B-10.1 Estimation of influence of sea level rise in coastal regions

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Abstract Rapid sea level rise (SLR) induced by global warming has been predicted in recent years. According to IPCC (Intergovernmental Panel on Climate Change) medium estimation, the rate of SLR would be 6mm per year during 21st century and the total SLR by 2100 would be 65cm. Global warming and SLR would change climates and hydrologic conditions in coastal regions around the worldwidely. These changes will induce natural disasters such as flood, innerflood, storm surge, salinization, along coastal regions. In order to adopt appropriate measures to these disasters and other effects of SLR, assessments of effects of SLR should be implemented.

We studied the method for grasping coastal properties which would be drowned in future under the "do-nothing" regime. First, acquiring ground elevation data, we can confirm the inundated area in the future. Processing land use data and socio-economic statistics, we can assign particular property density (unit value of property), to each landuse. Finally, we could get the lost properties by multiplying inundated area for each landuse by property density.

We selected the studied area both in Japan and Thailand. In Japan, we studied Kumamoto plain in Kyushu in 1990 and 91 FY, and Nohbi plain in Honshu in 1992 FY. In Thailand, we studied Bangkok area in 1990 and 91 FY and Bangpakong area, east of Bangkok, in 1992FY. In all the studied areas, we estimated the lost properties and affected population.

Key words Sea Level Rise, Ground elevation, Landuse, Lost property, Remote Sensing

1. Introduction

It has been predicted that SLR brings natural disasters such as permanent inundation, flood, storm surge, salinization, etc. to coastal regions all over the world. In order to adopt appropriate measures to these disasters and the other effects of SLR, basic assessments of effects of SLR should be implemented. Among these assessments, grasping the amount of properties in becoming drowned area by SLR is very important. Noticing the relationship between landuse and property density, we estimated the amount of lost property in drowned area in the future. Main framework of our study are shown in Fig. 1.

2. Research method and Results

(1) Case studies in Japan

In Japan, since the basic data are available, we developed the method of efficient data processing and the grasping precise amount of properties. The items of evaluated property are seven, land value, architecture, compensated property, stock property, productivity, population,

and working population .

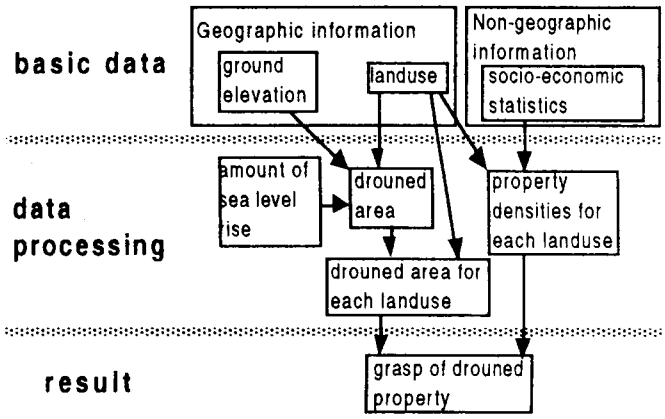

Fig. 1 Main flamework of the study

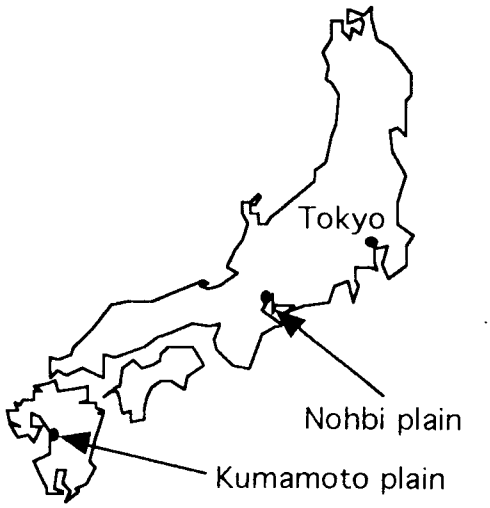

Fig. 2 Studied area in Japan

① Kumamoto plain.

We selected Kumamoto plain in Kyushu as the studied area in 1990-1991 FY(Fig.2). In 1990, a computer program to edit the ground elevation data from big scaled map(1:2,500) into 1:50,000 ground elevation map in the area. In 1991, Using this ground elevation map, land use data and socio-economic statistics, we evaluate the amount of lost properties at each 1m step of SLR (25cm step, from 0m-2m rise) up to 9m.

② Nohbi plain

In 1992 FY, an evaluation of lost properties of Nohbi plain in central Japan was carried out(Fig. 2). Nohbi plain, including Nagoya metropolitan area, has the biggest area below sea level in Japan. The inundated area at 1m SLR is shown in Fig.3. The amount of lost land value from 0m SLR to 5m are shown in Fig.4. The total amount of lost properties at 1m SLR are shown in Fig.5.

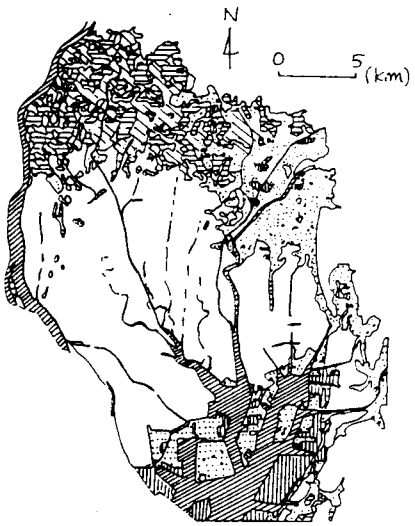

Fig. 3 Inundated area at 1m SLR

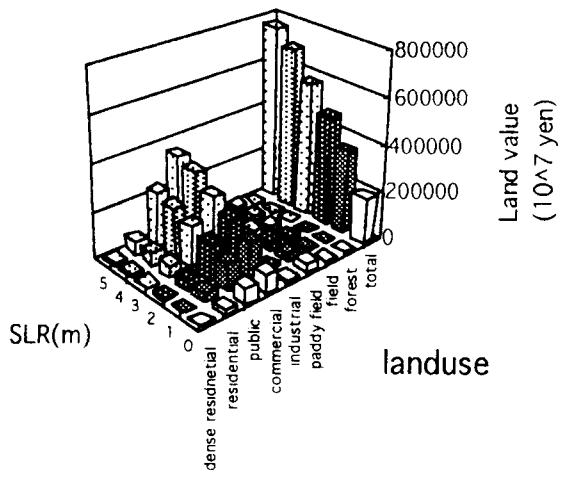

Fig. 4 Lost land value by SLR (0-5)m

socio-economic property	Land value	Architecture	compensated property	stock property	productivity	residential population	working population
unit	10^8 yen	10^8 yen	10^8 yen	10^8 yen	10^8 yen/year		
dense residential	3995	3599	1332	0	0	71044	
residential	34033	32504	12011	0	0	685348	
public	111190	2435	4874	132	4544		35266
commercial	156500	4177	8353	3012	18323		218118
industrial	13082	2819	5636	3118	11551		157665
paddy	33558	49	95	13	105		8927
field	7554	21	33	8	31		2357
forest	109	0	0	0	1		6
water	0	5	8	1	10		267
total	360021	45609	32342	6284	34565	756392	422606

Fig. 5 Affected properties at 1m SLR in Nohbi plain

(2) Case studies in Thailand

Generally, the basic data are not always available in developing countries due to lack of land information. Therefore, we got landuse and ground elevation data from satellite image. The studies in Thailand, we have been carried out in cooperation with Thai counter part, Remote sensing division of NRCT (National research council, Ministry of Science, Technology and Energy)

① Bangkok area

Thailand capital Bangkok have been developed on Chaophraya river delta. It is supposed SLR affects the city directly. Thus we selected Bangkok as the study area in 1990-1991 FY(Fig.6). Landuse data was obtained by Landsat image, using image processing technology.

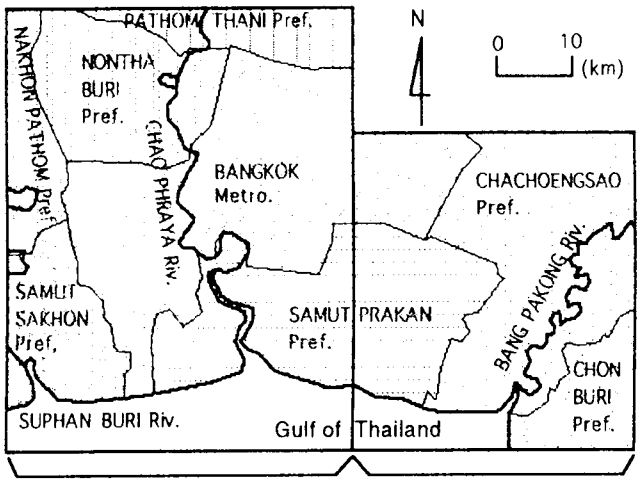

Fig. 6 Studied area in Thailand

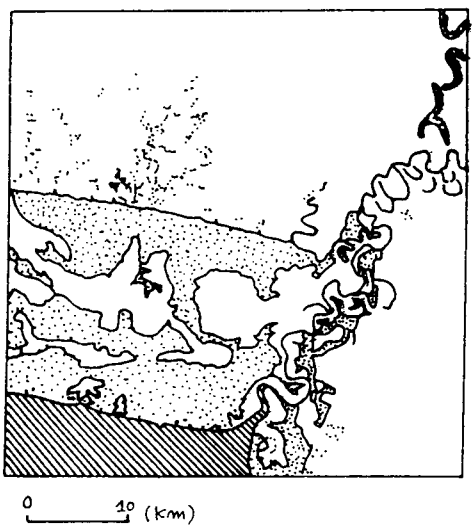

Fig. 7 Inundated area at 1m SLR(dotted)

② Bangpakong area

In 1992FY, we studied Bangpakong area which locates the east of Bangkok area(Fig. 6). In Bangpakong area, since both landuse and ground elevation data have not been constructed, we obtain these data from Landsat Image. Especially, we developed the method to

acquire ground elevation data from Satellite Image. Noticing relationships between ground elevation and physiography in Bangkok, we extrapolated these relationships into that in Bangpakong area, finally we could get ground elevation data. Fig.7 shows the inundated area at 1m SLR. Fig. 8 shows increase of affected population by SLR from 0m to 3m. Fig. 9 summarize the effect of SLR at 1m in the area.

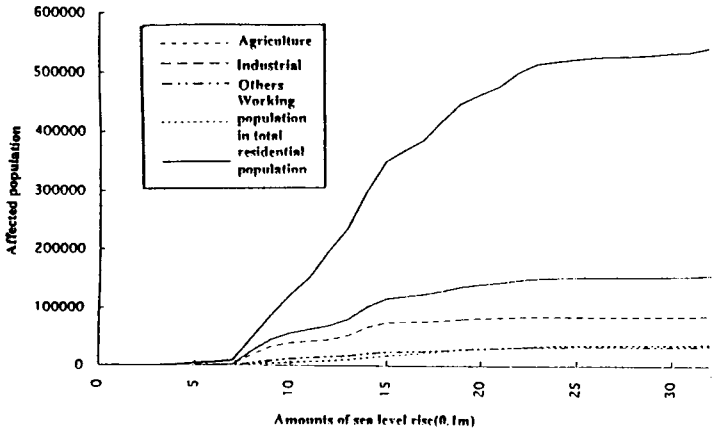

Fig.8 Increase of affected population

	Landuse							
property	paddy, double cropping	paddy, single cropping	orchard	fish pond	mangrove	commercial/ industrial	residential	total
land value	paddy	paddy	orchard	shrimp farm	barren	commercial/ industrial	residential	
(10^8 baht)	1878	2769	621	935	844	5571	173	12790
productivity	harvest once	harvest twice				commercial / industrial		
(10^4 baht)	9432	22396	3779	85465		695 / 2888		124655
residential population							122079	122079
working	Agriculture					Others / Industry		
population	4977					11703 / 39801		56481

Fig.9 Affected properties at 1m SLR in Bangpakong area

3 Results

(1) In Japanese case, we established the method of acquiring precise ground elevation, landuse and property density (unit value) of each cities and towns.

(2) In Thai case, we developed the method of obtaining ground elevation and landuse data from satellite image, using remote sensing technology.

(3) In the study, Affected property and population are evaluated under the situation without coastal protective facilities such as coastal dike, drainage pomp, etc.. Therefore the amount of affected properties would be important indicators for cost-benefit analysis for measures of coastal managements. If there would not be taken any appropriate measures: this occasion would be much more plausible in developing countries, the affect of SLR clarified in this study will become in reality.

References

Figures in this report are from fiscal reports of the study.