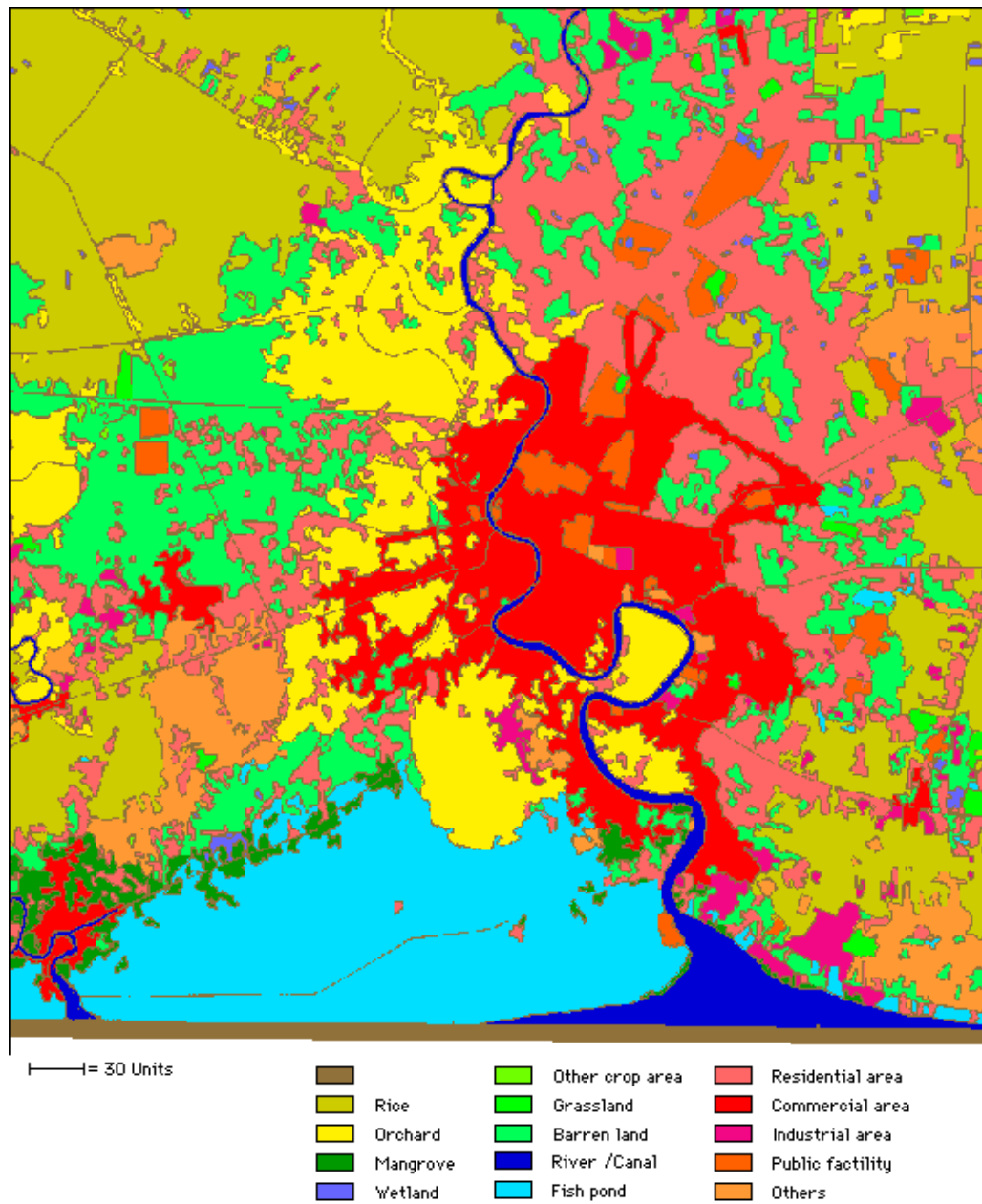
Generated DEM



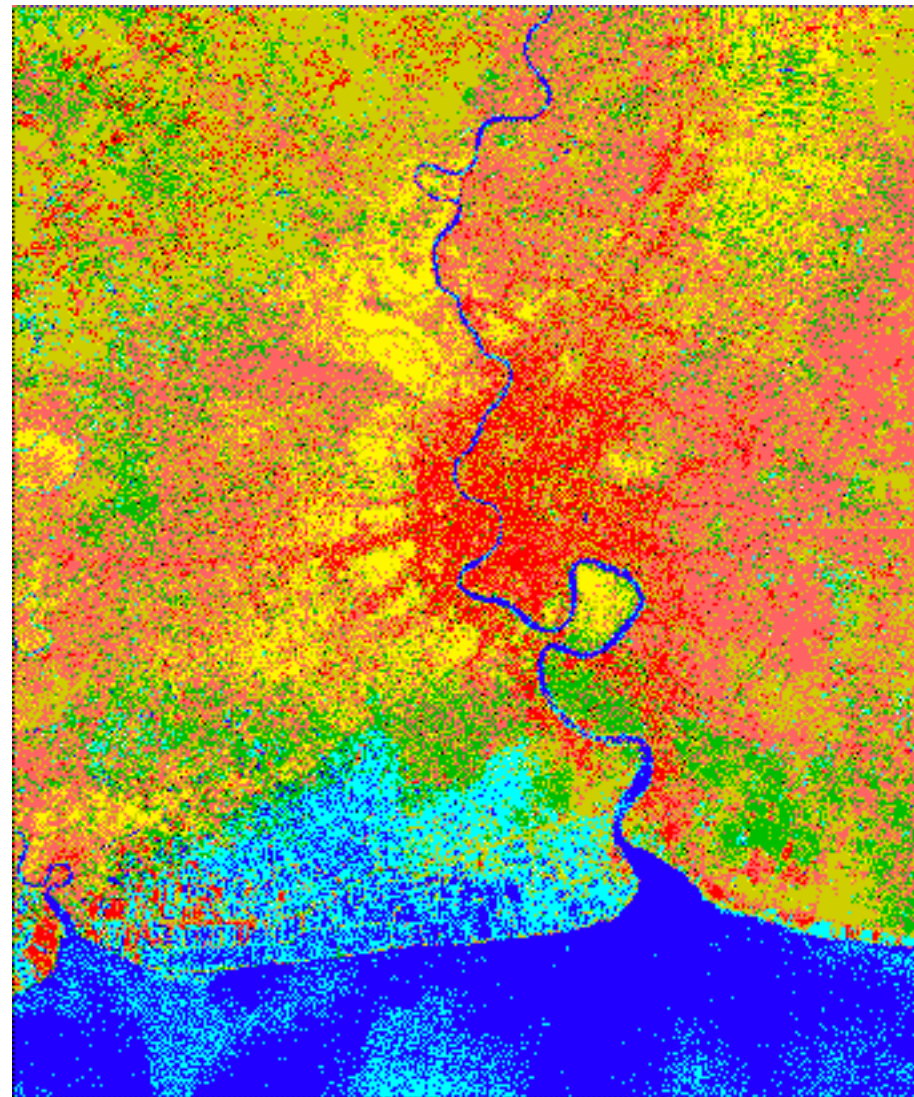
LANDSAT TM False Color Image



Land Use Map by Visual Interpretation



Land Use Map by Maximum Likelihood Method

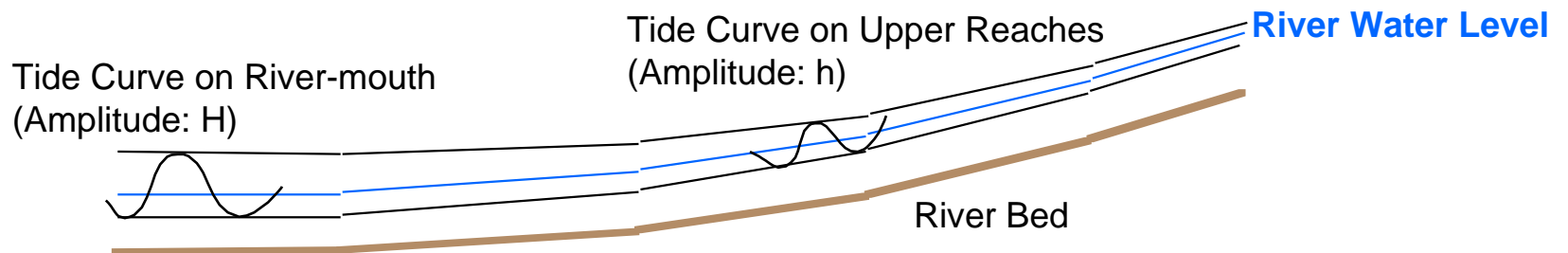


Estimation Method of Submergence Area

- ◆ Submergence area according to sea level rise can be calculated from DEM
- ◆ Sea level rise influences river water level and tide
 - ◆ Corrected DEM was used

$$\text{Corrected Elevation} = \text{Current Elevation} - \left(\left(\frac{\text{Sea Level Rise}}{\text{Reduction Ratio}} \right) + \text{River Water Level} \right)$$

General Idea of Corrected Elevation Calculation

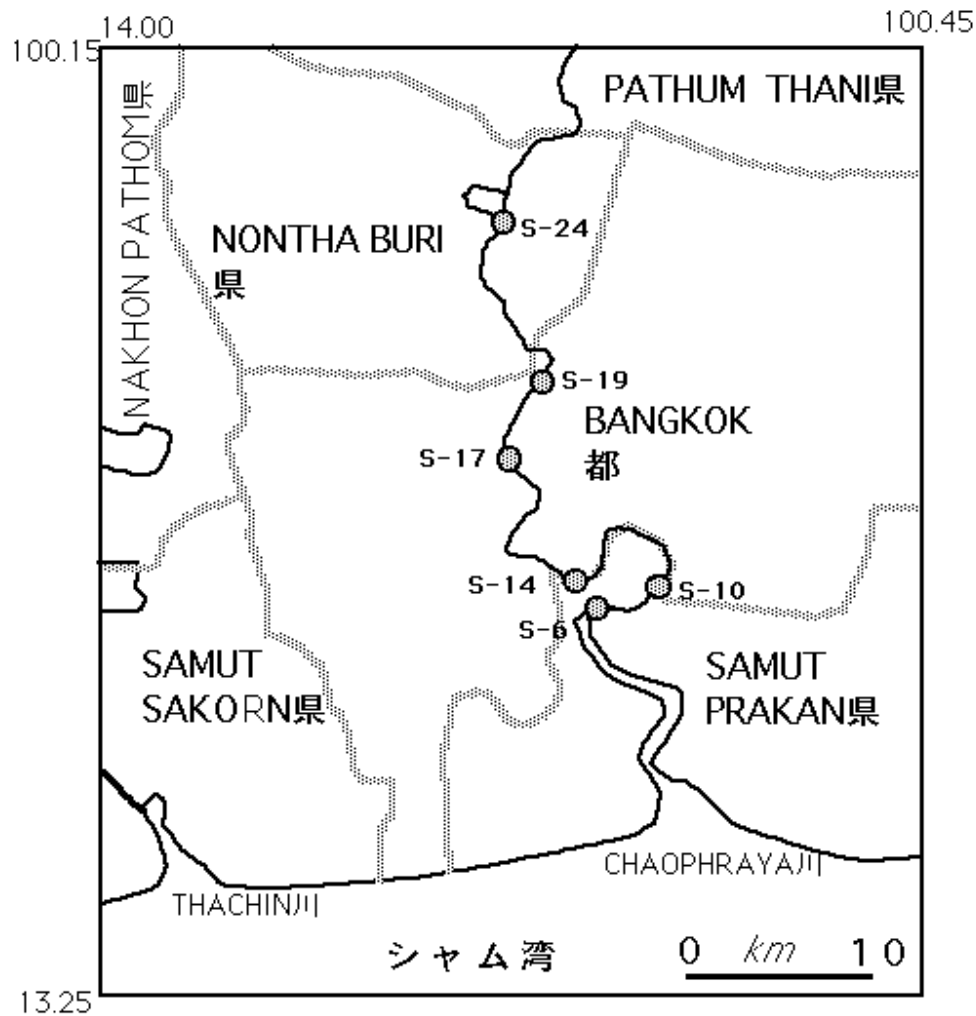


$$\text{Corrected Elevation} = \text{Current Elevation} - \left(\left(\frac{\text{Sea Level Rise}}{\text{Reduction Ratio}} \right) + \text{River Water Level} \right)$$

$$\text{Reduction Ratio} = h/H$$

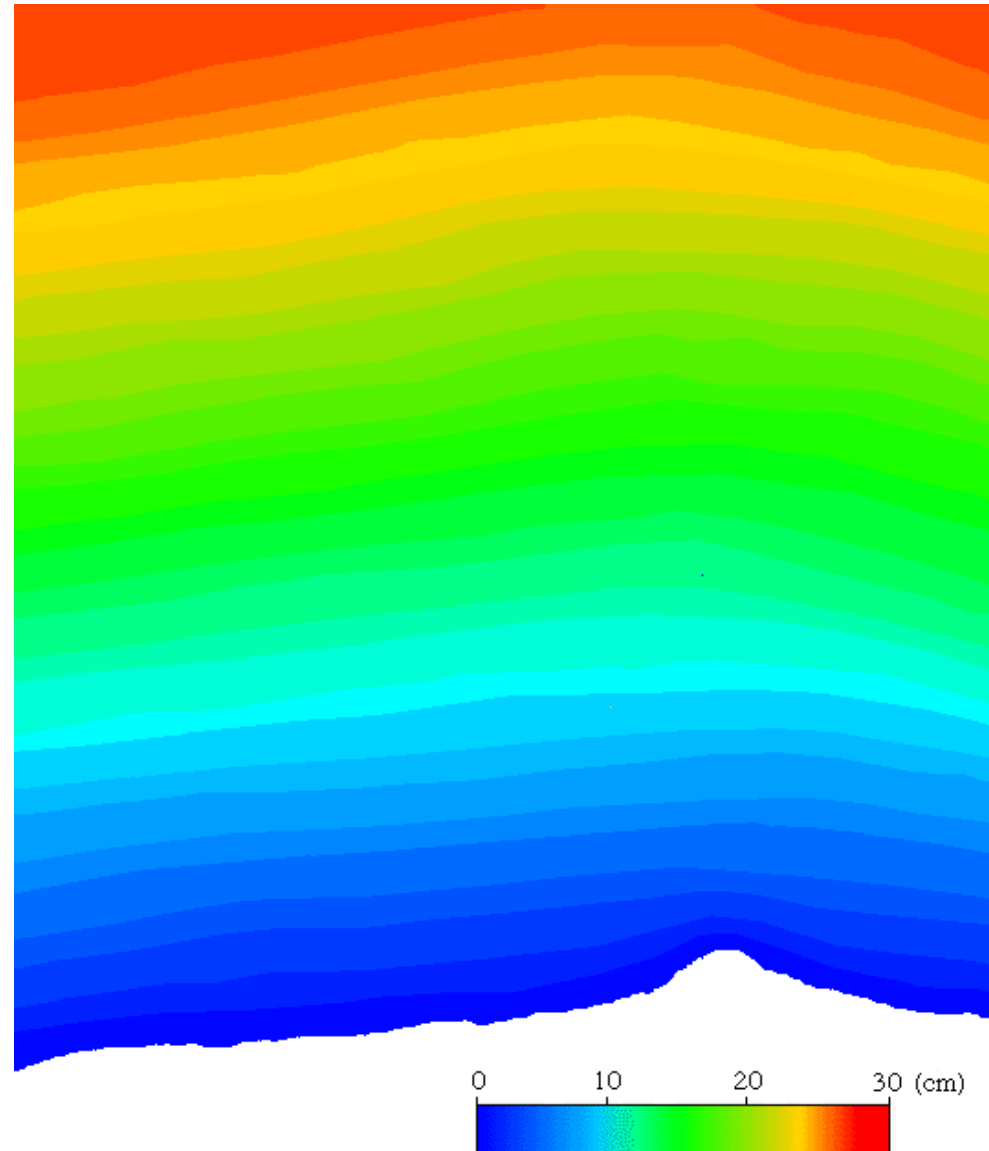
Estimation of River Water Level Increasing by Sea Level Rise

Water Level Measurement Points and the Results

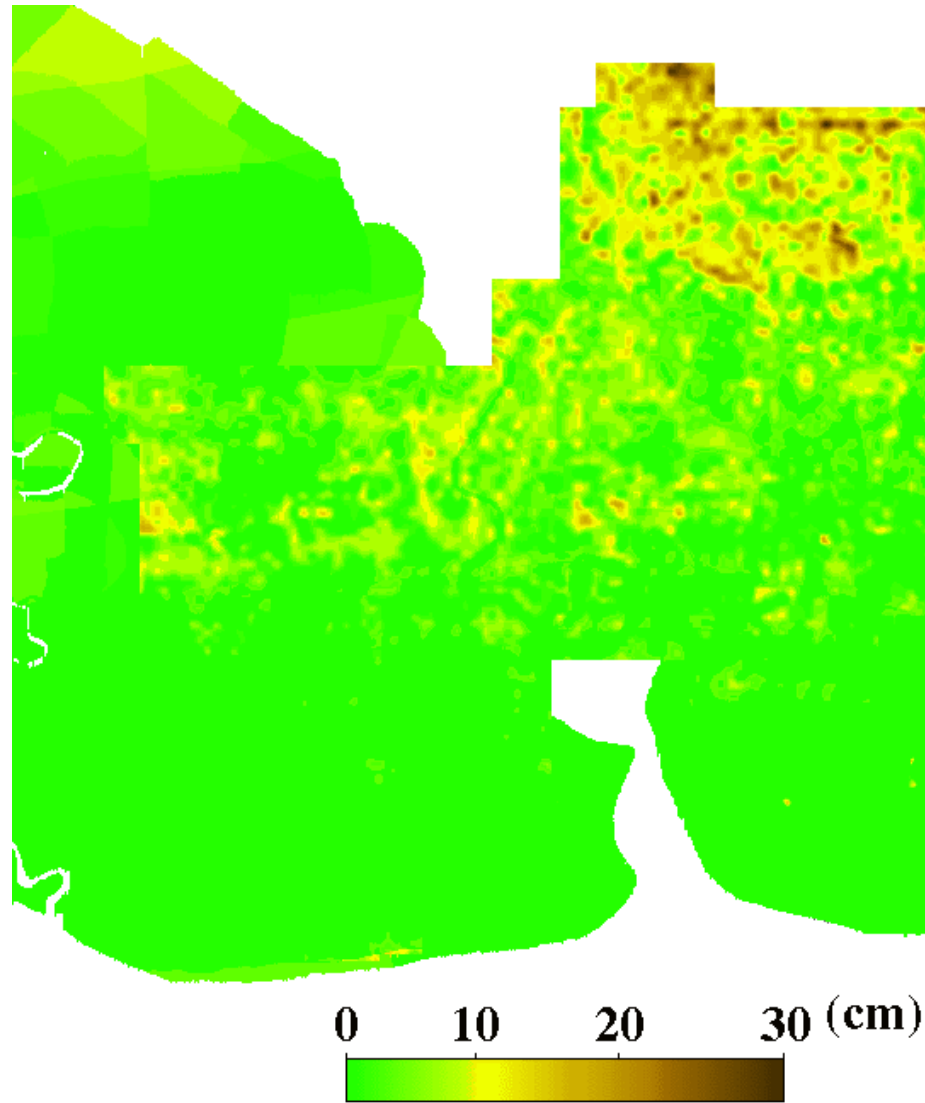


No.	Water Level	Amplitude	Reduction Ratio
S-06	55.00	166.00	100.00
S-10	76.00	140.00	84.00
S-14	105.00	105.00	63.00
S-17	136.00	64.50	39.00
S-19	148.00	47.00	28.00
S-24	192.00	22.50	14.00
	(cm)	(cm)	(%)

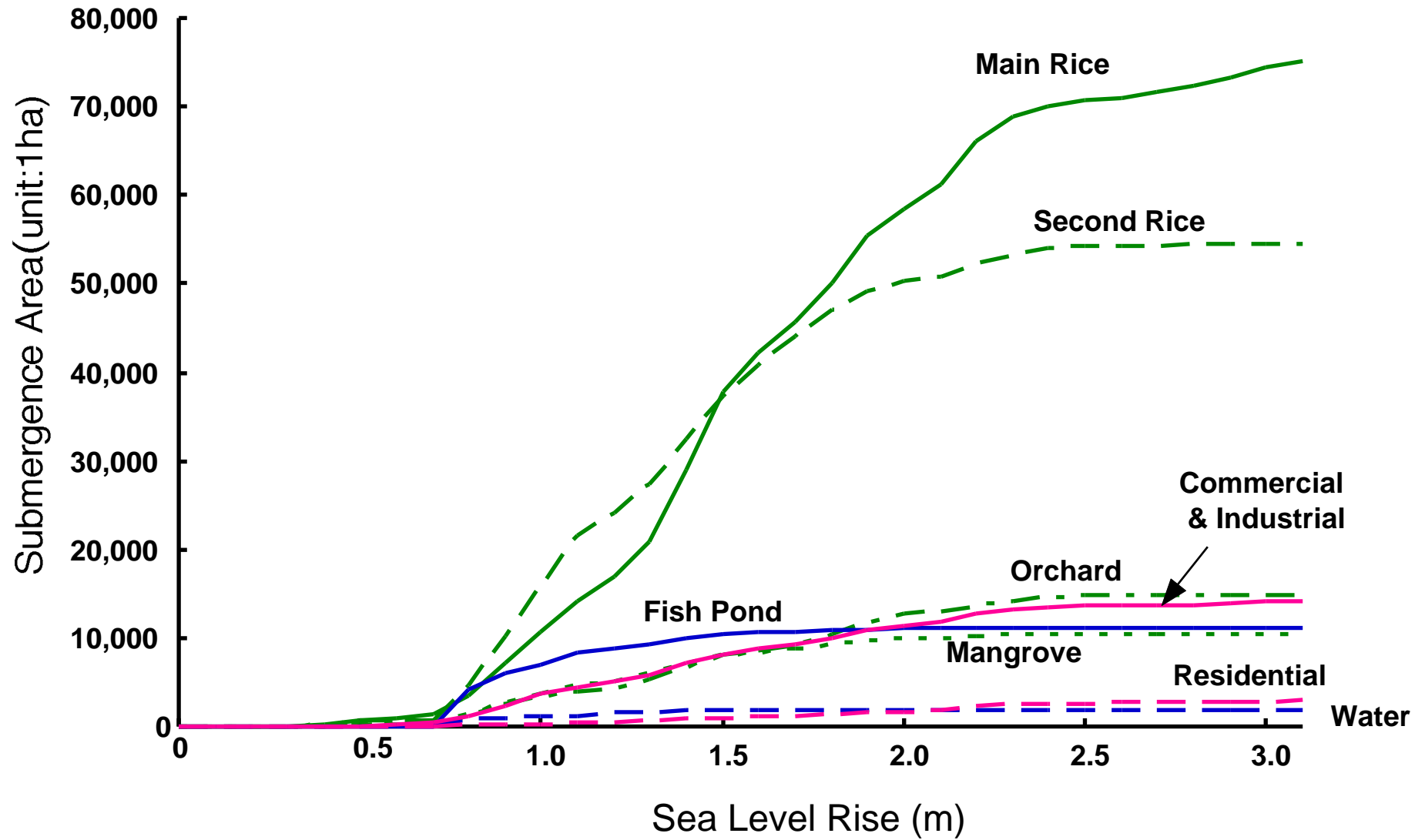
Estimated River Water Level Map



Estimated Submergence Area by 1m Sea Level Rise



Estimated Submergence Area by Sea Level Rise



Estimation of Degree of Damage

◆ Socio-Economic Data

- ◆ 103 Administrative Districts (Tanbon) in test Area
- ◆ Population, Land Price, Economic Productivity (from NRCT)

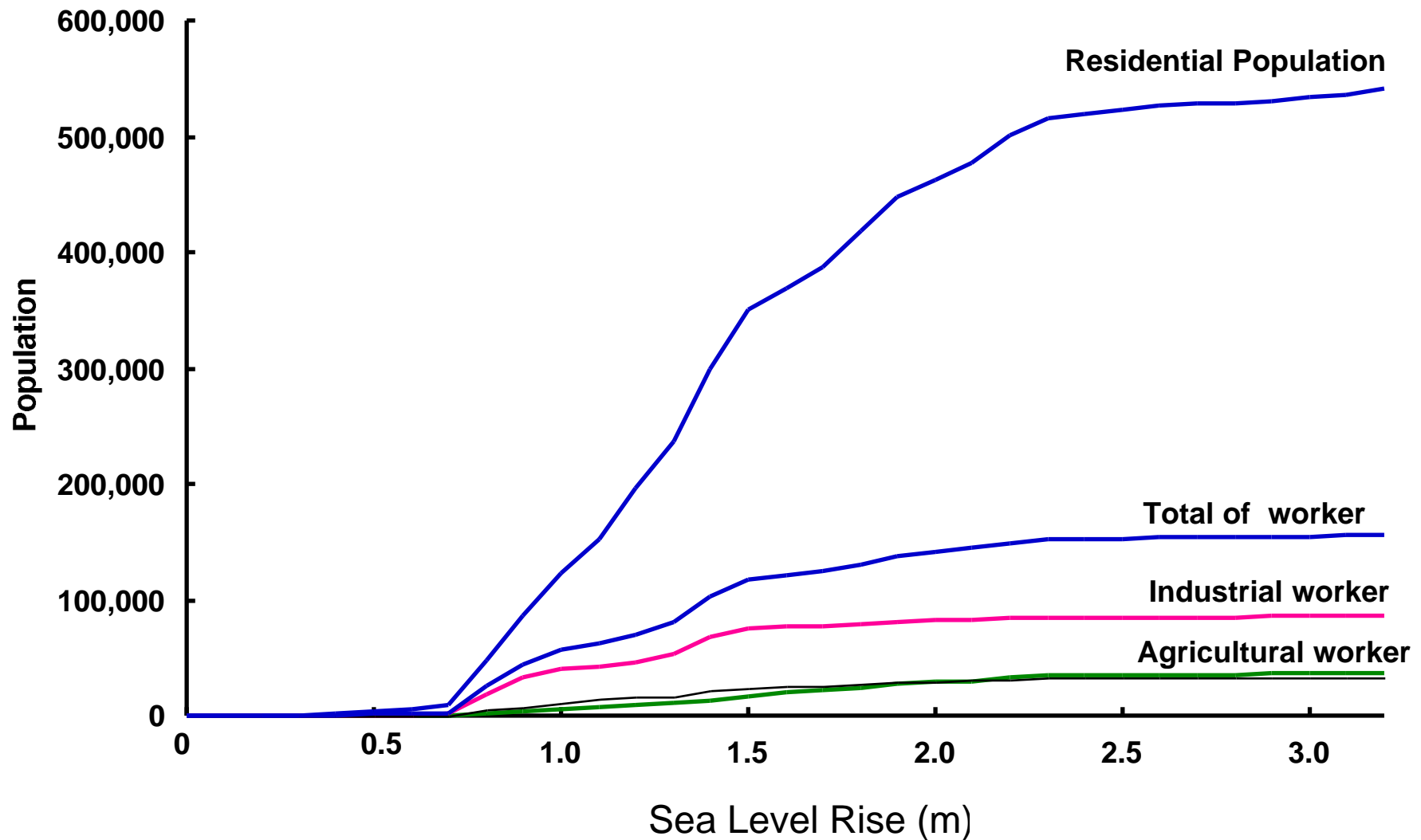
Land Price

Land Use	Land Price
Paddy Field	1750
Orchard	1833
Mangrove	2250
Fish Pond	1333
Residential	5000
Commercial	15313
	(Baht/m ²)

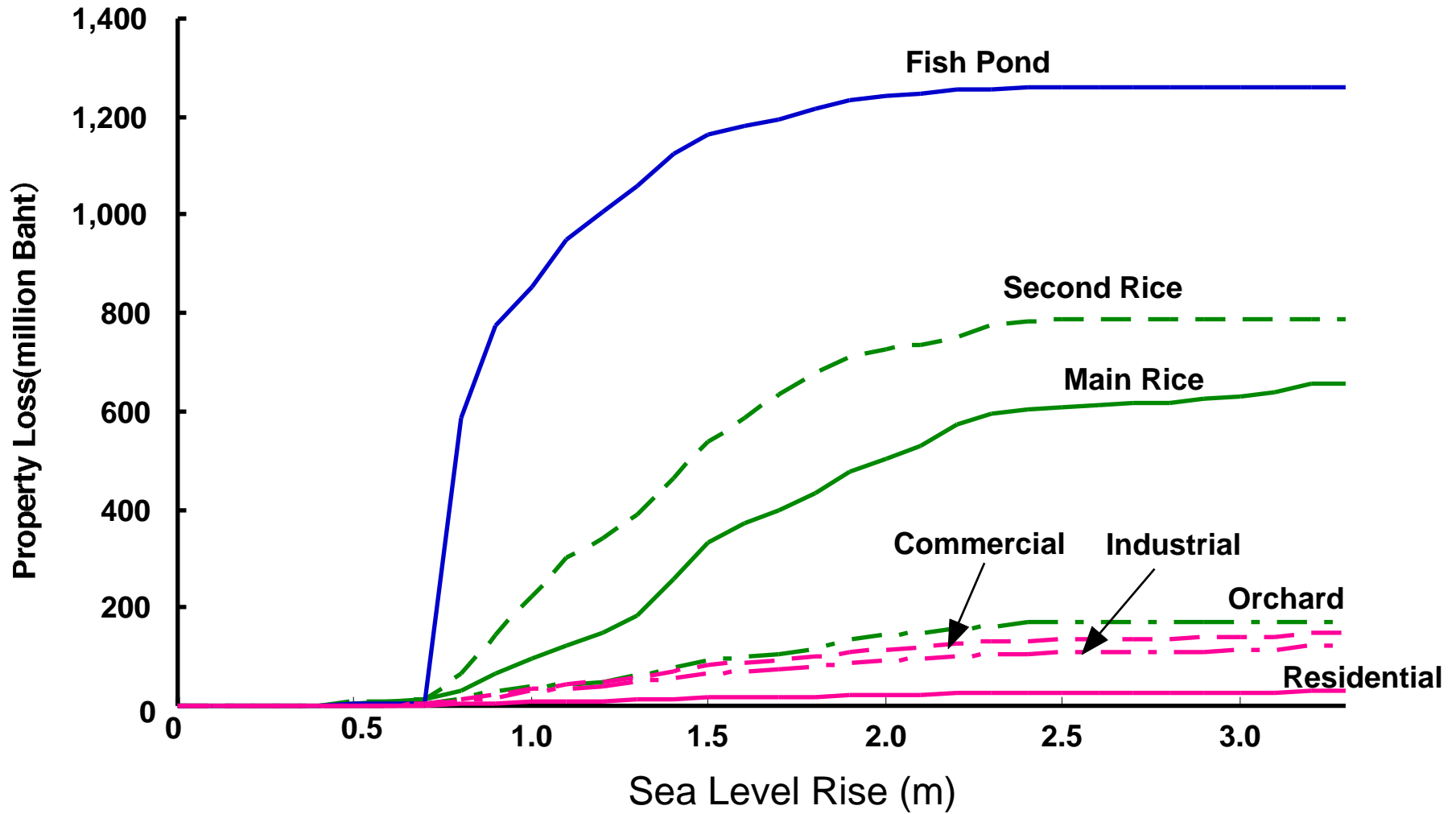
Productivity

Land Use	Productivity
Commercial	1060
Residential	37
Industrial	4260
Agricultural	9
Fish Pond	5
Other	727
	(Baht/m ²)

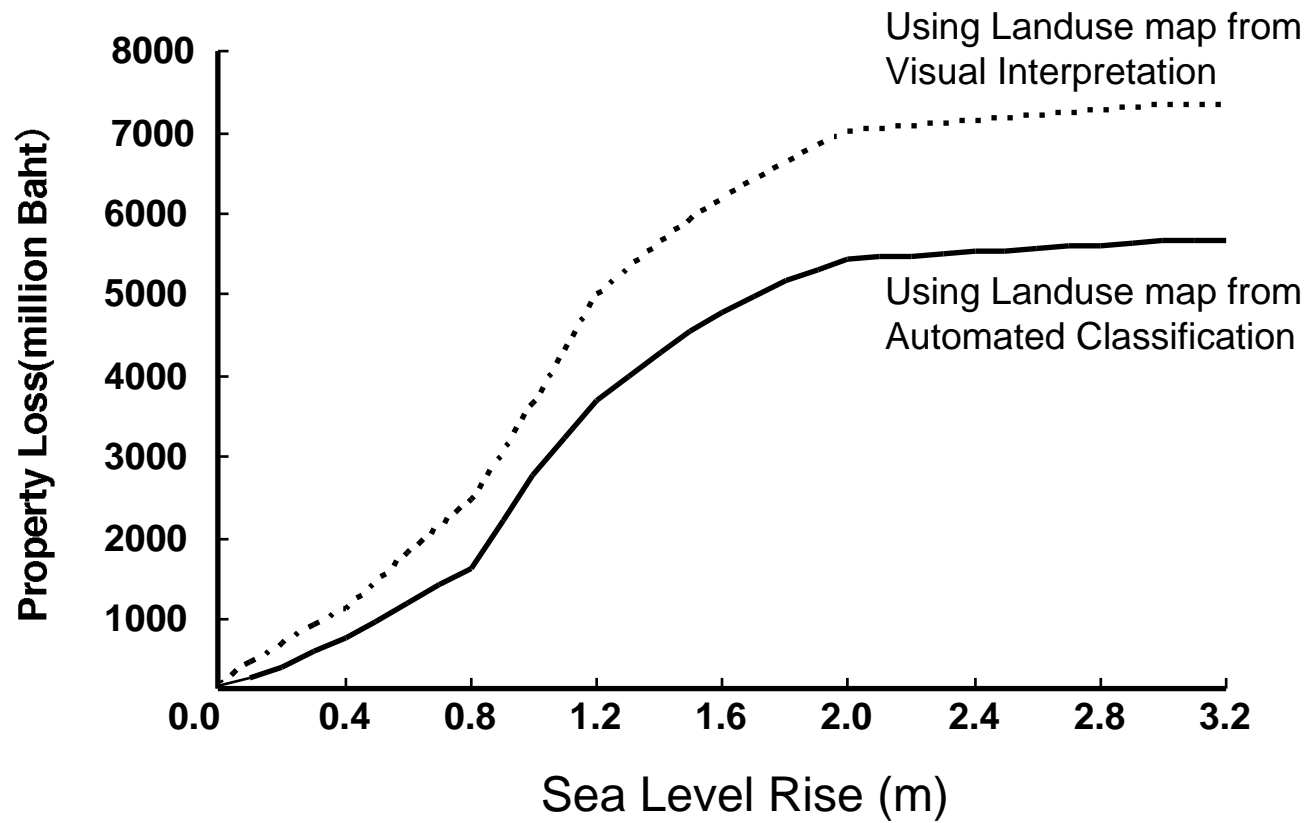
Estimated Suffered Population by Sea Level Rise



Estimated Economic Property Loss by Sea Level Rise



Estimated Property Loss from each Land Use Map

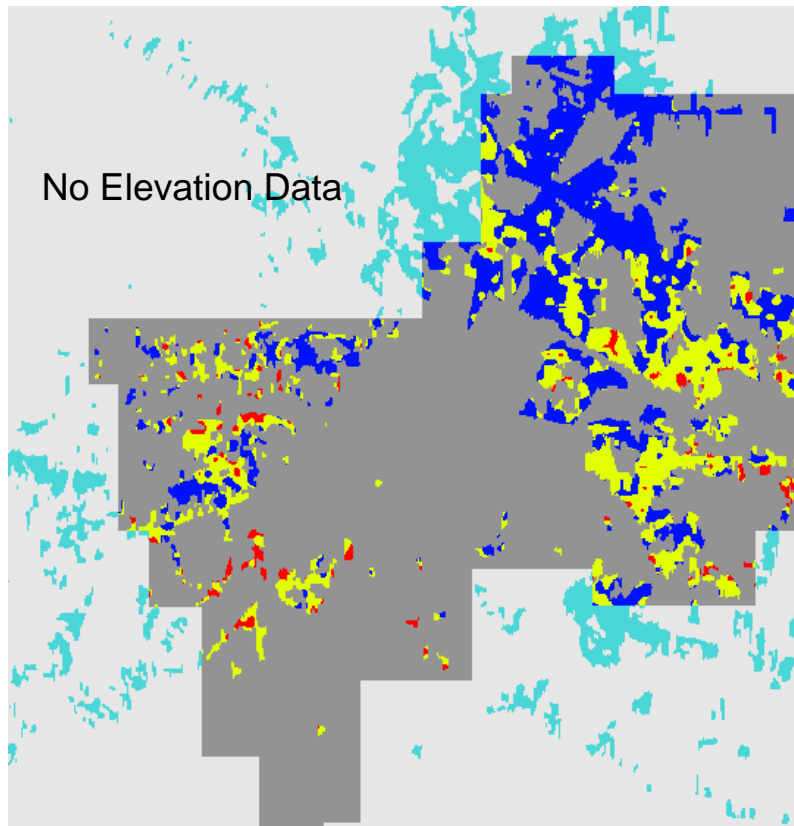
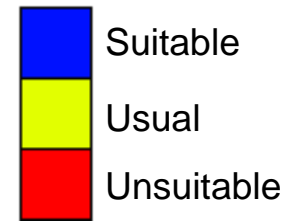


Suitability of Current Land Use

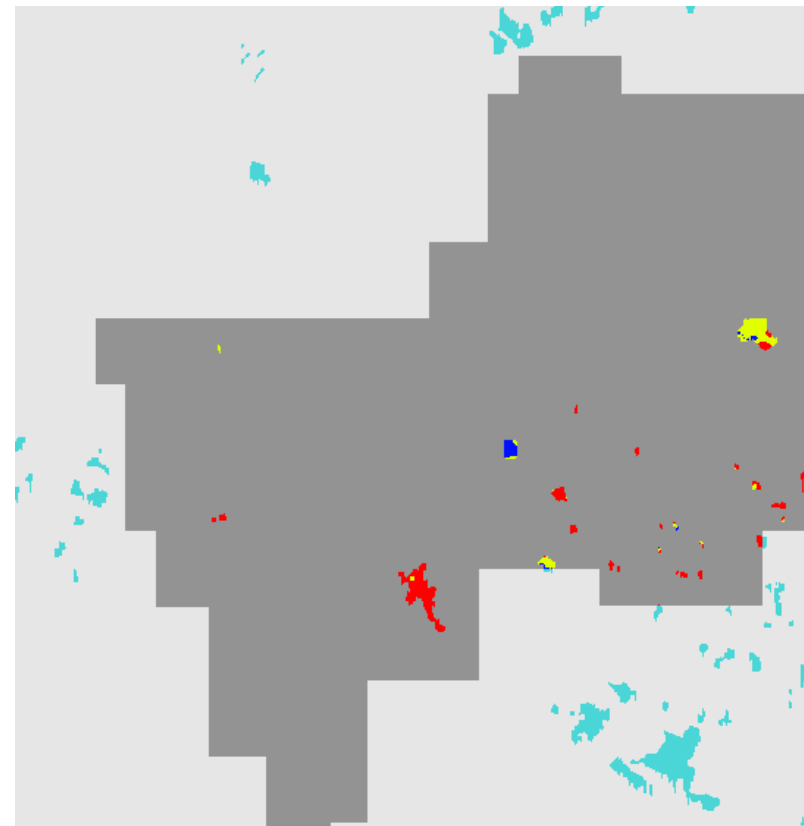
Items	Unsuitable	Usual	Suitable
Residential	0.0-0.8	0.9-1.6	1.7-5.0
Industrial	0.0-1.6	1.7-2.2	2.3-5.0
Commercial	0.0-1.2	1.3-1.8	1.9-5.0
Public Facility	0.0-1.4	1.5-2.0	2.1-5.0
Rice Field	0.0-0.8	0.9-2.0	2.1-5.0
Orchard	0.0-0.8	0.9-1.6	1.7-5.0
Fishpond	0.0-0.6	0.7-1.4	1.5-5.0

Evaluation Table of Land Use Category and Corrected Elevation

Suitability Map

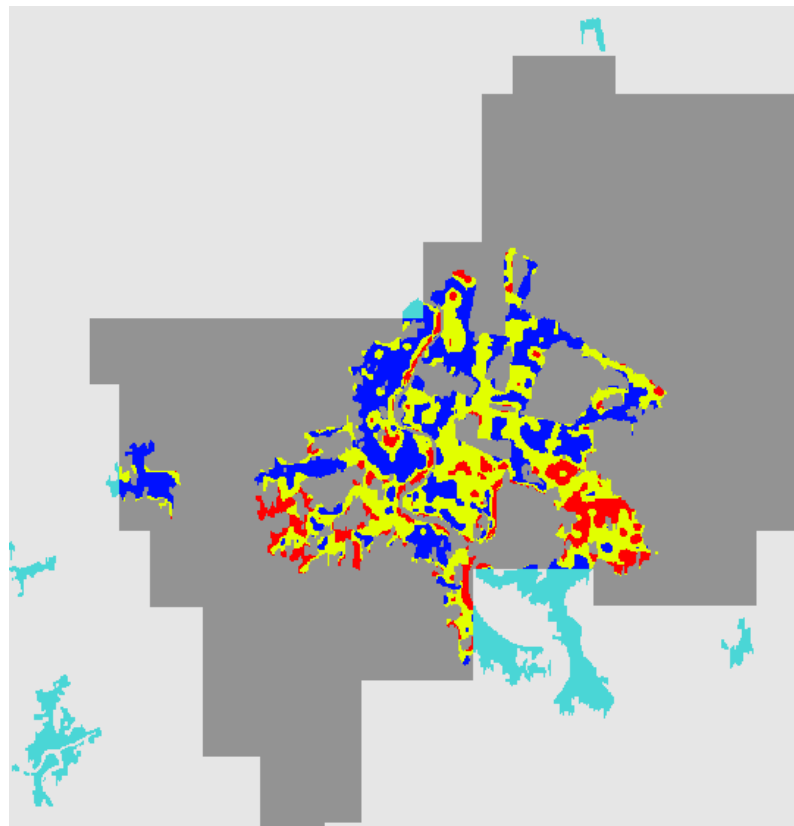
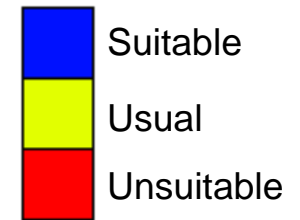


Residential Area

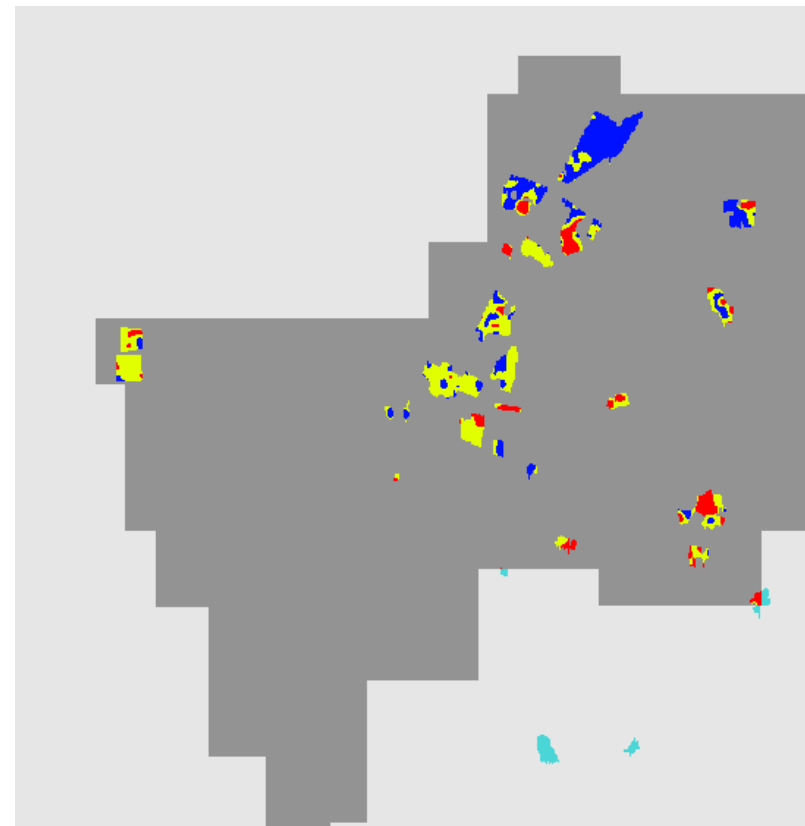


Industrial Area

Suitability Map

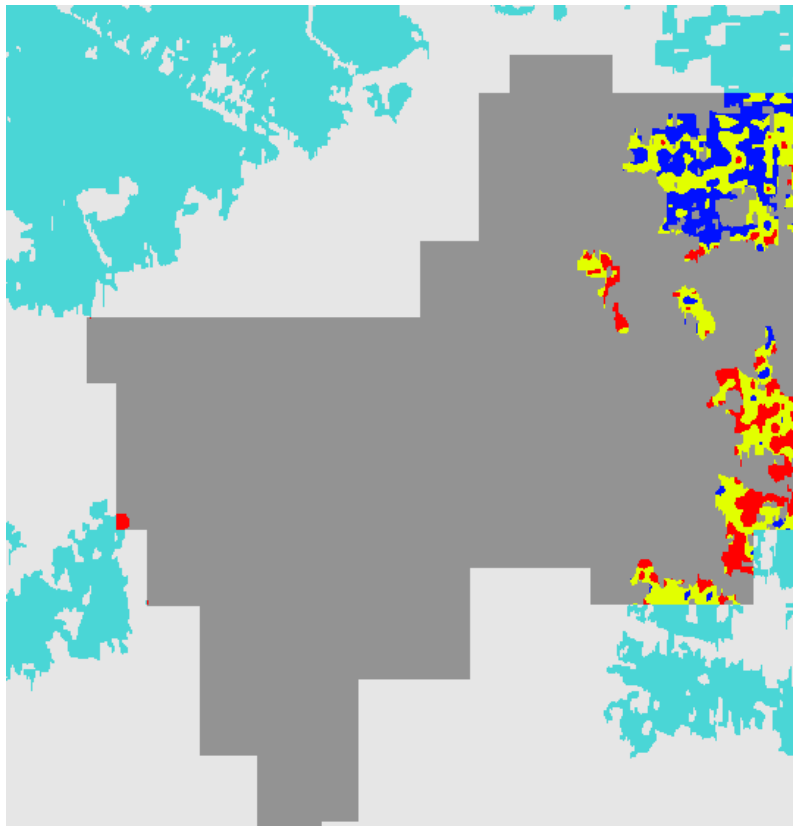
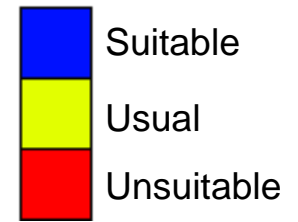


Commercial Area

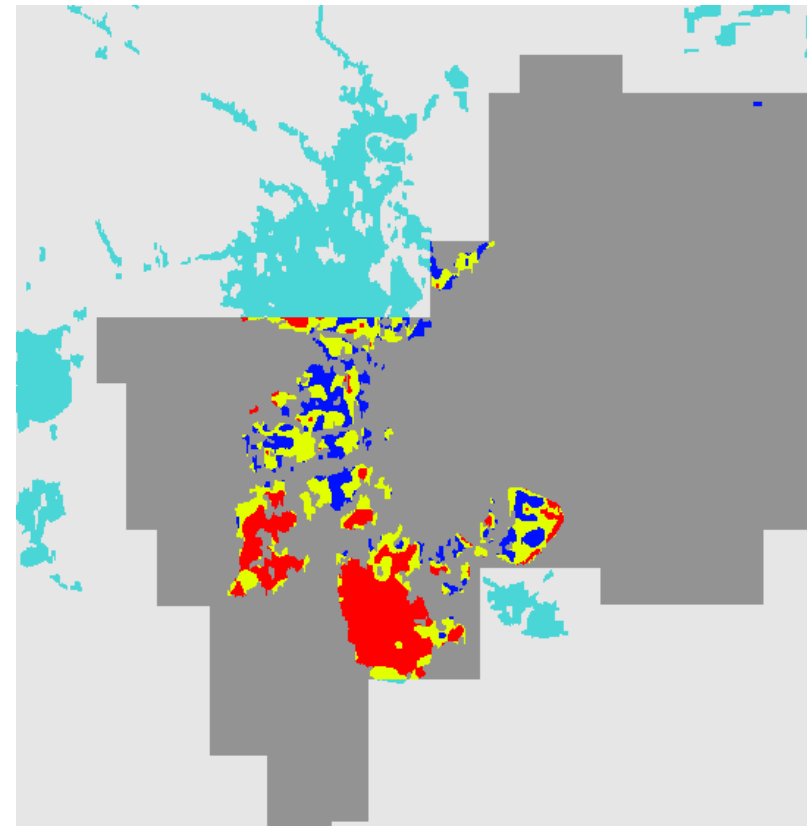


Public Facility

Suitability Map



Rice Field



Orchard

Conclusions

- ◆ Submergence area can be extracted from DEM.
 - ◆ High accurate DEM is required.
- ◆ GIS was very efficient for damage prediction.
- ◆ 1m rise of sea level will make serious damage in Bangkok.