PART TWO :

FACT FINDING

In this part, fact finding on building damages and social economic disruptions in inundation areas in 7 cities are shown.
In the first fiscal year (FY2000), 6 cities were observed through literal and field survey, in order to list-up the possible phenomena caused by the future SLR. Types of urban districts and urban houses were listed. Contents of damages caused by flood and high water (inundation) were recorded.
Losses caused by inundation were evaluated as deterioration of physical building (functional loss), requirement for repairing cost (financial loss or investment loss) and social loss (stop of social / economical activities).
In the second fiscal year(FY2001), along with the sampling survey of houses and households in 7 cities, more precise and detailed data on the identified phenomena and possible problems were collected. Especially the situation in land subsidence zone was quite suggestive for identifying what will happen after SLR. And also, various forms of adaptation to high water were recorded, including re-location, reclamation, reconstruction of houses, provision of polder and pumps, etc.
Several attempts for adaptation, which have been already undertaken by individual families, local communities or local governments are also recorded.

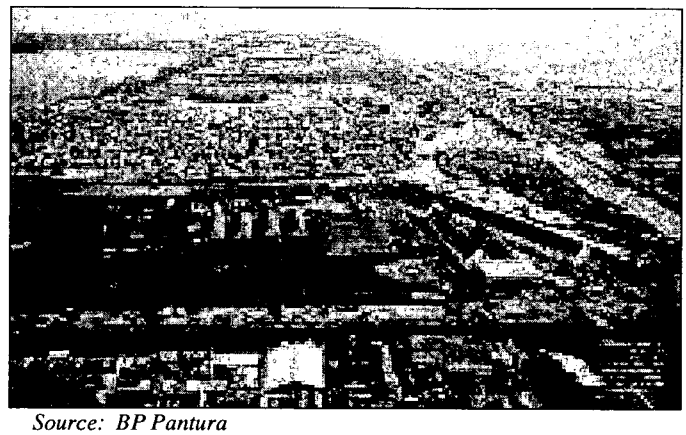
2.1. NORTH JAKARTA

2.1.1. General Information

(1) Natural Conditions

a. Geography

The North Jakarta ward of Jakarta Metropolis is locally called "Jakarta Utara". Total area is 7,133.51 Km^2, consist of oceanic area (6,979.4 Km^2) and land area (154.11Km^2). The East-West length is around 35 km, and the North-South width is between 4 to 10 km, Most of land is around 0 – 2 meter from the sea level. The 1 to 2 meters land is in the South part. There are around 110 islands, in the north seashore, so called Seribu Archipelago



Source: BP Pantura

Photo 2.1.1. Existing condition of north beach, North Jakarta

b. Climate

The temperature is about 27°C through the year. In May to October the east wind blows, and November to April the west wind blows. Overage rain intensity is 2.000 mm and the highest intensity is in December. Average water temperature in Jakarta Bay is 29,6°C and the detail is shown in table 2.1.1.

Table 2.1.1.Water temperature in Jakarta bay and Seribu Archipelago

NO	SEASON	TEMPERATURE (°C)			
		JAKARTA BAY		SERIBU ARCHIPELAGO	
		RANGE	AVERAGE	SURFACE	BASED
1	North	25,5 - 29,0	28,0	28,2 – 28,8	28,1 – 28,6
2	Changes I	29,1 – 30,6	29,8	29,0 – 30,2	28,4 – 29,6
3	East	28,7 – 30,2	29,3	28,1 – 28,6	28,1 – 28,6
4	Change II	29,4 – 30,4	29,6	29,1 – 29,4	29,1 – 29,3

Source: Final report The Impact of Sea level Rise on Indonesian Coastal Cities, 2001

c. Geomorphology

1) Flood area.

Jakarta as a flat platform territory is north morphology of the Java Sea Formation. The main rivers in this area are high risk of flood. The physical construction around the city makes the city over saturated and the surface water is difficult to penetrate. Some data indicate that the floods in Jakarta often occur in the north, the west and the central Jakarta when it is in rainy season around November – December (Ongkosongo, 1981) and the water flow along 3.22 km, such as along Cideng River, to the North-part.

2) Sedimentation.

According the data of North Seashore of Jakarta in 1990 – 1994 there are some contribution sediment from the river and canals, such as::

- Cengkareng drain. Sedimentation suspension in estuary Cengkareng drain is about 4,68 m^3/day.
- Angke river,
- Sunter river which empties in to Tanjung Priok Harbor,
- Cakung drain,
- Blencong river,
- Tawar river.

3) Abrasion and Accretion.

Jakarta seashore had changed through the 72 years (during 1918-1980), the abrasion is about 12,31 m/year to the sea. East part the abrasions are along the Binaria, Sanggar, Bahari and Cilincing. This abrasion is about 0,15 m – 1,69 m/year (Dir.GTL,1994). The abrasion factors are:

- Sea pollution because of oil and industry pollution,
- Digging seashore sand and seashore scrape off,
- Slashing the mangrove trees, make the waves scraping down the beach,
- Sea dike construction and reclamation seashore change the waves,
- Sedimentation movement,
- Scrape off by sedimentation.

4) Seashore change

The changes of seashore are caused by accretion in estuary of Cengkareng Drain, accretion in estuary of Angke River, reclamation of Mutiara seashore, Jetty in Pantai Indah Kapuk, Muara Karang, Muara Tawar, and seashore erosion in Cilincing/Marunda.

5) Worn-out land.

Worn out land in Jakarta has a high compressibility and it consists of alluvium materials which unmixed well. The housing developments in this area are to make the land more worn-out. The worn-out guarded in swamp trace, which made of the granular materials.

d. Morphology

According to the landscape, topography and geology data, Jakarta land is divided in some category of geomorphology (modification Suwiyanto, 1977) such as: alluvial land, wavy hill and young Volcano.

e. Geology

Based on Jakarta Geological Map and Seribu Archipelago (Turkadi et.al, 1992), Bogor flat (Effendi et.al., 1986), Serang flat (Rusmana et.al., 1991) and Karawang (Achmad et.al, 1992), there are 4 rock formation in Jakarta Area. Those are Rengganis formation (Tmrs) made of sandstone-coarse sand, *conglomerate* and clay; Kelapanunggal formation (Tmk); Jatiluhur formation (Tmj); Bojongmanik formation (Tmb); Genteng formation (Tpg); Coral clay Rock (Q1).

Sedimentations surface, among others are Dark alluvial (Qoa), Bogor volvano (Qva), Sediment seashore (qbr), Alluvial (Qa), Group of mountain rock. Rocks Grouping are : Tuft Basten (Qtvb), Volcanic unapart (Qvub), Satuan Volcanic G. Kencana (Qvk), composed by breksi with andesit and basalt chunk, Volcanoes (Qvsb), Salak volcano (Qvsl), Pangrango volcano (Qvpo), and Pangrango volcano (Qvpy).

Rock Intrusion group of Dago made of basalt and Andesit porfiritic. Three main directions are : northwest to southeast, north east to south west and west to east (Sumawijaya, 1978), Jakarta structure predict based on landsite and seismic.

Seashore Geology, mainly on three kind sediment that is : sand muddy sedimentation, depth about 15 m in the northwest Jakarta bay, consist of volcanic materials, mixed color among Grey, back and green with clamshell on it. Muddy sand sedimentation, is found in 4 locations of Jakarta bay, near Tanjung Priok, and consists of mud sedimentation and sand sedimentation. Muddy sedimentation spreads along the beach about 80 % between the Jakarta's entire bay and the Citarum estuary which flows the mud materials along with.

f. Salinity

Marine salinity and Estuary River in Jakarta bay is as follows:

Table. 2.1.2. Average salinities (per mil) Jakarta Bay, 1996

NO	LOCATION	MONTH			
		JAN'96	MARCH'96	SEPT'96	DEC'96
1	Surface	29,02	26,90	30,65	30,63
2	Based	31,51	31,58	32,20	32,53

Source : Final report The Impact of Sea level Rise on Indonesian Coastal Cities, 2001

1) The tide

The rise and fall of the tide in Jakarta Bay which are "diurnal" (one rise and fall of the tide in one day) is as follows:

Table 2.1.3. Rise and fall of the tide in Jakarta bay, 1993

NO	CONDITION	MONTH							
		JAN	FEB	MARC	APR	MAY	JUNE	JULY	AUG
1	Maximum	147,0	144,0	136,0	155,0	154,0	145,0	160,0	147,0
2	Minimum	36,0	40,0	42,0	40,0	40,0	28,0	38,0	32,0
3	Average	85,3	87,2	90,9	-	102,0	-	92,1	81,3

Source : Final report The Impact of Sea level Rise on Indonesian Coastal Cities, 2001

2) Stream/current pattern
Sea surface current in Jakarta bay depend on season, on islands near the bay and also on the tide. The current speed between 0,25 – 0,38 m/sec in west season and in east season the speed between 0,12 – 0,25 m/sec and in the change season the current direction is various and the current speed is generally weak.
3) Waves
Height of waves in Jakarta Bay are about 0,1 – 1,0 m, which take 1 – 8 sec/period, length are about 1 – 12 m, because of the wind blows strongly and wind makes the waves higher.

(2) Social condition

a. Jakarta Utara Municipality

According to Jakarta Lay-Out General Plan (1995 – 2010), the Jakarta Utara is integrated to the Special District of Capital Jakarta and has land use plan as follow:

1) Conservation area in Penjaringan sub district is 327,70 Ha. This area has 200,000 Ha as the green area. In the Seribu Archipelago sub district, (100,91 Ha) as natural preservation and protected islands as a National Sea Park.
2) The land use in North Jakarta is :
   - Housies in North Jakarta are in Penjaringan, Koja, Tanjung Priok, Pademangan, and Kelapa Gading, and the reclamation areas for residential use are in Penjaringan and Pademangan.
   - Business/services areas and offices perform for Jakarta as a service city. The business and services areas are in: Pasar Pagi Mangga Dua, Ancol village Pademangan sub-district, Tanjung Priok, Penjaringan and Pademangan. Services areas are in the Laksamana Yos Sudarso Street in Koja and Tanjung Priok sub-district and RE Martadinata Street in Pademangan.
   - Industrial area and warehouses are located in ;
     1. Industrial areas in Kamal Muara and Penjaringan village (sub-district Penjaringan),
     2. Nusantara Harbor area in Tanjung Priok,
     3. Nusantara Berikat Area (sub-district Sukapura), and Marunda (Kalibaru, sub-district Cilincing),
     4. Industrial area and warehouses in North Jakarta beach (sub-district Cilincing and Koja),
     5. Industrial area along the Pegangsaan Dua street in Kelapa Gading.

After the several administrative modifications, the North Jakarta Municipality now consists of 7 Districts (Kecamatans), 35 Sub-Districts (Kelurahan), 406 RWs and 4,639 RTs with Kelapa Gading, Cilincing, and Seribu Archipelago.

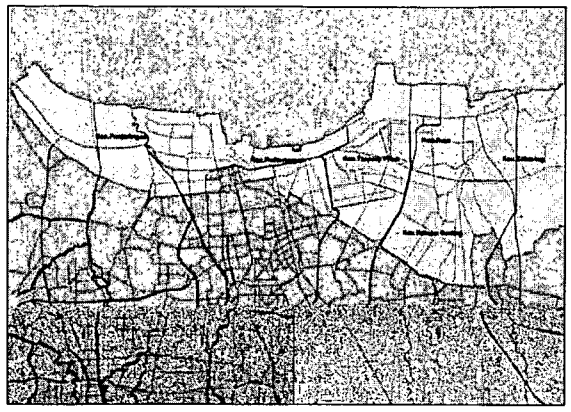


Figure : 2.1.1.
Administrative border North Jakarta District
Source: Pemetaan Jakarta Utara

The characteristic of North Jakarta Municipality is shown in table below (Table 2.14).

Table 2.1.4. Kecamatan in Jakarta Utara,
showing area, number of kelurahan, number of house, number of RW and number of RT

No	Kecamatan	Area(Km^2)	Kelurahan	HH	RW	RT
1	Penjaringan	35.49	5	44,616	60	752
2	Pademangan	11.92	3	28,373	34	406
3	Tanjung Priok	24.80	7	78,566	101	1,235
4	Koja	11.43	6	59,168	74	810
5	Kelapa Gading	16.12	3	29,305	47	495
6	Cilincing	42.54	7	51,314	74	837
7	Seribu Archipelago	11.81	4	4,628	16	104

Source : Jakarta Utara in Figures, 2000 BPS-statistics Jakarta Utara Municipality,
HH = household
RT (Rukun Tetangga) is a neighborhood unit, and
RW (Rukun Warga) is a union of RT

c. Land utilisation

The land used of Jakarta Utara is consist of:

- housing 47.58 %
- industry 15.87 %
- office 8,89 %
- others 27.66% (warehouse, farmland etc.)

The land status is consist of:

- ownership right 13.28%
- building right 29.04%
- others 58.68% (utilization right, development right, squatters etc.)

d. Housing

The number of residential building devided by its physical condition in North Jakarta, in 1999 is shown in table 2.1.5.

Table 2.1.5. The total housing devided by its physical con dition.

NO	SUB-DISTRICT	PERMANENT	SEMI PERMANENT	TEMPORARY	TOTAL
1	Penjaringan	32,142	8,727	5,786	46,655
2	Pademangan	8,935	5,961	3,474	18,370
3	Tanjung Priok	20,859	14,622	10,242	45,723
4	Koja	16,266	6,363	3,200	25,829
5	Kelapa Gading	19,270	1,964	97	21,331
6	Cilincing	11,467	12,012	8,157	31,636
7	Seribu Archipelago	1,997	2,499	1,056	5,552
	North Jakarta	110,936	52,148	32,012	195,096

Source : Jakarta Utara in Figures, 2000 BPS-statistics Jakarta Utara Municipality.

e. Population

Based on Census in 2000, population number in North Jakarta is 1,435,207 people and the growth rate population is 0.52 % per annum. It is consisted of 713.754 male and 721.453 female. This high density of population (9.313 people/Km^2) potentially may cause social problems such as quarrels among resident, so that government needs to anticipate actions to prevent the problems.

The area, number of population, population and density in North Jakarta following in table 2.1.6. bellow.

Table 2.1.6. Total Population of North Jakarta-2000

NO	SUB-DISTRICT / *DISTRICT*	AREA (KM^2)	POPULATION		TOTAL POPULATION	DENSITY (PRS/KM^2)
			MALE	FEMALE		
1	Kamal Muara	10,53	3.580	3.714	7.294	692
2	Kapuk Muara	10,06	12.063	12.449	24.512	2.438
3	Pejagalan	3,23	35,559	34.596	70.155	21.708
4	Pluit	7,71	24.145	27.990	52.135	6.760
5	Penjaringan	3,95	52.132	46.430	98.562	24.925
All	***Penjaringan***	***35,49***	***127.479***	***125.179***	***252.658***	***7.120***
6	East Pademangan	2,61	17.152	17.299	34.451	13.187
7	West Pademangan	3,53	34.852	32.391	67.243	19.030
8	Ancol	5,77	13.165	12.000	25.165	4.359
All	***Pademangan***	***11,92***	***65.169***	***61.690***	***126.859***	***10.644***
9	Sunter Agung	6,55	35.039	36.739	71.778	10.958
10	Sunter Jaya	4,68	36.829	36.723	73.552	15.711
11	Kebon Bawang	1,73	23.415	22.298	45.713	26.470
12	Papanggo	2,80	19.998	20.273	40.271	14.364
13	Warakas	1,09	21.029	21.132	42.161	11.597
14	Sungai Bambu	2,36	13.989	13.427	27.416	11.597
15	Tanjung Priok	5,59	17.595	19.584	37.179	6.651
All	***Tanjung Priok***	***24,80***	***167.894***	***170.176***	***338.070***	***13.629***
16	Tugu Selatan	1,86	14.428	13.705	28.133	15.166
17	Tugu Utara	2,37	32.259	31.531	63.790	26.973
18	Lagoa	1,58	29.144	28.805	57.949	36.677
19	Koja	3,28	12.832	12.137	24.969	7.617
20	Rawabadak Utara	1,33	17.051	17.246	34.297	25.714
21	Rawabadak Selatan	1,02	18.858	18.088	36.946	36.357
All	***Koja***	***11,43***	***124.572***	***121.512***	***246.084***	***21.533***

NO	SUB-DISTRICT / *DISTRICT*	AREA (KM^2)	POPULATION		TOTAL POPULATION	DENSITY (PRS/KM^2)
			MALE	FEMALE		
22	Kelapa Gading Barat	4,53	18.013	19.156	37.169	8.203
23	Kelapa Gading Timur	5,31	23.238	24.969	48.207	9.086
24	Pegangsaan Dua	6,28	31.516	32.721	64.237	10.221
All	*Kelapa Gading*	*16,12*	*72.767*	*76.846*	*149.613*	*9.280*
25	Sukapura	5,61	26.598	38.101	64.699	11.525
26	Rorotan	10,64	13.129	12.782	25.911	2.436
27	Marunda	7,92	7.326	6.853	14.179	1.791
28	Cilincing	8,31	19.017	18.460	37.477	4.509
29	Semper Timur	3,16	15.463	15.503	30.966	9.795
30	Semper Barat	4,44	33.393	33.782	67.175	15.146
31	Kali Baru	2,47	32.159	32.112	64.271	26.052
All	*Cilincing*	*42,54*	*147.085*	*157.593*	*304.678*	*7.161*
32	Pulau Tidung	1,75	2.473	2.444	4.917	2.810
33	Pulau Untung Jawa	2,15	728	697	1.425	663
34	Pulau Panggang	0,98	2.190	2.077	4.267	4.336
35	Pulau Kelapa	6,92	3.237	3.239	6.636	958
All	*Seribu Archipelago*	*11,81*	*8.788*	*8.457*	*17.245*	*1.460*
All	*Jakarta Utara*	*154,11*	*713.754*	*721.453*	*1.435.207*	*9.313*

Source : Jakarta Utara in Figures, 2000 BPS-statistics Jakarta Utara Municipality.

2.1.2. Study Area Condition (Kecamatan Penjaringan in North Jakarta)

(1) Physical characteristics

In this study, we pick up Kecamatan Penjaringan whicih is located in northern part of North Jakarta and which total area is about 35.49 Km^2. "Kecamatan" is an antonomous unit of region, governed by the head named "Camat", and usually translated as "District" in English. One Kecamatan consists of "Kelurahan" ("Sub-district" or "Village"), which has no autonomous leader in urban area. The borders of Kecamatan Penjaringan Sub-district are as follow:

North : Java sea
South : Bandengan street – touch to Central Jakarta
West : Pluit Damp- Muara Karang River and Jembatan Tiga Street.
East : Sunda Kelapa Harbor and Jelakeng River.

5 Kelurahan (Sub-districts or villages),namely Kamal Muara, Kapuk Muara, Pejagalan, Pluit, and Penjaringan, are located in Kecamatan Penjaringan. Most of them are swamp which height is about 1 – 2 meters above the sea level. The total length of coastline in Penjaringan is about 6.5 km. The building types obserbed in Penjaringan Sub-district are as follows:

Table. 2.1.7. Building types in Penjaringan-Subdistrict

LOCATION			TYPE		STRUCTURE			CONSTRUCTION		
Land	Sea	Float	Single story	2 Story	Concrete	Steel	Wood	Permanent	Semi-P	Temporary
O	-	O	O	O	O	-	O	O	O	O

*[O]:observed, [-]: not found

The description of land use in Penjaringan Sub-district is as follows:

Table. 2.1.8. Land used in Penjaringan

SUB-DISTRICT	HOUSING (%)	INDUSTRY (%)	OFFICE (%)	GARDEN (%)	AGRICULTURE (%)	REST AREA (%)	OTHER (%)	TOTAL (%)
Kamal Muara	9,12	13,50	5,30	1,00	7,0	43,08	21,0	100,0
Kapuk Muara	38,18	21,65	9,23	0,00	0,0	27,14	3,8	100,0
Pejagalan	72,97	17,64	3,40	1,20	0,0	0,0	5,0	100,0
Pluit	59,00	28,00	5,00	3,00	0,0	0,0	5,0	100,0
Penjaringan	79,34	5,00	5,50	5,25	0,0	2,5	2,41	100,0
Penjaringan	***41,83***	***18,39***	***6,20***	***1,64***	***2,06***	***20,76***	***9,10***	***100,0***

The houses in survey area are built in squatter area with several building type. Most houses are two or more storey. Likely other slum area, the quality of buildings is almost under standard. Some of them are highly damaged, after the recent flood. The orientation of houses does not have clear order.

To meet the needs of housing has been still increased in the limited a high rise building policy are typical, such as apartment or multi storey building is selected (such as Penjaringan multi storey building).

(2) Socio-Economic Profile

The number of villages and population in Penjaringan district is as follows:

Table. 2.1.9. The village and population in Kecamatan Penjaringan

NO	VILLAGE	AREA (KM2)	RW	RT	HOUSEHOLD	POPULATION
1	Kamal Muara	10,53	3	21	1,464	7.294
2	Kapuk Muara	10,06	5	54	4,902	24.512
3	Pejagalan	3,23	18	226	14,031	70.155
4	Pluit	7,71	17	216	10,515	52.135
5	***Penjaringan***	***3,95***	***17***	***235***	***13,704***	***98.562***
	T o t a l	***35,49***	***60***	***752***	***44,616***	***252.658***

The livelihoods of the inhabitants in Penjaringan Kelurahan are as shown in Table 2.1.10.

Table. 2.1.10. The livelihood of the people in Kelurahan Penjaringan

NO	LIVELIHOOD	NUMBER OF PEOPLE
1	Fishery.	949
2	Trading	683
3	Private Employee	9,612
4	Government Employee	868
5	Worker, laborer, etc	9,209
6	Service	15
	Total	52,562

2.1.3. The Effect of the inundated Area on Building and inhabitant's live

(1) Building Deterioration

The impact of flood on buildings is the lost of the function of the buildings and physical damage. Both are an economic lost in view of restoration cost and lost of opportunities to do activities. There are three main aspects that cause the deterioration of the buildings; mental, functtional, and chemical.

a. The mental aspect can be seen in the change of the color, the peeling off of the wall paint, water absorption, humidity, porosity, which disturb the comfort of the residents

b. The physical aspect is the decline of the building strength, because of the organic materials that do not resistant against climate and humidity.

c. The chemical aspect, such as sulfate and chlorine, affects the stability of the building because of corrosion and damage of iron and cement components after a certain time.

The damage of the building caused by inundation is indicated by:

a. White, yellow, and red spots scattered all over the wall surfaces

b. Decay and the peeling off of the plaster are caused by the capillarization of salt water from the foundation of the building that contains much chloride and sulfate. When the water evaporates, salt remains and slowly reacts against the cement mortar.

In generally the chemical equations of salt (chloride and sulfate) to the cement mortar equation are as follow:

a. $Ca(OH)_2 + CO_2 \rightarrow Ca CO_3 + H_2O$

b. $Mg SO_4 + Ca(OH)_2 \rightarrow Ca SO_4 + Mg(OH)_2$

c. $Mg Cl_2 + Ca(OH)_2 \rightarrow Ca Cl_2 + Mg(OH)_2$

Normally the peeling started from the bottom part of the structure or wall continues to the high part of the structure which about 120 cm from the bottom. From this urban line the water capitalization will be stop and the water evaporates. This condition is generally an environmental effect of sulfate and chloride. The masonry collapses because of cement-mortar peeling on the brick and the structure where the masonry strength will be decrease bellow collapsing strength. Cracking of the masonry wall and settlement of foundation are mostly caused by settling of soil base especially on the soft soil area. The complex effect of inundation on building can be minimized by the adaptation through betterment of the site (land condition). However, for the time being, it seems to be inevitable for the people to build their houses based on their technical capacity to ensure the quality of their life.

The total of lost by inundation depends on the condition of geography and land use or type of building. Our site observation shows that the main building materials used in Penjaringan Sub-district are as follows:

- Land fill/cover : Coarse aggregates and hard soil
- Foundation : Masonry stone, masonry brick and concrete,
- Floor : Concrete/mortar, ceramic tile and cement tile
- Wall : Masonry Brick and block, wooden panels, etc.
- Doors & windows: Wood

- Exterior : Wood frame, multiplex board, and cement board.
- Roof : Ceramic & concrete tile, corrugated asbestos/aluminum/zinc.
- Column : Concrete, wooden frame and brick masonry.
- Beam : Concrete, wooden frame and brick masonry.

The constructural building type is as follows:

- Type of foundation : Continuous, fix foundation and under standard concrete.
- Type of building : Single storey and multistory building
- Type of structure : Concrete frame, wooden frame and brick masonry,
- Roof system : Wooden frame
- Roof covered : Ceramic tile, concrete tile and corrugated asbestos

The effect of inundation on building will be categorized into two aspects: *function aspect* and *finance (investment) aspect* (see 3.1, p.93). According to the building conditionsurveys, the losses of function and finance aspects obtained from 12 respondents were as follow:

Table. 2.1.11. The function and finance loss of building by inundation

NO	TYPE OF BUILDING	TYPE OF STRUCTURE AND COMPONENT	FUNC-TION LOSS(%)	FINAN-CIAL LOSS (%)
1	Landed house Three storey	Practical column and beam, masonry wall, concrete pile, corrugated asbestos roof, ceramic tile, and wooden frame of door and window	40	11,4
2	Landed house single storey	Masonry wall, continuous brick foundation, ceramic roof tile, soil covered, wooden frame of door and window	75	54,85
3	Landed house Two storey	Practice column and beam, masonry wall, continuous foundation, second floor by wood, corrugated asbestos roof, ceramic tile, and wooden frame of door and window	25	10,1
4	Landed house Two storey	Wooden frame, half masonry wall, wooden wall on second floor, ceramic roof tile, wooden frame of door and window, cement plaster floor.	50	43,1
5	Landed house Two storey	Practice column and beam, masonry wall, continuous foundation, corrugated asbestos roof, ceramic tile, and wooden frame of door and window	25	7,9
6	Landed house Two storey	Wooden frame, half masonry wall, wooden wall and floor on second floor, corrugated asbestos roof, wooden frame of door and window, cement plaster floor.	50	54,85
7	Landed house Two storey	Practice column and beam, masonry wall, continuous foundation, corrugated asbestos roof, cement plaster floor, wooden frame of door and window	25	5,2
8	Landed house single storey	Masonry wall, continuous foundation, ceramic roof tile, cement plaster floor, wooden frame of door and window	50	27,0
9	Landed house two storey	Masonry wall, continuous foundation, corrugated zinc roof, cement floor tile, wooden frame of door and window, wooden wall and floor on second floor	25	23,25
10	Landed house single storey	Masonry outdoor wall and plywood for indoor wall, continuous foundation, corrugated asbestos roof tile, cement plaster floor, wooden frame of door and window	50	18,35
11	Landed house two storey	Masonry wall, continuous foundation, ceramic roof tile, ceramic floor tile, wooden frame of door and window	50	14,9
12	Landed house multi storey	Wooden frame, half masonry wall, wooden wall and floor on second floor, corrugated zinc roof , wooden frame of door and window, cement plaster floor, wooden floor on second floor	50	46,2

(2) Socio Economic

The inundation supposed to be 4 a 24 hours a day and its height be about 50- 80 cm and the flood is imposed to starts in 1:00 13:00 in the noon pm, it really disturbs the community activities.

Most respondents are working in private sectors and the flood obstructs their activities to do their job or and daily activities. The flood mostly flashs into the bedroom, and the play-ground is also inundated, therefore children can't play. The effect of such flood to activities is shown in table bellow,

Table. 2.1.12. The effect of inundation to daily activity

VARIOUS	DISTURB	%
Eating	33	73.3
Drinking	34	75.6
Cooking	10	22.2
Washing	11	24.4
Playing	7	24.4
Chatting	10	15.6
Sleeping	11	20.2

Source: field data processing,

Beside these, other social and economic activities are also hindered, such as going to the office, to the working places, to the religious place and to the school. This effect is shown on table bellow:

Table. 2.1.13. The effect of inundation to other daily activity

ACTIVITIES	DISTURB	%
To the school	41	95.1
To the office	43	95.6
To the work	45	100
To the religious service	45	100

Source: field data processing,

The infrastructure are also obstructed by the flood, as shown on this table,

Table. 2.1.14. The effect of inundation to infrastructure

VARIOUS	DISTURBED CASES	%
Clean water	35	77.8
Sanitation	45	100
Bed-room	145	100
Dining-room	45	100
Kitchen	45	100
Children play ground	42	93.3

source : field data processing,

(3) Adaptation

a. Physical Adaptation

A community houses are to be, built base on supposing their physical adaptation and prediction the sea level rise ; the flood comes easily to his area. According to the 2000 statistic data permanent houses become to 32,142, semi permanent 8,727 and temporary houses 5,786 houses. This data seems physical adaptation, they are trying to adapt themselves to the environment by making the beach reclamation but their efforts mostly depend on the economic condition, as a reality only the capable owner house can make the floor higher than other or build a dike to protect from the flood.

The citizens have their own way to face the fact of physical condition. They have already preparing something for handling the flood. Most of them have already stayed in this area for 9 to 40 years and none of them want to move. Such as physical adaptation have been done, for example elevating floor and making the yard fence, but some of them does nothing because they do not have any choices, and they do not have enough money to make up their house.

Table 2.1.15. Action against flood

KIND OF ACT	FREQUENCY	%
Elevated floor	44	97.8
Fence the yard	-	-
Doing nothing	1	2.2
Others	-	-
Total	***45***	***100***

source : field data processing,

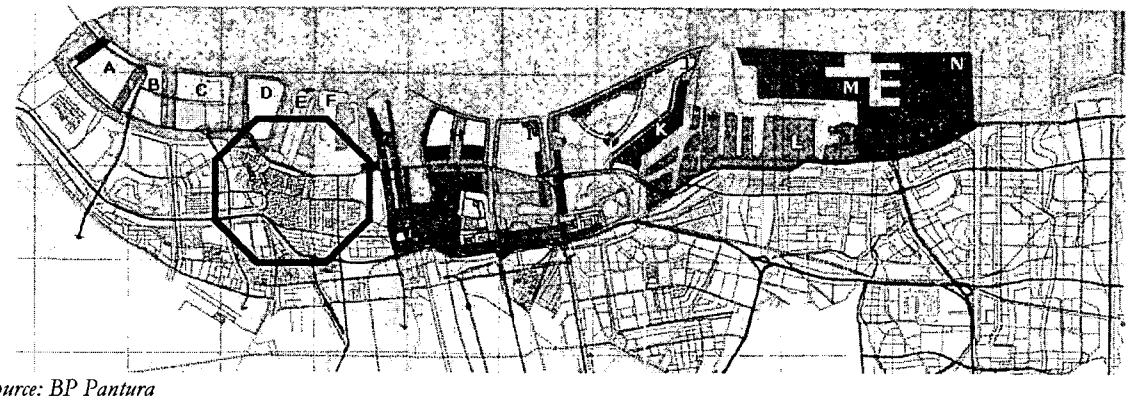
Against the sea rise level, the government has tried to provide drainage systems (damp and pump) and reclamation program (the President Decree No. 5, 1995 and local Government rule No 6/1999 about handling the sea level rise by reclamation, RTRW Penjaringan district 2005).

Reclamation is the biggest scale adaptation to the tide causing inundation, it has been proclaimed in the President Decree No 52/1995 about the North Jakarta beach and DKI Decree No 8/1995 and DKI Decree No 982/1995 about establishment of reclamation committee organizer for North Jakarta beach (BPR).

The committee has a main task to switch the Jakarta expansion to the South Part, into the North. Though reclamation program makes the opportunity to expand the Jakarta to the North orientation. This new orientation plan provides better transportation, drainage, housing, and others urban facilities. It is also to decrease the flood problem.

The north Jakarta (Part of Pantura)[1] project has been carried out along the beach line about 32 km, the wide area is about 1–2 km from the 8 m sea depth line. All the reclamation area is about 2,700 ha.

[1] Pantura stand for "pantai utara" that has meaning of "the north coastal of Java Island".



Source: BP Pantura

Figure 2.1.2. Map of North seashore Jakarta Reclamation Planning

This reclamation planning has three sections;

The west section covers of the Pantura Project which includes Mutiara Beach Project, Green Beach Project in Pluit, Muara Angke Fish Harbor, Pantai Indah Kapuk (PIK) Project, and totally reclamation area about is about 1,000 ha (6.5 km x 15 km).

The middle section covers Muara Baru, Sunda Kelapa, the Central City, West Ancol & East Ancol and Tanjung Priok. The total reclamation area is about 1,400 ha (8 km x 1.7 km).

The *East section,* covers East Tanjung Priok in Marunda. The total reclamation area about is 300 ha (3 km x 1 km).

The mainland section covers Penjaringan sub district, Tamansari, Pademangan, Tanjung Priok, Koja and Cilincing.

b. Inhabitant Adaptation

The inhabitant know exactly how to face on the risk of the tide causing inundation while they live the beach. All the risks from their job and their place are introduced in their early livelihood, with difficulties in their living to be fishermen. The job diversities still depend on the location. They are as fish seller, green shell cultivator, labor on the harbor, labor on the factories, etc.

As an economic people, they are too poor to handle and to manage their environment. Because of the inundation frequency more than 12 times in a year, they know well enough that the flood will subside in one whole day, so their daily activities will continue in the other day. Most of the respondents want to stay in their current location because they have no other choice and their houses are near to the work location. According to the respondent, the water flood is the most interference thing in making there more comfort for staying there, it shows in the table bellow.

Table. 2.1.16. The effect of inundate to infrastructure

INTERFERENCE THINGS	FREQUENCY	%
Water flood	43	95.6
Security	1	2.2
Others	1	2.2
Total	***45***	***100***

Source: field data processing,

Some people are active to adapt to the condition, such as elevated land or floor, but others only stay and do nothing because of their poor economical condition

Table. 2.1.17. The effect of inundate to infrastructure

KIND OF ACTIVITIES	FREQUENCY	%
floor elevated	44	97.8
Fence the yard	-	-
Doing nothing	1	2.2
Others	-	-
Total	***45***	***100***

Source: field data processing,

After inundation, normally, they clean their houses as the mud turns cleaner. It is economical activities.

Table. 2.1.18. The effect of inundate to infrastructure

ACTIVITIES	FREQUENCY	%
Doing nothing	38	84.4
Moving out	4	8.9
Others	3	6.7
Total	***45***	***100***

Source: field data processing,

2.2. SEMARANG

2.2.1. General Condition

(1) Urban Scope

Semarang is the capital city of central Java province of Indonesia. It lies in the 0.5 meter to 348 meters above sea level. Geographically, Semarang is located in the south latitude of $6^{o}.50"$ to $7^{o}.10"$, and the east longitude of $109^{o}.50"$ to $110^{o}.35"$. Semarang with the area of 373.7 square kilometers, consists of the coastal zone and lowland area in the northern part (Kota Bawah) in the slope of $0 - 2^{0}$, and upland areas in the southern part (Kota Atas) with the slope up to 45^{0} (see figure 2.2.1). The northern part of Semarang is the area where harbor, airport, and rail station are located, so that this area has high accessibility to the central activities. The land use of the northern part is utilized to serve the activities of harbor, warehouses, and industrial matters, and its facilities such as residential, office, retail, public use, and open space. Southern part, in the past, was used to serve the activities of agriculture used with the large unbuilt areas as catchmentsr area, but now gradually the southern part is developed to be built areas which serve the activities of education and housing matters, including its facilities, such as offices, retail, etc. The remains of the unbuilt area are still used for agricultural activities. As catchmentsarea, recently this region cannot store anymore rain water in the rainy season, so that rain water flows directly through some river from the high land in southern part to the lowland in northern part. Frequently, this condition makes the northern part prone to inundation of rain water.

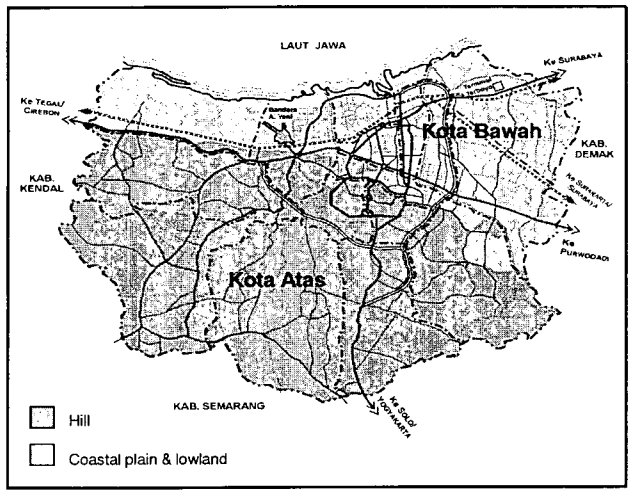


Figure 2.2.1:
Existing Condition of Semarang Territory

Source: Public Relations Division, Semarang Municipality (1993)

As Semarang is situated in a tropical regions in global scale, this city has two seasons; the rainy and the dry season. An average annual rainfall is about 2100 mm per annum and an average duration of rainfalls is 178 days per annum. The climate generally is warm of between 24 to 30 degrees centigrade, and an average annual temperature is 28.4 degrees centigrade.

Housing condition in Semarang generally can be viewed through 3 aspects, those are :

- The qualities of housing stock, such as permanent and non permanent houses.
- The rate of urban population growth, as long as the urban population growth increases, the housing development normally will increase as well.
- The availability of the land for residential areas.

The data from BPS Semarang (2000) noted that the development of housing increases as the urban population growth increases as well. The rate of urban population growth is 1.5%. The total number of population in 2000 is 1.3 million peoples, and the total number of houses in Semarang in the year of 2000 is noted 278,352 houses which consists of 182,744 permanent houses, 63,674 semi permanent houses, 30,234 timber houses, and 1,700 bamboo houses. Development of housing in Semarang has been led to the west and the south of Semarang, it seems that these areas are the only land available for housing development, because in some areas in the northern part have an environmental problem, an inundation, land subsidence, and also flooding.

(2) Inundated Area

As mention above, in northern part there are subject to tide in the dry seasons, land subsidence annually, and also flooding in the rainy seasons. Following three factors can be gaimed:

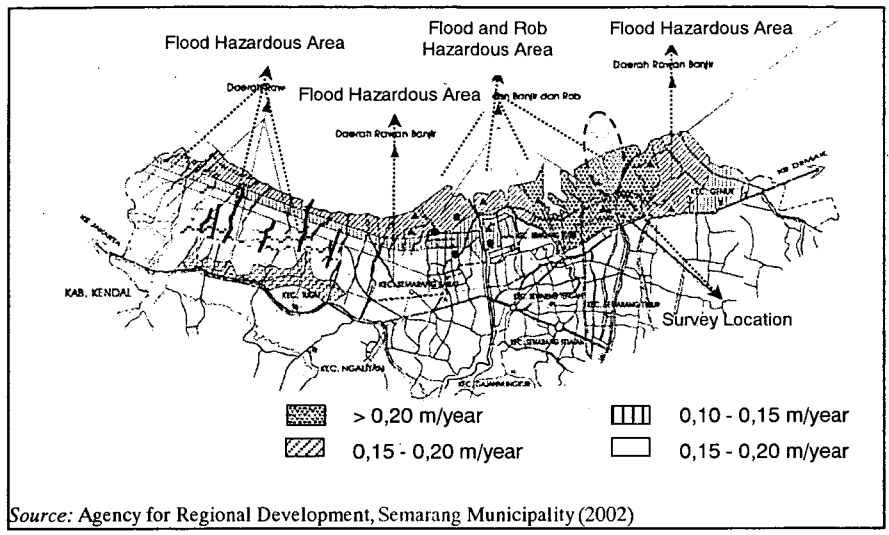
1) sea level rise
   - Based on the observation of PT. Pelabuhan during 1998 to 1999, the average of sea level rise in the harbor is about 23.37 cm. According to the inhabitants, their houses locate next to sea, when the tide comes, its height reaches 40 to 60 cm from the ground.

2) flood
   - Flooding increase in the coastal zone because the capacity of the drainage and also rivers are inable to discharge the water. In the last five years, the run off of rain water from the southern part increase drastically, because the land use changes from unbuilt area to built area, such as housing development in the southern part..

3)subsidence
   - Land subsidence in the coastal zone is varied. It depends on the nature of the soil layers and the lessening of hydraulic pressure in the soil layers. Land subsidence in the coastal zone can be identified into 4 zone categories, those are :
     1. the zone of land subsidence which is more than 0.2 meter per annum
     2. the zone of land subsidence which is between 0.15 and 0.2 meter per annum
     3. the zone of land subsidence which is between 0.10 and 0.15 meters per annum
     4. the zone of land subsidence which is less than 0.10 meters per annum.

The figure 2.2.2. identifies the four zone categories of land subsidence. It can be recognized that the district of North Semarang is the worst area which is affected by the mixedly three factors above. The total inundated areas of the northern part of Semarang now cover about 1.895 ha where the height of inundation is about 40 to 60 centimeters from the ground. However, the inundated areas increase annually, in the future, when inundation will have reached 1 meter from the ground, it is predicted that the inundated area will reach 4,080 ha, and it will be a crucial problem for the local government and also the inhabitants.

Supporting data which is related to inundation areas on the survey on the 35 respondents who live in sub-district of Tanjung Mas, indicate that the frequency of each inundation in this area is 2 up to 3 time a day during the dry season (almost 4 months in a year). The duration time of each inundation is about one hour in the area next to the sea. The duration time of inundation is longer in the areas where the dwellings units are far from the sea, because the sea water takes time to reach and insert dwelling units in the area where is far from the sea.



Source: Agency for Regional Development, Semarang Municipality (2002)

Figure 2.2.2: The Spread of Flood Areas and Land subsidence

(3) Study Area

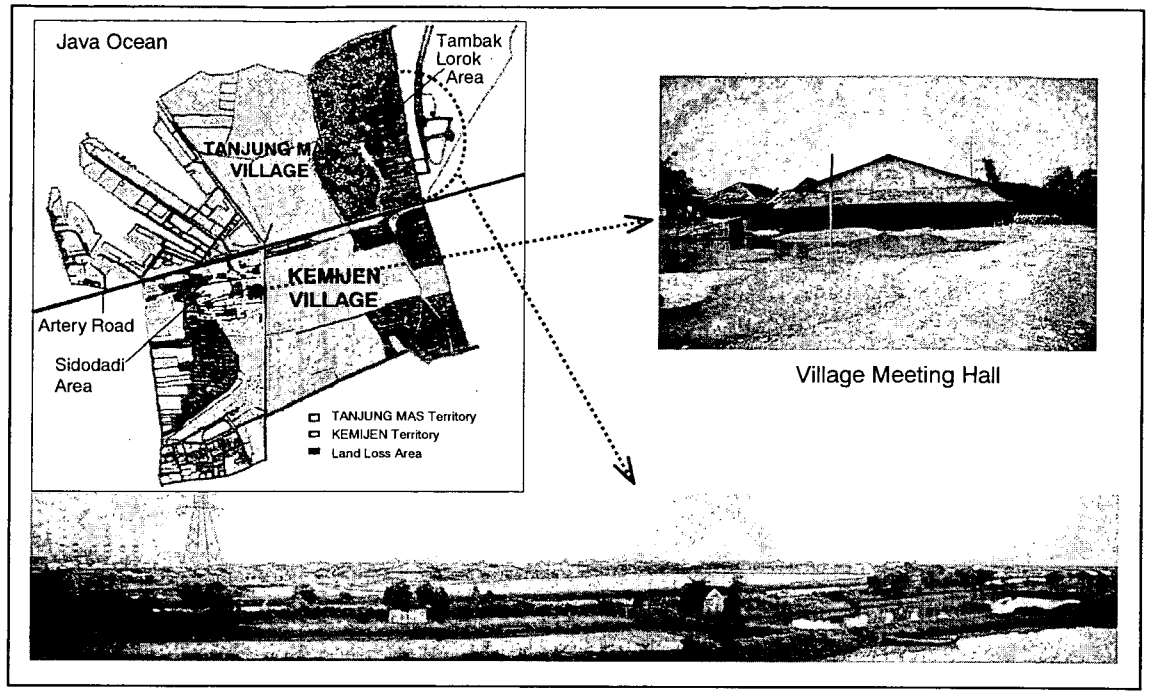
As mention above, A part of the northern territory is the coastal zone which the area covers 5,257.369 ha. Administratively, coastal zone consists of the district of Tugu, West Semarang, North Semarang, and Genuk The coastal zone lies in the 0-4 meter above sea level, the land is plain land which the slope is $0\text{-}2^0$.

Sub-district of Tanjung Mas is located in 0.5 m above sea level and a part of the coastal zone of the district of North Semarang. The area of Tanjung Mas covers about 323.7 ha which is divided into the area of kampong Tambak Lorok in the north and kampong Sidodadi in the south (see figure 2.2.3.).

This area is chosen as the research area. According to BPS, the residential areas of Tanjung Mas Sub-district is the largest compared with others areas among the inundated areas in the North Semarang, and this is the main reason why this area is selected as a sample for the research.

The borderline of Tanjung Mas area can be identified as follows :

- to the north is Java sea,
- to the west is Sub-district Bandarharjo,
- to the east is Sub-district Tambakrejo, and
- to the south is Sub-district Kemijen.

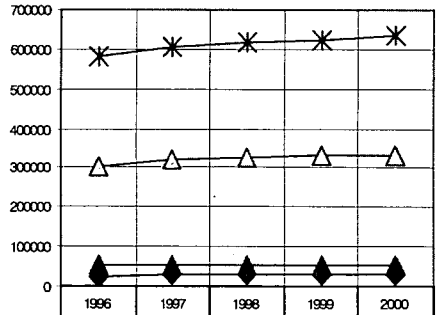


Source: Tanjung Mas Administration Office & Field Observation, February 2002.

Figure 2.2.3: Existing Condition of Tanjung Mas Village Territory

This area has high accessibility to the central activities. It is only about 5 km away from the city center. However, housing development in the district of North Semarang tends to be stagnant. At the same time, during the last five years the growth of urban households in the same area declines neither. The stagnation of housing development in the district of North Semarang is related to the characteristic of the land in this area. This area is prone to the tide (*rob*), land subsidence and also flooding. This area is not suitable for housing.

Table 2.2.1. The Growth of Households and Dwelling Units Numbers



	1996	1997	1998	1999	2000
City-households	278371	284567	289704	292242	299048
City-dwellings	249533	262969	270061	277012	278352
District-households	27816	27604	27611	27604	27643
District-dwellings	26014	27616	27625	27625	27647

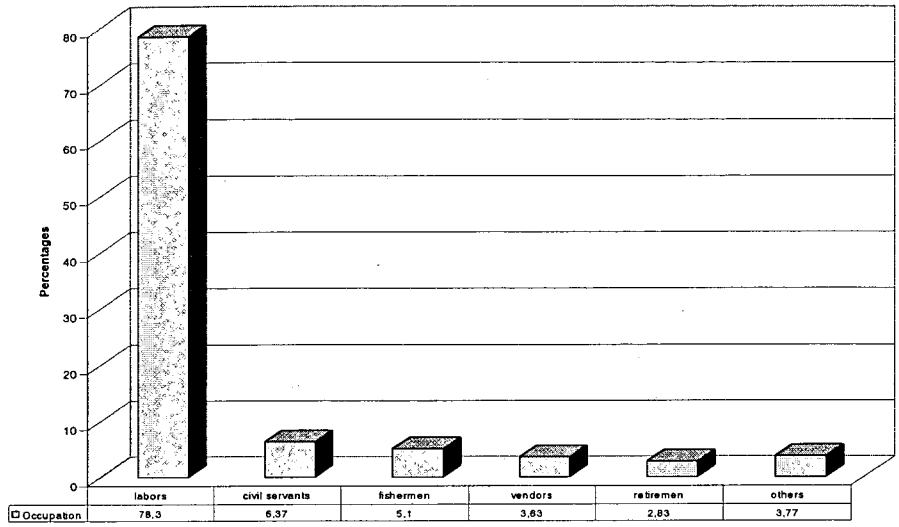
On the graph (table 2.2.1)the growth of urban households and the growth of dwelling units in the district of North Semarang can be compared with the growth of urban households and the growth of dwelling units in the in Semarang city as the whole.

Apparently, the condition above makes the inhabitants in this area prefer to move out rather than to remain here. Who remains here are the low income people, they cannot afford to choose their dwellings far from their work place. From the data, it is found that the majority of the inhabitants who still live and remain are labors.

Sub-district of Tanjung Mas has the

population of 28,413 persons (5,628 households), nearly 80 % of the inhabitants are in this area work labors, 6.3% as civil servants, 5% fishermen, 3.63% venders, and 2.83% as pensioner (see table 2.2.2 below).

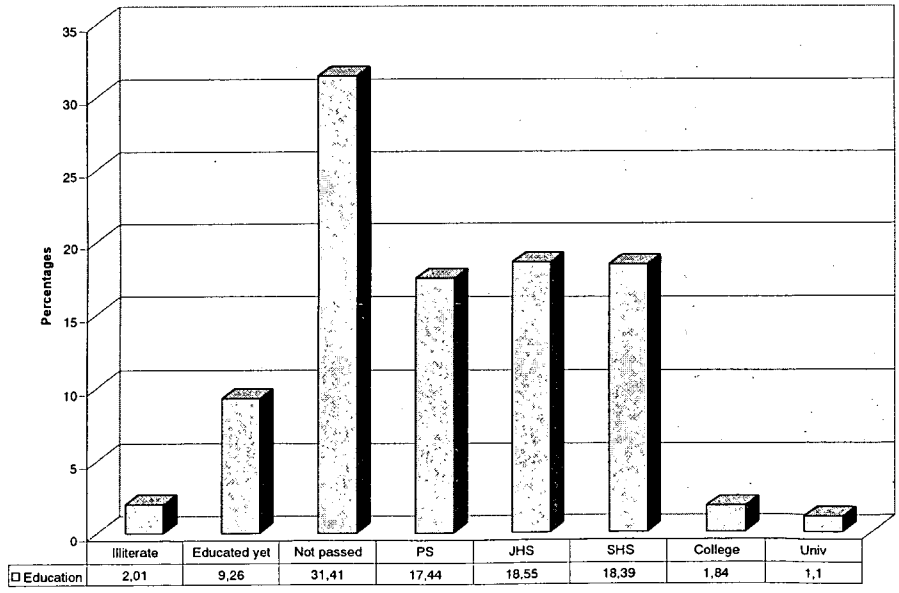
Table 2.2.2 Occupation of Inhabitants



The majority of the inhabitants do not have any special skill. The educational background is elementary, junior, and senior high school. Those are seen from the table 2.2.3 below.

Actually, the district of North Semarang has a high accessibility to the central activities, because it is only 5 km away from the central activities, and the district of North Semarang is

Table 2.2.3 Education of Inhabitants



the central of three type transportations; rail ways station, airport, and also harbor. This area becomes a potential asset for urban economics Some urban activities, such as distribution of goods and services from or to harbor are still being ran in this area. The fly over roads to or from harbor is built to sustain the harbor activities, including activities of trade and warehouse matters. Some main roads; primary and secondary roads surroundings areas are also risen gradually to avoid the inundation of sea water when the tide comes.

Semarang has such environmental problems that inundated area covers 1,895 ha. And furthermore recently, this area has these complicated urban management problem for the inhabitants, and the local government. The survey that has been conducted by the Research Institute for Human Settlements (2001) indicates that the inundated area has exactly affected the buildings and also the inhabitants' lives.

2.2.2. The Effect of the Inundations on the Buildings and the Inhabitant's Lives

(1) Buildings Deterioration

As mention earlier, sub-district of Tanjung Mas covers two separate unplanned settlement areas, namely Tambak Lorok area in the North part and Sidodadi area in the South part. Total numbers of dwelling units that exist in these areas are 5.296 units in varying building kind, as shown in the Table 2.2.4. All of them are classified as type of landed house, varies from one up to twostories.

Table 2.2.4.The total number of existing houses in Tanjung Mas village

No.	Kind of Building	Total Number
1	Masonry Building	1.125
2	Mixed: Brick & Timber/Bamboo Building	1.679
3	Timber Building	1.992
4	Bamboo Building	500
	Total	5.296

(Source: Tanjung Mas Monograph, 2002)

The effect of the past inundations on the buildings deterioration in Tanjung Mas has reached thousands of dwelling units. The main cause of buildings deterioration is land subsidence and the tide (*rob*) which reaches the height of 40 to 60 cm from the ground and unfortunately these matters take place at the same time annually. Furthermore, the all parts of sub district of Tanjung Mas are located in the inundated areas which is 0.5 m above sea level and which the slope is $0 - 2^0$.

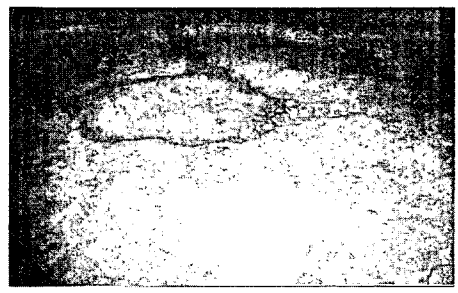
That natural double phenomenon badly affected the constructed building performance greatly. The most part of dwelling units in sub-district of Tanjung Mas has a dilapidating appearance in spite of they have upgraded periodically. Even though such development efforts have been unceasingly done in this area, there is no apparent progress, in fact it's still impressed like

slum area. As an illustration, observation results for 12 varying dwelling units (houses) are shown in the table 2.2.5 and figure 2.2.4.

Table 2.2.5.The performance of constructed dwelling units (houses) in Tanjung Mas village

Component of Building	Kind of Building		
	Masonry	**Mixed Brick & Timber/Bamboo**	**Timber/Bamboo**
Floor	Floors become bumpy or broken to pieces.	Floors become bumpy or broken to pieces.	Floors become bumpy or broken to pieces.
Wall	• Walls become slants • Walls become cracked, especially at the corner joint • Wall plasters get peeled off • Wall covers look dull, moldy, and damp.	• Walls become slants • Walls become cracked, especially at the corner joint • Wall plasters get peeled off • Wall covers look dull, moldy, and damp • Plank walls look moldy and decayed • Triplex walls get peeled off.	• Plank walls look moldy and decayed • Triplex walls get peeled off • Plaited bamboo walls decayed
Ceiling*)	Cracked or broken to pieces, look dull & stained (due to water spots)	-	-
Roof Frame	Timber/bamboo decayed	Timber/bamboo decayed	Timber/bamboo decayed
Roof Cover	Roofs become bumpy or broken to pieces.	Roofs become bumpy or broken to pieces.	Roofs become bumpy or broken to pieces.
Door & Windows Frame	• Frames become slants and decayed • Windows cannot be opened.	• Walls become slants and decayed.	• Walls become slants and decayed.
Column	• Reinforced bar cover concrete which get peeled off • Timber decayed • Wall-Column joint be apart or cracked.	Timber decayed	Timber decayed
Beam	• Reinforced bar cover concrete which get peeled off • Timber decayed	Timber decayed	Timber decayed
Beam-Column Joint	Beam-Column joint to be apart or loose.	Beam-Column joint to be apart or loose.	Beam-Column joint to be apart or loose.

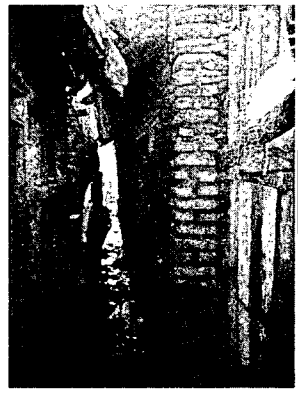
(*Source:* Field Observation, February 2002)



Floor broken to pieces, the water seeping in or through the floor

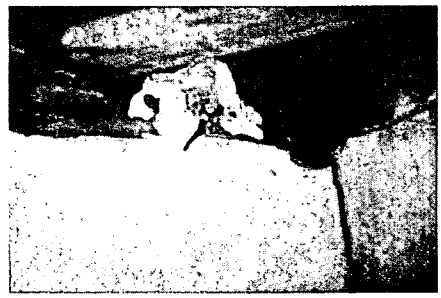
Corner joint of walls to be apart or cracked.

Wall covers look dull, moldy, and damp. While plasters get peeled off.

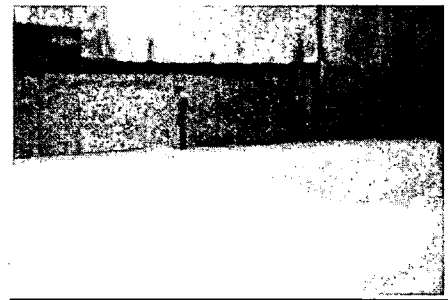


Walls become slants.

Beam-Column joint to be apart or loose



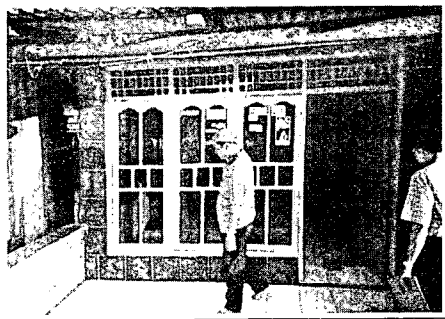
Beam joint to be apart or loose



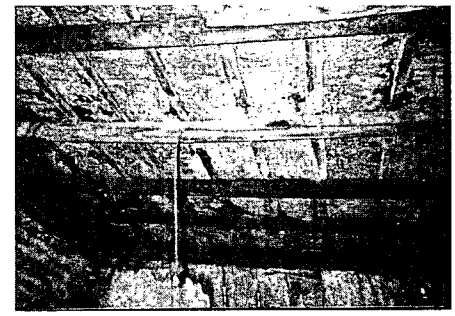
Timber beam decayed, Plywood's wall get peeled off

(*Source:* Field Observation, February 2002)

Figure 2.2.4: Deterioration of Building Elements



Frames got slanted and decayed, while windowdoors cannot be opened



Roof frame decayed & deflected

(*Source:* Field Observation, February 2002)

Figure 2.2.4 (Continuation): Deterioration Kinds of Building Elements

(2) The Daily Activities

The disrupted effects of the inundation area on the inhabitants' lives can be identified through the daily activities of the inhabitants which are disrupted. The table 2.2.6 below shows the bad effect of the inundation on the inhabitants' activities.

Table 2.2.6. The Effects of the Inundation on The Inhabitant's Lives.

Daily Activities which are disrupted	The percentages of the respondents who are disrupted (n = 35).
Domestic works	
- cooking	100%
- eating	100%
- drinking	100%
- washing	100%
Productive works	
- working	77.1%
- learning activities	80%
Leisure activities	
- sleeping	100%
- social interaction	100%
- worships	97.1%
- playing time	85.7%

The height of each inundation is up to 50 cm from the ground, the duration time of each inundation is at least 1 hour. Frequency of inundations in a day is about 2 up to 3 time a day, frequency of inundation in a month is about 10 days, and frequency of inundations in one year is about 40 days (in the dry seasons).

- Domestic works, such as cooking, eating, drinking, and washing cannot be done normally. Social facilities to supporting domestic works, such as electricity, water

supply, and sanitation cannot be utilized while he tide comes, so they cannot do domestic works.

- Productive works, such as going to school or to work place are hinderd as well, because the roads in the neighborhood areas which are connecting people transportation to the main roads and the work place are inundated. Roads are vital for the daily activities in urban areas. Daily activities of the inhabitants exactly are hindered inundations..
- Leisure activities, such as sleeping, worship, social interaction, are also interrupted, because every times the tide comes, the inhabitants are so busy to cope with the post-inundated matters, even when the tide is over, they have to spend a lot of time to clean up their dwellings. Frequently, in the area where their dwellings are next to the sea, the tide comes so suddenly. Too often, the tide does not come only once in a day, so during the tide seasons they have to be alert all the time to cope with and survive for their living.

Furthermore, the effect of inundation on the inhabitants is not only on the activities of the on habitants, but also financially, on the annual expenses. They have to expend some money for improving their dwellings, and also for raising up the ground floor though filling in the ground by soil every 3 years as high as 50 cm.

(3) Adaptation

a. Physical Adaptation.

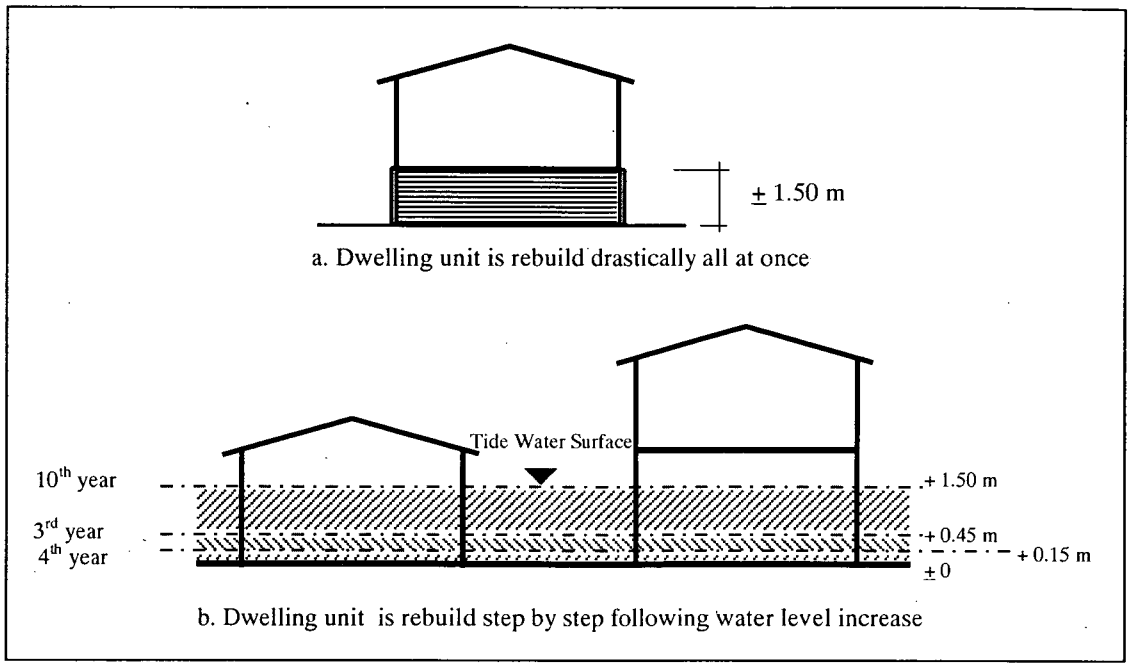
Since the inundation caused by high tide (*rob*) as well as land subsidence began to occur a year long, the inhabitants have adapted themselves, by following coutermeasures::

1) Building Physical Adaptation

To make inhabitants feel secure living in the area affected caused by continuously uprising sea water level, building physical adaptation is done by the residents for themselves. The most common adaptation is to build a small embankment in the front entrance, or to elevate both the yard as well as floor house step by step to sea water level up. On the other hand some people who belongs to middle to high-income level are able to rebuild their dwelling units drastically all at once. The rubble stone foundation of their houses is built as high as 1.5 – 2 meters from the ground, so the floors of their houses are about 1.5-2 meters above the land surface. The newly rebuilt landed houses are constructed about 1.5-2.0 m above the existing land surface. They realize that life time of their houses are only for 10-15 years, because within 15 years their houses will be influenced by inundation either (see figure 2.2.7).

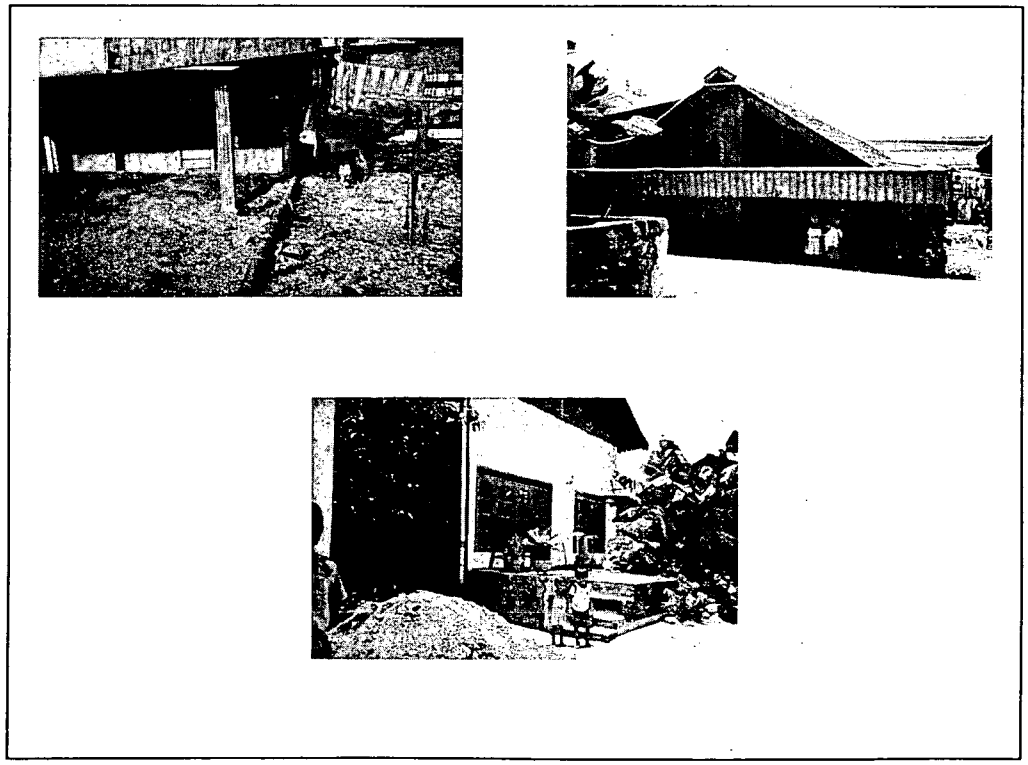
In the case of the step-by-step adaptation, people fills sand on the floor of the house. This is directly done without giving additional forcing of the existing building components (wall, column, beam, door and windows frame, etc), except door leaf that must be reduced suitable with the new building height.

At the same time, in the community level, the community elevate the roads surrounding their houses by self-helpworks, and so far, they still survive to live in such area.



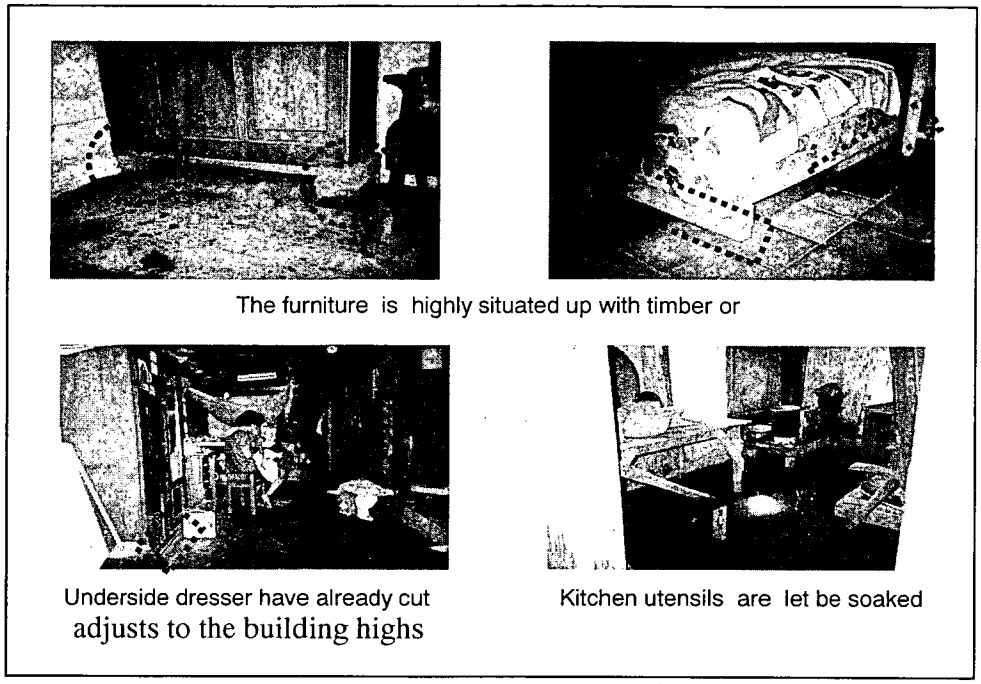
(Source: Field Observation, February 2002

Figure 2.2.5: Sketch of the Building Physical Adaptation Method



2) Furniture Adaptation

Since inundation destroyed most of household furniture and also kitchen utensils, the most common effort which is done by residents are to put furniture and kitchen utensils in the high place to secure from flood. But some people let their furniture be soaked every time. When the floor was heightened, some furniture has to be cut shorter to adjust to the new building heights. According to some respondents, generally their furniture has only three year usage time, because inundation decayed as well as had to cut completely.



(Source: Field Observation, February 2002)

Figure 2.2.7: Furniture Adaptation

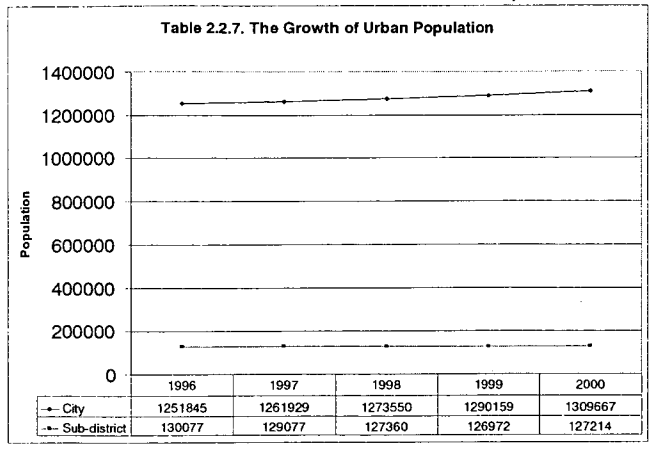
b. Inhabitants Adaptation

In the normal situation, residential areas should not be inundated by the uprising of sea level, but the fact shows that sea level continuously rises annually. Uprising sea level absolutely is the only one interference thing for all inhabitants' lives. This condition gradually is getting higher and larger. All respondents (100% of the respondents) stated that inundation is the extremely worse for their habitats. The inhabitants become aware of what is being happened on their dwellings and its surroundings during the last five years. They have experienced how disastrous inundation disrupted their home and their lives. Therefore, there are three alternatives have to be adapted to such environmental condition.

1) Move out

- The first group is the one who prefer to move out and choose others areas where they can live physically and socially secure. The evidence indicated is that the numbers of the inhabitants in sub-district of North Semarang tends to decrease (see table 2.2.7. below). The decreasing of the inhabitants is caused by that some people who cannot be able to accept such condition above, so that they moved out

Table 2.2.7. The Growth of Urban Population



2) Protect

- They try to survive rising up their ground floor to avoid sea water or inundation inserting their houses. That is seen from table 2.2.8. below

Table 2.2.8. Adaptation of the inhabitants' lives

To be adapted :	**% of inhabitants**
By rising up the ground floor	77.1
Nothing can do	17.1
Not mention	5.8

Source : survey 2002

3) Bear

- Some others peoples who cannot rise up their ground floor has no choice to adupt such conditions above. This means that they try to be adapted to such condition by lessening their standard of living, and accepting its all consequences, such as they have to live in a house with the floor what is always soaked and wet by sea water all the time. The majority of the inhabitants in North Semarang are labors.

Table 2.2.9. The reason of that inhabitants live

The Reason	**% of inhabitants**
No choice	62.9
Close to the work place	17.1
Not mention	20

Source : survey 2002

Right now inundated area in North Semarang is not a suitable place for living. No matters how the inhabitants try to adapt by rising up the ground floor, sooner or latter their habitat will be inundated, because of continuously sea level rise and land subsidence as well, unless physically there is a sophisticated technological approach which cost is extremely expensive, and a proper urban environmental treatment and management at the same time.

2.3. SURABAYA

2.3.1. General condition

(1) Urban Scope

a. Geography

Surabaya as the capital city of East Java is located on coastal area which, administratively enclosed by :

- North : Madura Strait and Bangkalan Regencies
- West : Gresik Regencies
- East : Madura Strait
- South : Sidoarjo Regencies

Astronomically Surabaya is located in 7°12' up to 7°21' South latitude and 112°36' up to 127°54' East longitude. Most of the area locates on low land between 3 and 6 m above sea level and the height is 25 up to 50 m above sea level. Surabaya Municipality is also located around hill called Bukit Lindah and Gayungan on southwest direction. Total area under authority of The Surabaya Municipality is 32,638 Ha and it consists of 5 Assistant Majors, 28 Districts and 163 Sub-Districts, as shown Figure .2.3.1.

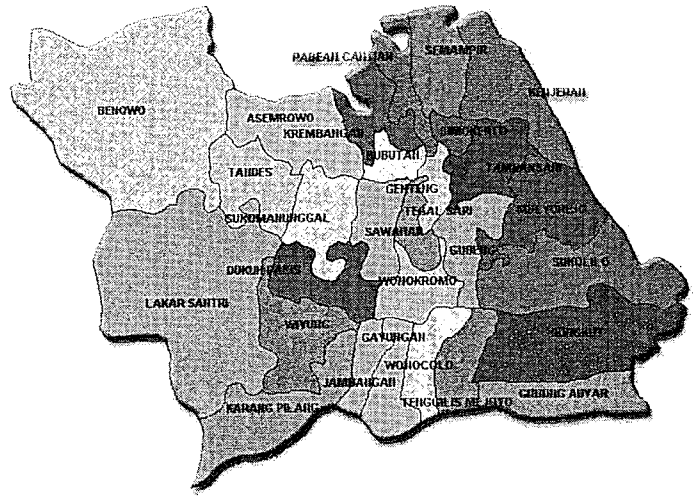


Fig.2.3.1: Territory of 28 Districts in Surabaya Municipality

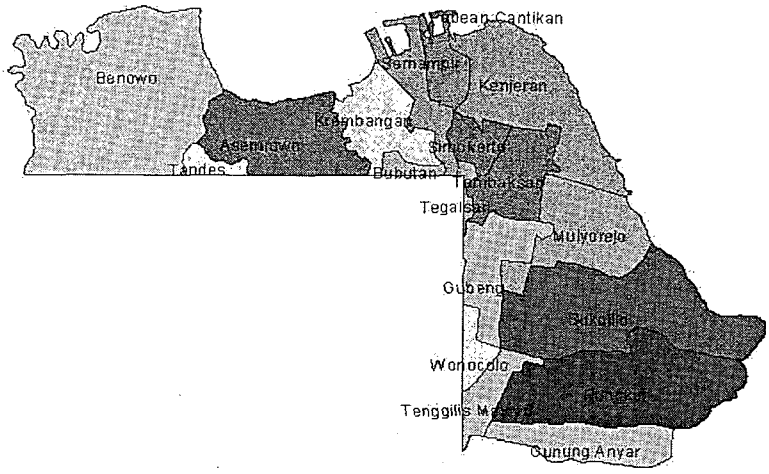
Surabaya is known as metropolitan city covers an area of 32,639 Ha (326 km^2) which mostly low land and almost 50% is located in coastal areas. Although the whole land use of Surabaya is categorized as urban land, part of the area is clasified as rural utilized such as for rice field, dry rice field, fishpond or forest. This type mostly found in the border of Surabaya on west, southwest, and east region of the center.

The total area of Surabaya Municipality is about 12,474.42 Ha utilized for housing (38,89 %), rice field (20.02 %), dry rice field (19.98 %) and the rest is used for others function such as industrial land, warehouses, etc. Land in east part of Surabaya is majority for rice field,

fishpond or coastal area (about 52.07% in totally), while in west part approximately 50% of total area is dominated for fishpond and salt-making pond.

As the capital city, Surabaya carries the governmental center with typical activities such as industrial and commercial sectors. In such condition then it has stimulated the people to move in. Data of demography year 2000 indicated that population is about 2.4 million people and the density is approximately 75 person/Ha. The population growth is estimated 0.32% in central city and 7.34%. in coastal areas. Fast development growth in central city has consequence those inhabitants to move out to outskirts of city were usually unoccupied lands in coastal areas.

Those people mostly are fishermen, fishpond worker, salt-maker, or traditional boat renter. Their limited skill has prevented the inhabitants to work in other sector beside marine-based activities. Even though the people also complained about recent narrower land than previously. Looking to their daily condition, the inhabitant is classified as low-income people.



Focusing into coastal areas that locate nearest distance from coastline, it may be consist of wet and dry land that still affected by sea behavior. Those areas cover between Tanjung Perak harbor in west direction, and Sidoarjo district in east part as shown in Figure .2.3.2 and table below.

Fig. 2.3.2: Coastal Areas in Surabaya City
Source: City Government Bappeda Surabaya, 1996

Table 2.3.1. Kecamatan and Kelurahan in Surabaya

Kecamatan (District)	Kelurahan (Sub-District)
Benowo	Romo Kalisari and Tambak Oso Wilangun
Asemrowo	Tambak Langen, Greges and Kalianget
Krembangan	Morokrembangan and Perak Barat
Semampir	Ujung
Pabean Cantikan	Perak Utara and Perak Timur
Kenjeran	Tambak Wedi, Bulak Banteng
Bulak	Kedung Cowek, Kenjeran, Komplek Kenjeran, Sukolilo, Bulak
Tambaksari	Kalijudan
Sukolilo	Keputih
Mulyorejo	Dukuh Sutorejo, Kalisari and Kejawan Putih Tambak
Rungkut	Medokan Ayu and Wonorejo
Gunung Anyar	Gunung Anyar Tambak

b. Climate

As tropical city Surabaya has two seasons. Dry season ocurs from November to April and wet season ocures from July to October, the remaining maonths are transition season. Average daily temperature in Surabaya is 22.7 - 33.7°C, maximum air moisture is 97% and air pressure is 101.84Mbs.

Between December - February wind flow direction in last 10 years trends to west and between May - October is to east, while the remaining is changeable direction.

According to rainfall record from 10 stations that organized by Meteorology and Geophysical central, The Brantas Irrigation Agency, Public Works Surabaya showed the maximum rainfall from 1980 to 1990 period indicated bellow.

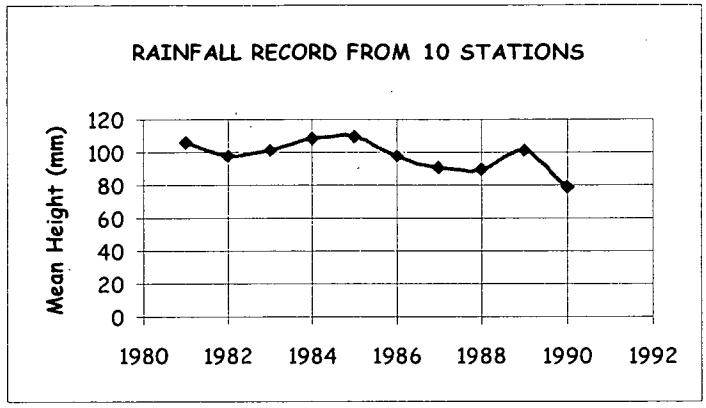


Fig.2.3.3: Mean Rainfall Height
Source: The river of Brantas Irrigation Agency Surabaya

c. Morphology

Looking into morphology Surabaya, there are large areas will be directly affected by sea level rise. About 25,919 Ha or 80.72% from total area of 32,639 Ha is located in low land which is between 0.5 - 5m SHVP or between 3 - 8 m height. By this condition the area susceptible to inundation if one-meter increasing of sea level. The remaining area or about 20% of total area is categorized as low wave hilly that particularly located in east, north and part of south region. The height of this land is lower than 10 m from sea level and the slope of area was less than 3%. Spreading hilly areas cover District Lokarsanti and Karangpilang. The height of this area is less than 30 m of sea level surface and slope land is 5 – 15%.

By such areas, City Government reported that based on quality of inundation the areas can be categorized in 3 zone as follows:

a. Non-inundated zone covers 9155.09 Ha
b. Periodical inundated zone covers 606.53 Ha
c. Always inundated zone covers 6337.05 Ha

Figure 2.3.4. indicates the zone and the covering areas.

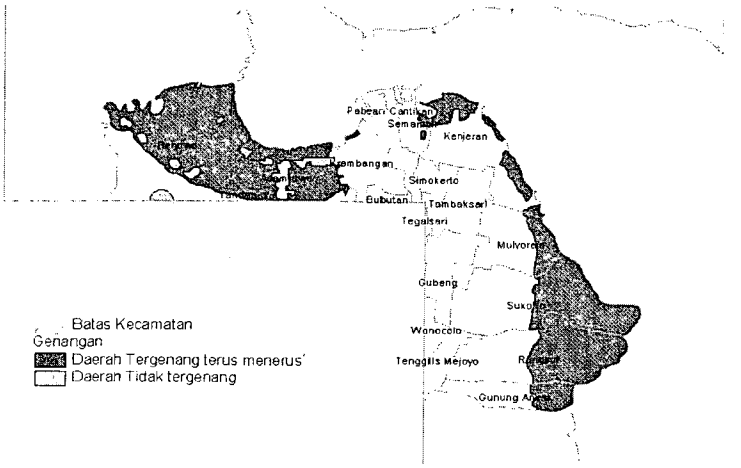


Fig. 2.3.4: Inundated zone in coastal areas
Source: City Government, Bappeda Surabaya, 1996

Overlaying one-meter height contour to the inundated zone shows the Sub Districts which have pre-requirement as defined in surveyed area consisting Benowo, Asemrowo, Krembangan, Pabean Cantikan, Semampir, Kenjeran and Mulyorejo.

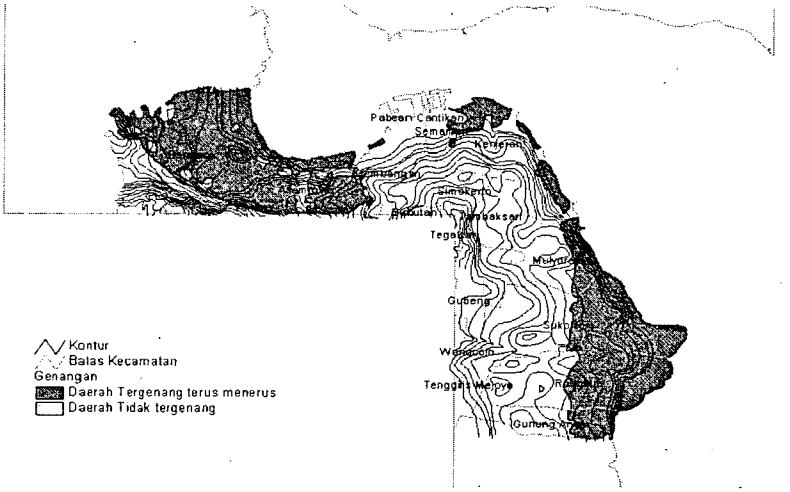


Fig. 2.3.5: Overlapping of Contour Line and Inundated zone
Source: City Government, Bappeda Surabaya, 1996

d. Geology

The soil in this land is composed by alluvial deposit developed from river and coastal features. Mostly Brantas River and Rowo River affect the characteristic of river feature and some part area of east and north part of Surabaya and continue to along Madura Strait.

The granular size of this soil was between 0.075 mm and 2 mm. It encompasses clay, silt and salty clay. A thin shellfish layer was found in some places. Geology of Surabaya Municipality consists of clay and sandy layer. Dominance soil is alluvial soil that is susceptible of cropland.

The soil containing a highly lime soil that less open for plantation was found in west of Surabaya.

Geological data ontained by Geology Directorate of Bandung reveals that the soil capacity in carrying a building construction is as follows:

(i) Soil type in Surabaya varies and uneven spreading that cause a different capacity from place to place

(ii) In old city such as in the districts of Wonokromo, Sawahan, Genteng, Tegalsari, Gubeng, Tambaksari, Simikerto, Semampir, Paben Cantikan, Krembangan and Bubutan; the soil are classified as clay soil with about 10 –18 m in depth. The building foundation that would be constructed in this soil type has to be grounded about 25-30 m in depth.

(iii) The hilly area in west city mostly contains clay soil then the building foundation has to be grounded about 4 -10 m in depth.

For determining the soil carrying capacity described above, the following main parameters has to be considered such as:

(i) Soil texture based on the granular size of soil. Surabaya mostly composed from fine granular size of soil.

(ii) The depth of fertile soil that available for plantation is 98% of total area. Effective soil has 90 cm in depth and the remaining or 13% has 60 and 90 cm in depth.

(iii) The slope of land of 80% of total area is 0 – 2 %, then the flow speed of surface water is slow.

(iv) In hilly area there is no erosion caused by eroding of water surface.

(v) Assessment of drainage condition is estimated by duration of inundation in a certain time. The inundation is classified in three condition, unaffected inundation, periodical inundation and high frequency inundation.

Concerning the chemical and physical parameter of the groundwater, as water source in coastal areas Surabaya, it mostly is not drinkable. According to the study by Mining Agency of Surabaya the groundwater condition is distinguished into five zones.

(i) Ground Freshwater Zone. This zone has high potential for drinkable water by controlled exploration. In this zone, the development of settlements and other function is not suggested, since those activities consume high groundwater.

(ii) Low Potential Zone of Ground Freshwater. This zone is suitable for any activities such as settlements or other function, which need less groundwater.

(iii) Moderate Potential Zone of Ground Saltwater. Exploration of groundwater in this zone has to be fully controlled to prevent the salinity concentration.

(iv) Low Potential Zone of Ground Saltwater. In this zone people can use the water for any daily activity but undrinkable. Although exploring the groundwater is not specifically requirement.

(v) Ground Saltwater Zone.

Mostly the freshwater condition in Surabaya has been polluted due to sea intrusion and sedimentation result. The salinity concentration was not only in the coastal area but also spread out in upland area. Result of the research done by the Local Mining Agency of Surabaya in 1996 on 83 sample points selected randomly in areas show that the intruded area is larger than fresh area, especially in northwest, north, east and southwest areas of Surabaya. Beside that, partly of the central and south city compose of intruded area with high salinity concentration. This condition, however, is caused by connate water due to sedimentation or sea intrusion.

The areas having over standard of drinkable source is 22,814 Ha or 78.54% of total area, while the freshwater area locates only in 6235 Ha or 21.46%. This report, however need to be considered by decision-maker to readjust the urban planning in protecting the health environment.

e. Housing

The area of housing in Surabaya is about 38,89% of the total area of Surabaya City. Based on monographical data of Surabaya sub district year1999, total houses in Surabaya are 109.575 houses consisting of 46.032 unit permanent houses and 63.543 unit temporary houses. In line with the trend that population move from city center to fringe area, the growth of population in fringe area is much more higher than in city center. The trend of location of housing areas is also moved fron center to fringe area. The condition is signed that many new housing areas now are located in the fringe area that is located in the western and northern part of Surabaya City and some of them are located in coastal area. The housing types consist of planned and unplanned housing areas. Planned housing area is the housing area built by developer while unplanned housing is the housing area built by every households.

(2) Inundated Area

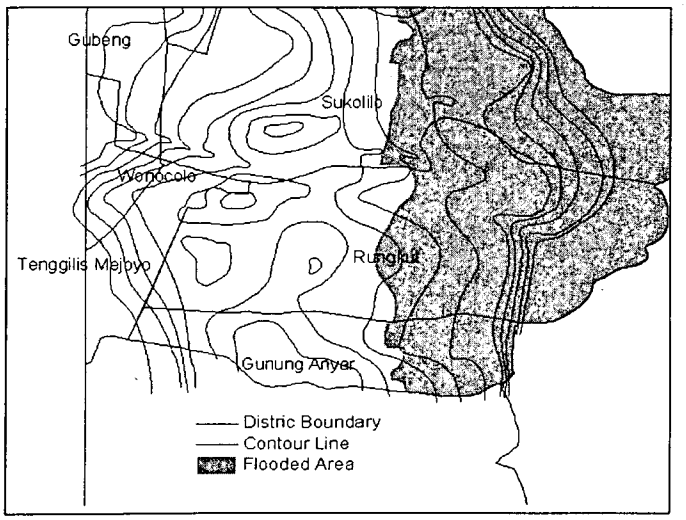


Fig. 2.3.6 : Flooded Area in Rungkut District

The inundated zone in costal area can be seen in Figure 2.3.4 and Figure 2.3.6. From the figure and also based on interview with the official from Agency of Flood Anticipation (Dinas Penanggulangan Banjir), the inundation is caused by overflow of river or high tide. When both ocure in the same time, the intensity of flood becomes higher. The condition indicates that sea level rise will has a big impact in Rungkut District. This is becaused the Rungkut District is dominated by low land area and most of them lay below the highest tide.

According to Rungkut District of inundation zone report, the location has been categorized as follows:

Table 2.3.2. Inundation Height and Duration in RWs of Kecamatan Runkut

No	Sub District	Location	Inundation Height (cm)	Duration (days)
1	Kali Rungkut	Rungkut Lor (RW VI)	50 up to 100	4
		Mejoyo (RW VII)	30 up to 70	4
		Kaliwaru (RW VIII)	50 up to 100	5
		Rungkut Harapan (RW II)	30 up to 50	4
2	Rungkut Kidul	Jl. Kalimir (RW II)	20	2 up to 3
		Jl. Kalimir (RW III)	20	2 up to 3
3	Kedung Baruk	Kedung Baruk (RW I)	5	1
		Kedung Asem	20	2
		Kedung Baruk (RW I and IV)	20	2
		Dicth beside gg IX	20	3
		Around aftur river (RV IV)	20	3
4	Penjaringansari	Jl. Pandugo (RW I)	10 up to 20	1
		Jl. Pandugo II (RW I)	10 up to 20	2
		Jl. Pandugo III (RW I)	10 up to 20	2
		Jl. Raya Penjaringan (RW II)	10	1
		Jl. Kendalsari Gg. I	15 up to 25	2
		Jl. Raya Pandugo (RW IV)	15 up to 25	2
		Kompleks Pandugo Baru (RW IV)	10 up to 20	2
		Pandugo Timur (RW V)	10 up to 20	1
		Pandugo Praja II (RW VI)	10	1
		Penjaringan Asri (RW VII)	5 up to 10	1
		YKP Pandugo I (RW VIII)	5 up to 10	1
		YKP Pandugo II (RW IX)	10 up to 20	1
		Penjaringan Timur (RW X)	10	1
5	Medokan Ayu	Jl. Raya Medokan Ayu (RW II)	10 up to 20	1
		Jl. Raya Jembatan (RW II)	10 up to 20	1
		Jl. Tambak Mendokan Ayu (RW II)	10 up to 20	2
		Jl. Wonoayu (RW III)	20 up to 30	2
		Jl. Medayu Utara (RW IX)	10 up to 20	1
		Jl. Raya Pandugo (RW III)	10 up to 20	2
6	Wonorejo	Jl. Wonorejo Timur (RW VII)	20	1
		Jl. Wonorungkut (RW II)	10 up to 20	1

Source: Report of Rungkut District 2001

(3) Study Area

a. Administrative Boundary

Selection of survey area is decided by the surveyor based on the following steps.

(1) Assessment that border of costal area has large settlement
(2) Plotting one meter of contour line in selected area
(3) Based on Inundated zone, select a District as vulnerable area
(4) Based on land use map, select the Sub-district which has large settlement area

The four steps above can also be taken through collecting secondary data from institutional reports or reports of previous research. Therefore the surveyors decided to analyze Rungkut District as study area. It is located in Eastern part of Surabaya City and consists of 6 sub district. It covers 2108 Ha area with total population 75,823 people and density 36 persons /Ha as described in Table below.

Table2.3.3. Kelurahan in Kecamatan Rungkut

No.	Kelurahan (sub-district)	Area (Ha)	Population	Density
1.	Rungkut Kidul	137	16940	124
2.	Medokan Ayu	653	7350	12
3.	Wonorejo	370	5293	15
4.	Penjaringan Sari	181	10408	58
5.	Kedung Baruk	146	15880	109
6.	Kalirungkut	258	24743	96

Source : Sub Districts on Figure 2000

The primary investigation on physical aspect (building) was done in Medokan Ayu and Kalirungkut sub district, while the primary investigation on aspect of socio-economy was done in sub district of Medokan Ayu, Kalirungkut, Penjaringan Sari, and Rungkut Kidul.

Fig.2.3.7 : Study area selection

b. Socio Economic Profile

Population of Rungkut District year 2001 is about 79556 persons consisting 38715 male and 40841 female. The occupations of the people are labor, farmer, fisherman, trader, and government official.

Table 2.3.4. Occupations in Kecamatan Rungkut

No.	Occupation	Number (person)	%
1	Labor	28956	68.84
2	Farmer	4414	10.49
3	Fisherman	426	1.01
4	Trader	4382	10.42
5	Government Official	2577	6.13
6	Other	1309	3.11

Source : Monograph of Rungkut District 2001

Land utilization of Rungkut District has the following table.

Table2.3.5. Land use in Kecamatan Rungkut

No.	Land Use	%
1	Housing, Industry, and their facilities	30.74
2	Rice Field	51.92
3	Fishpond	8.58
4	Swamp/Wet land	8.58
5	Dry land	0.18

Source : Monograph of Rungkut District 2001

Based on existing land use, Rungkut District is dominated by undeveloped area about 69,24% of total area such as rice field, fishpond, wet field and dry field. Domination of un-build areas indicated that there are a lot of areas possibly to be converted to housing, industry, trade and services area, etc.

Table2.3.6. Industries in Kecamatan Rungkut

No.	Industry class	Number	Number of Workers
1	Middle and Big Industry	225	3263
2	Small Industry	66	729
3	Home Industry	72	255

Source : Monograph of Rungkut District 2001

Based on the above table the industry in Rungkut District is dominated by big and middle scale instead of small and household industry. Number of big and middle industry is caused by existence of industrial estate located in Rungkut District. The existence of industrial estate makes Rungkut District as a strategic area in the constellation of Surabaya City.

c. Infrastructure

The education facilities consist of kindergarten, elementary school, junior high school, senior high school, college, and university. Religion facilities consist of mosques and churches. Health facilities consist of small hospital, and dispensary. Markets provide with permanent building and without permanent building. Type and number of facilities in Rungkut District has figure as table below.

Table 2.3.7. Facilities in Kecamatan Rungkut

No.	Kinds of Facilities	Numbers
1	Education (School)	79
2	Religion	108
3	Health	20
4	Market	7
5	Hotel and Restaurant	6

Source : Monograph of Rungkut District 2001

In Rungkut District number of houses constructed on 875 hectare or 50,1 % of the area is 15.662 units consisting of 15.578 permanent houses and 84 temporary houses. Some houses are rental houses. The existence of rental houses is to support demand of industrial workers who stay in adjucent industrial estate. Most of them are classified to be informal housing areas.

It was found that some of the housing areas are located in the areas having high risk to be inundated. The inundated housing areas increase almost every year because of the construction development such as formal housing, industrial estate, university, etc. All the land conservation of rice fields and other wetland lead to the decrease of catchment areas.

d. Housing

Landed house was the dominant building type in the surveyed area. In general the constructions of cased houses are permanent building with reinforced concrete frame and masonry. Wooden houses are also found in surveyed area. According to District Monographic year 2001, number of house based on the structural type is as follows:

Table2.3.8. Building Types in Kecamatan Rungkut

Building type	Number
Permanent houses	8568
Semi permanent houses	3599
Wooden houses	1608

The spreading of housing area in Rungkut District also can be seen in Land Use Planning as Figure . 2.3.7 below. This figure shows that housing area dominated in this Sub-District

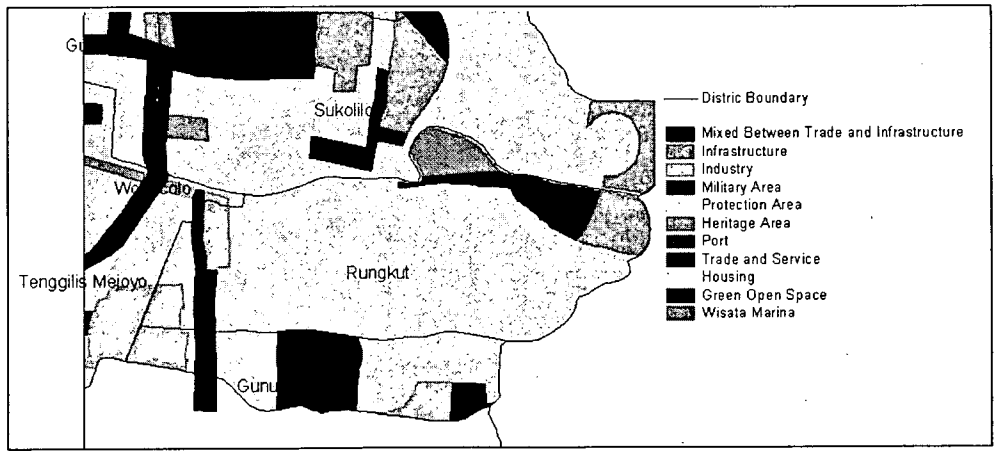


Fig.2.3.8. Land Use Planning in Rungkut District

Based on Detailed Spatial Planning of Surabaya City, land use plan of Rungkut District is dominated by housing and industry. Land use plan for housing is intended to accommodate the spillover of population of Surabaya City. This is because the city center of Surabaya is only intended for trade and service and no longer accommodates new housing activities which will be located in fringe area like Rungkut District. Besides new housing, Rungkut District also has to accommodate industrial and commercial activities.

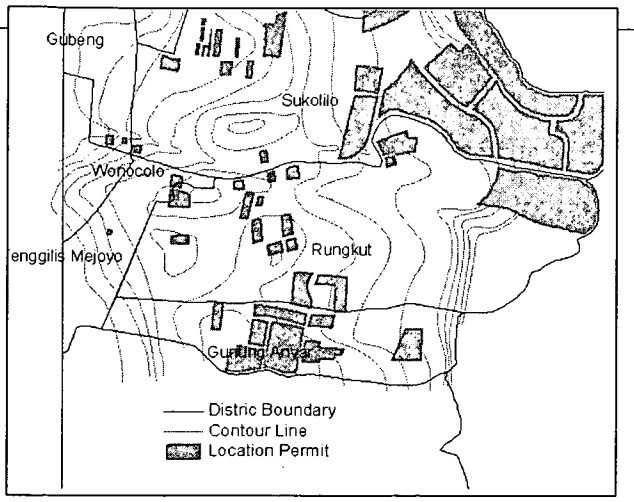


Fig. 2.3.9: Planned Area for Housing in Rungkut District

Figure 2.3.8 shows Planned Area for Housing in Rungkut District while Figure 2.3.7, shows Land Use Planning in the flooded area. Comparing both figures therefore, planned area for housing is influenced by the sea water tide and sea level rise. The condition gives negative impact to the investment in the area.

Based on the existing condition and the allocation of activities of the detailed spatial plan of coastal areas in particular and the master plan of Surabaya City in general, the Rungkut District has an important role in the context of Surabaya City. This is because currently the Rungkut District is developed for Industrial Estate, and in the future also has to accommodate new industrial estate and new housing area. With regard to the condition, any disturbance to the Rungkut District will give big impact to the socio and economic condition not only for Rungkut District itself but also for Surabaya City in general.

2.3.2. The Effect of the Inundation on Building and Inhabitants' Lives.

(1) Building Deterioration

Existing condition against inundation of 12 houses of cased houses choosed randomly in Sub-District Kalirungkut and Mendokan Ayu can be described each component as follows:

- Building type; generally the houses are constructed on land namely single landed houses, and 3 houses are row houses. Two of 12 houses are designed as two stories building.
- Building construction; typical structural system is reinforced concrete, masonry and wooden construction.
- Foundation; this findation can not be observed directly. Regarding interview to the owners the foundation construction is shallow stone foundation.
- Wall; brick masonry dominates the wall construction material. Although timber was also used in a few houses.
- Floor and flooring; this component is usually designed by based floor then covered by ceramic tile or plaster. Compacted original land was used as floor in some houses.
- Roof; all roof material is roof tile and some are corrugated zink. Majority of roof construction is wood while and reinforced beam is used in one or two houses.
- Ceiling: all houses are provided with ceiling. Generally the material for ceiling is asbestos and plywood.

- Window and door: all door leafs of the entrance in the houses are made of plywood. Sometime they put curtain for temporary cover. Door and window frame are made of wood.
- Sanitation; water supply in the respondents' houses are categorized in three sources, PDAM (water supply corporation), well and public collected. For sewerage facilities, majorities were provided inside and some of them were used as common facilities.

Loss due to the inundation can be visually observed for each part of house components. In general, inundation mainly affects component of foundation, floor, wall and door frame. The remaining such as ceiling and window components may not be directly affected but they can still be damaged due to humidity. Alike in analysis flood effect, the deterioration due to sea level rise depends on not only intensity of the inundation itself but also reaction and adaptation regarding flood. To reduce degree of damage people usually elevate floor level and/or construct a small embankment on main entrance. The example how people adapt to change environment to their house can be shown in appendixes.

Based on interview of 12 respondents in District Rungkut, flood comes approximately 12 times especially in wet season. The inundation height is 30 cm minimum and 70 cm maximum and will take about 12 hour or even 3 days.

Loss measurement in physical building will be classified into three categorizes, that is light damage, moderate damage, and heavy damage. This classification for each component is precisely explained in the Survey Guidance (see Appendixes 1). Based on those classifications, deterioration of 12 respondents' houses in Surabaya can be described as follows.

Table 2.3.9. Deterioration of Building Components

Building component	**Existing deterioration or building damage**
Foundations	Although wet or flooded foundation will be a continuous source of moisture, in physically this components are still good condition and may not require special attention during the aftermath of a flood.
Main frame construction	A main frame may not have been destroyed by flood water, but wood frame is still damaged by humidity. In field at survey time this deterioration was found neither reinforced concrete frame, masonry, nor wood frame.
Floor and flooring	Unfortunately, most floor covering will not survive a flood and that why some inhabitants have probably been replaced. In field survey, the deterioration can be classified between light damage and heavy damage. Although a good floor finish helps by preventing the water from penetrating from the surface the surface from the surface above to the surface bellow, the underside of the floor allows water to penetrate from bottom up and causes swelling and damage.
Walls	Plastered brick masonry is used most houses for building envelope. Plaster can regain its strength when flood is over, but wall become very fragile if it stays wet for a long time. However, it was found the wall condition is between light and heavy damage, while some that in good conditions may be because of refurbishment.
Door and windows	Door and windows are not disturbed by flooding. The decay is due to humidity. Existing units are mostly in good condition, then improving the performance is less cost.
Ceiling	The ceiling structure cannot be investigated directly during the survey, because this construction is covered by asbestos sheet and/or plywood. Ceiling is not influenced by

Building component	Existing deterioration or building damage
	flooding.
Utility	Mostly electrical installations are in good condition because the switch and flug are installed in higher place than floodwater. To avoid hazard and fire the central electrical office is always turned off the power. Clean water is supplied by State Owned Company of Water Supply directly to individual houses and public tap, those it may not contaminated. While clean water from shallow well is always contaminated by flooding. During flooding, sewerage facilities cannot be used totally. Often happen the wastewater flows back inside to the room.

Briefly the physical condition building is described in other part.

2. The Daily Activities

Although the flooding continuous more than 24 hours and its height is about 50 cm, the respondents' activities dones not stop. When flood comes, the inhabitants can find the dry place and put the stuff up on the table or bed and they do their activities on both places.

Table 2.3.10.Daily Activities Disturbed by Inundation

Activities	Disturb	%	Not Disturb	%
Eating	11	24.4	34	75.6
Drinking	7	15.6	38	84.4
Cooking	11	24.4	34	75.6
Washing	11	24.4	34	75.6

source : field data processing

Morever, infrastructure for supporting domestic works, such as clean water and sanitation, are still working during flood season, so that domestic works are not hinderd. as can be seen from table below :

Table 2.3.11.Life Line Disturbed by Inundation

infrastructure	Disturb	%	Not disturb	%
Clean water	10	22.2	35	77.8
Sanitation	10	22.2	34	75.6

source : field data processing

Other social activities, such as going to the office, to the working places, to the religious place and to school. are not disturbed as can be seen from table bellow :

Table 2.3.12.Schools not Disturbed by Inundation

Activities	Disturb	%	Not disturb	%
To the school	7	15.6	38	84.4
To the office	7	15.5	38	84.4
To the work	11	24.4	34	75.6
To the religious service	6	13.3	39	86.7

The inhabitant who live in inundated area in Rungkut District have no reason to move out from this area, because they have following reasons:

- The area is not far to the work place then no travel expences.
- During and after flooding, the inhabitants get some aid such as food and free medicine.

- Social relationship among neighbour is close enough. This is the most important things that makes Rungkut is a place where the inhabitants found ease living. The flood makes the inhabitant more closer one to each other with all sympathetic.

(3) Adaptation

a. Physical Adaptation

How people adapt to present environment regarding flooding in their surround living area depends on people awareness and capability. Residents who are able to renovate their house will repair it. Since the houses are constructed on inundated land, the brick wall as well as floor are usually damp and highly tend to destroy. Moreover, timber frame structure and furniture will become weak and unsightly. This worse condition often occurs in surveyed area which mostly ocupied by people classified as low and middle income bracket.

As informed by the residents flooding occurs in regular time within a year. This regular condition drives residents to adapt by repairing their house through elevating the floor or constructing a small embankment at building entrance.

b. Inhabitant adaptation

Facing the frequency of flood (7 – 12 times in a year), the residents realize that the flood occurs all day long, therefore they continue daily activities the days after. According to the inhabitants, flooding is the most interference thing on their live. However, the wealthy inhabitants initiate to reduce flood water inserted their houses by elevating the floor, while some other inhabitants are doing nothing, as can be seen from table bellow.

Table 2.3.13.Adaptation by Inhabitants

Inhabitant Adaptation	Frequency	%
Elevated floor	38	84.4
Fence the yard	-	-
Doing nothing	6	13.3
Others	1	2.2
Total	45	100

Source: field data processing

The majority of inhabitants are the people who work as informal sector around Rungkut district and their educational background is only in the level of secondary schooll while they do not have any expertise. These social condition are not possibly for them to move to other places where locate far from their work place. This may reflect that they have no choice and they really reliance to this place to earn the living.

2.4. DENPASAR

2.4.1. General

(1) Urban Condition

Denpasar geometrically is located in 08°35'31'-08°44'49" South Latitude and 115°10'23'-115°16'27" East Longitude, it is consist of 3 (three) Districts and 43 Villages/Sub-Districts. The area of Denpasar is about 12.780 KmĂ (2.18% of Bali Island). The land unit and Geological condition of Denpasar City are shown in Figure 2.4.1 and Table 2.4.1.

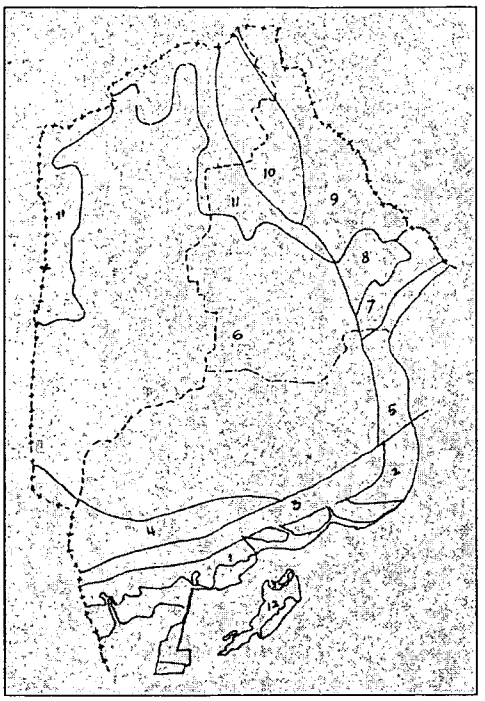
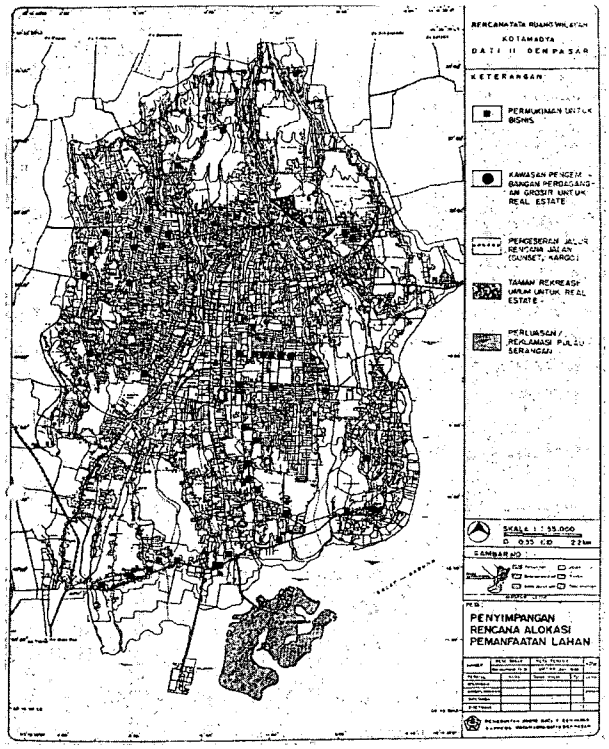


Figure 2.4.1. Land Unit of Denpasar City

Table 2.4.1. Geological Condition of the Denpasar Land Unit

No Land Unit	*Soil Type*	*Texture*	*Drainage*	*Slope*	*Effective Depth*	*Sedimentation*
1	Brown-Grey Regosol	Rough	Inundated	Flat 0-2%	30-60 cm	Alluvium
2	Brown-Grey Regosol	Rough	Porous	Flat 0-2%	> 90 cm	Alluvium
3	Brown-Grey Regosol	Moderate	Non-inundated	Flat 0-2%	> 90 cm	Alluvium
4	Brown-Grey Regosol	Moderate	Non-inundated	Flat 0-2%	> 90 cm	Tuff and Buyan Lava
5	Brown-Grey Regosol	Rough	Porous	Flat 0-2%	> 90 cm	Tuff and Buyan Lava
6	Brown Latosol	Moderate	Non-inundated	Flat 0-2%	> 90 cm	Tuff and Buyan Lava
7	Brown-Grey Latosol	Rough	Porous	Waved 0-8%	> 90 cm	Alluvium
8	Brown Latosol	Rough	Porous	Waved 0-8%	> 90 cm	Tuff and Buyan Lava
9	Rough	Rough	Porous	Waved 0-8%	> 90 cm	Tuff and Buyan Lava
10	Brown Latosol	Rough	Porous	Flat 0-2%	> 90 cm	Tuff and Buyan Lava
11	Brown Latosol	Moderate	Non-inundated	Waved 0-8%	> 90 cm	Tuff and Buyan Lava
12	Brown-Grey Latosol	Moderate	Non-inundated	Flat 0-2%	> 90 cm	Alluvium



Area of land use planed for Settlements in Denpasar City in 1998 is 4.094.40 hectare or about 32.24% of city area. The area spread all over the City especially in the middle, north, east and Serangan Sub-district. In Sanur beach, only small area is utilized for settlements while the other large area is dominated by tourism accommodation. (See Table 2.4.2.).

Being known as internationally Paradise Tourism, Serangan Sub-district offers two main attractions i.e. surfing and Hinduism ritual ceremonies. The development of these activities is hoped to increase local income.

Figure 2.4.2. Settlements area spreading over Denpasar City

(2) Inundated Area

Some of Villages and Sub-district in Denpasar are in Coastal area. They are: Kesiman Kertalangu village and Kesiman Pethilan village which located in East Denpasar then Sanur Sub-district, Sesetan Sub-district, Serangan Sub-district, Pedongan Sub-district, Sanur Kaja village, Sanur Kauh village and Pemogan village located in South Denpasar.

The South-part of Denpasar District is dominated by coastal areas that mostly well maintained because it is sacred area that often functioned for Hinduism ritual activities. The length of the coastal line is about 43,380 kilometer comprising of three types of utilization such as preservation (mangrove), settlements and tourism as shown in Table 2.4.2.

Table 2.4.2. Type, length and function of coastal area

No	*Coast Type*	*Length (Km)*	*Function*	*Location*
1	Mangrove Coast	10,560	Preservation area	Suwung
2	Sanded Coast/Island	9,120	Tourism	Mertasari-Padanggalak
3	Reclamation Coast/Serangan island	23,700	Settlements	Coastal in Serangan
	Total	**43,380**		

The Serangan sub-district is a fishery housing area that is used to be inundation during high tide of seawater. Currently, the inundation area increases that has disturbed about 384 households. This is because of the expansion of the nearby airport that may block the seawater flows.

Research result in 1992 shows a huge abrasion along the shore that reduces about 50 meter of coastal line. The island then cannot be utilized effectively since its area spreads out into small part of dry lands. To revive the island reclamation has been done in 1997 that has enlarged the

area from 101 hectare into 481 hectare (mostly unregistered land). The 101 hectare is dominantly utilized for preservation area (mangrove) and farming, while only about 20 hectare is utilized for settlements. Figure 2.4.3. shows the land condition before and after reclamation.

Reclamation has made some changes such as improvement on land lot and houses and also environmental infrastructure. Tourism is an activity that is relatively newly developed that has changed some residents' livelihood that is used to be fisherman to be involved in tourism activities. The island is now easily accessible from the Bali Island that has been connected by the road.

Figure 2.4.3. The expansion of the Serangan Island

(3) Study Area Condition

a. Administrative Boundary

Serangan Sub-district that is located in Serangan Island has been decided to be the survey area. The 101 hectare is dominated for preservation area (mangrove) and farming, while only about 20 hectare is utilized for settlements. The borders of Serangan Sub-district are as follows:

- North: Sanur Kauh village
- South: Tanjung Benda Sub-district
- West: Pedungan Sub-district
- East : Badung strain

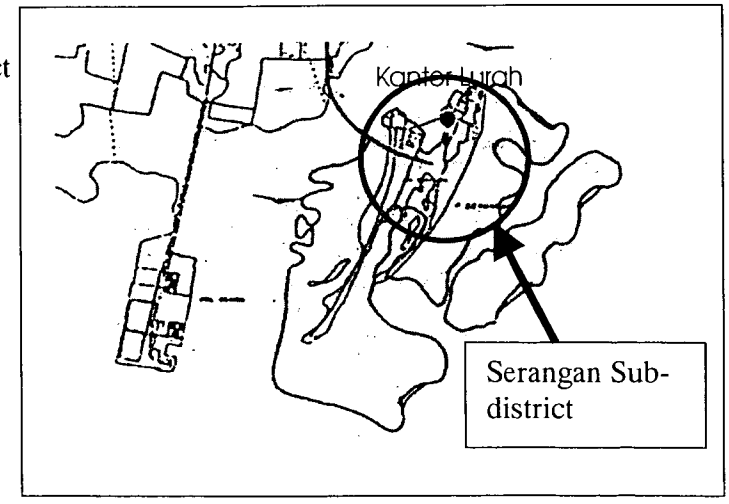


Figure 2.4.4. The location of Serangan Sub-district

b. Socio-Economic Profile

The number of people in Serangan Sub-district is about 3200 persons. The livelihoods of the people are explained by Table 2.4.3.

Table 2.4.3. Livelihood of people in Serangan

No	Livelihood	Number of Person	Percentage (%)
1	Fisherman.	1047	64.2
2	Trading	165	10.2
3	Private Employee	145	8.9
4	Government Employee	21	1.3
5	Worker, laborer.	95	5.8
6	Service	157	9.6
	Total	**1630**	**100**

c. Infrastructure and facilities

Based on *"Kecamatan Denpasar Selatan Dalam Angka 2000"* book, existing infrastructures cover Electricity Power, Clean Water, Transportation and Communication. Electricity and clean water of residents' needs are supplied by PLN (State Electricity Enterprise) and PDAM (Municipal Waterworks). The other infrastructure is communication that served by PT. TELKOM (Telecommunication Inc.). However the consumer of this service is only one household. There are two kind of transportation infrastructure: 1 road and 2 bridges. Length of this road is 8191 Km to accommodate 259 bicycles, 21 carts, 557 motorcydes and 47 private cars. Public transportation is not provided in this sub-district.

d. Housing

Based on monograph data of Serangan Sub-district, housing development involves neither public nor private investor such as BTN, Real Estate, and Perumnas. It is the sporadically housing development. Total numbers of houses in Serangan Sub-district are 700 houses comprising 635 permanent houses, 74 semi-permanent houses and 1 (one) non-permanent house. Housing needs still increase for all level income in Denpasar. The slum area emerges lastly 5 year and it is usually generated in the riverbank, and in almost all of vacant land. Building density increases in the center of city as inhabitants increase.

In Serangan Island, houses are constructed based on traditional rules, such as building orientation and site plan. A house is a compound of building for bedroom, kitchen and so on. The conditions of houses are almost new building after reclamation. Physically, the spirit of religion based on Hinduism is reflected in their house design. They believe that they need to build 'Pure' (shrine) along their house to protect them from evil spirit. At least there are three 'Pure' (shrine) must be build: Pure Tugu (Penunggun Karang), Pure Surya (Sanggah Surya) and Pure Kemulan (Pure Keluarga).

2.4.2. The Effect of the Inundated Area on Buildings and Inhabitant's lives

(1) Building Deterioration

Based on data obtained from the filed survey, various building materials used in Serangan Sub-district are explained as follows:

- Land cover : Sea Sand
- Foundation : Corral

- Floor : Ceramics tile
- Wall : Clay brick masonry
- Doors & windows : Kamper wood
- Ceiling : Multiplex
- Roof : Wood construction, clay tile
- Column : Concrete
- Beam : Coconut wood, concrete

Generally, the loss and deterioration occurred in the house component are explained bellows:
1) Foundation: All of the foundation is in good condition.
2) Structure and construction: All of construction structures are in good condition.
3) Roof Construction: Almost the entire roof frame is in good condition, except in roof of kitchen that may be because of low quality of materials and long lifetime.
4) Floor: Almost all of floor is in good condition except in the kitchen.
5) Wall: Wall conditions are various. Some of them are in good condition because they are newly built buildings and the rest are slight deterioration due to slight crack.
6) Doors and Windows: The doors and the windows are not directly influenced by inundation because the level of floor has been raised 50 cm up.
7) Ceiling: The component of ceiling construction cannot be observed directly but generally it is in good condition or slight damage.
8) Utilities: Electricity facility is in good condition because the plug is fixed more than 50 cm from the floor. Clean water supplies are got from PDAM (Municipal Waterworks) so it is in good condition. For waste disposal, septic tank system is used and it is in good condition.

(2) The Daily Activities

Generally, the outdoor activities are not totally disturbed by the inundation. The two outdoor activities which are not disturbed at all are 'go to school' and go to the office' meaning that 100% of respondents affirmed these facts. The activity of 'go to business' and 'go to pray' more than 90% respondents feel disturbed but the rest, less than 5% say that it occasionally disturbed. It can be inferred that the majority of people are not disturbed by the inundation in doing their outdoor activities. The explanation of this is explained on Table 2.4.4.

Table. 2.4.4. Outdoor Activities.

Activities	Disturbed	%	Not be disturbed	%	Occasionally	%	Total	%
Go to school	0	0	47	100	0	0	47	100
Go to office	0	0	47	100	0	0	47	100
Go to work	0	0	45	95.8	2	4.2	47	100
Go to pray	0	0	46	97.9	1	2.1	47	100

Resource: Field Survey

Most respondents explained that inundation has occasionally disturbed on cooking and playing activities, while few of them feel the two activities are fully disturbed. The result is shown in Table 2.4.5.

Table 2.4.5. Indoor activities

Activities	*Disturbed*	*%*	*Not be*	*%*	*Occasionally*	*%*	*Total*	*%*

			disturbed					
Eating	0	0	47	100	0	0	47	100
Drinking	0	0	47	100	0	0	47	100
Cooking	11	23.4	0	0	36	76.7	47	100
Washing	0	0	47	100	0	0	47	100
Playing	9	19.1	6	12.8	32	68.1	47	100
Chatting	0	0	47	100	0	0	47	100
Sleeping	0	0	47	100	0	0	47	100

Resource: Field Survey

(3) Adaptation

a. Physical adaptation

There are some physical adaptations to adjust to the inundated area. The adaptations are as follows:

- To cover the land by sand which can absorb water quickly
- To increase the floor about 50 centimeters therefore the water cannot reach the inner house.

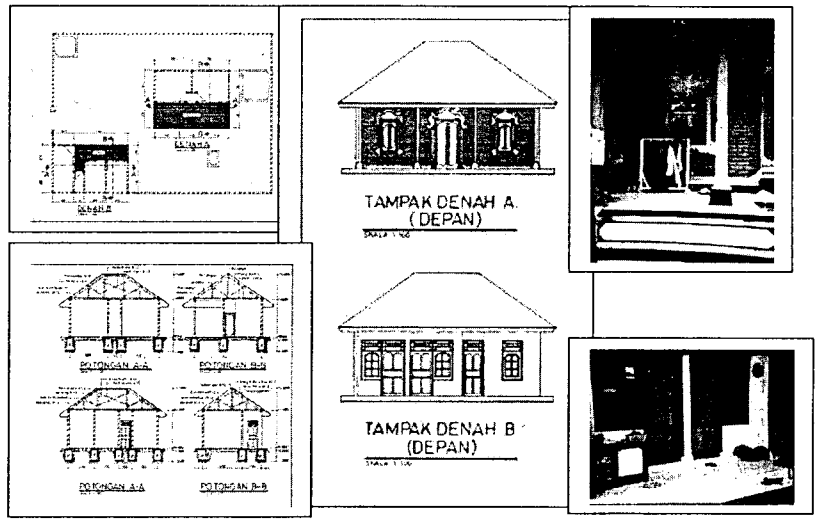


Figure2.4.5: House in Serangan Sub district (Owner: I Nyoman Tanda)

b. Inhabitant Adaptation

To survive with inundated condition, people should do adaptation. It can be either physically or non-physically adaptation. In Serangan Sub-district, there are some non-physical adaptations recorded.

Table 2.4.6. The activity after inundation

No.	*activity*	*Number of respondent*	*%*

1.	Removing the mud	14	29.8
2.	Fix the damage	0	0
3.	Do not do anything	33	70.2
5.	Others	0	
	Total	47	100

Resource: Field Survey

Table 2.4.7. People who clean the house after inundation

No.	*Actor*	*Number of respondent*	*%*
1.	House user/owner	20	42.6
2.	Servant	0	0
3.	Worker	14	29.8
5.	Others	13	27.6
	Total	47	100

Resource: Field Survey

Table 2.4.8. The number of people who clean the house

No.	*Number of people*	*Number of respondent*	*%*
1.	1 – 2 person	41	87.33
2.	3 – 4 person	6	12.67
3.	> 5 person	0	0
	Total	47	100

Resource: Field Survey

In Serangan, it seems that the people are accustomed to the inundation. It is clearly inferred by their statement in the questionnaires that 70.2% respondent do nothing and about 29.8% of them clean their house by removing the mud. This activity is did by themselves (42.6%0, worker (27.8%) or by anybody else (27.6%).

Table 2.4.9. The number of respondent who spend their money to clean the house

No.	*Answer*	*Number of respondent*	*%*
1.	Yes	4	8.5
2.	No	43	91.5
	Total	47	100

Resource: Field Survey

To clean their houses after inundation, few of the respondents ask for help then they spend some money (8.5%). The majority of them do by themselves (91.5%) meaning no expenses.

2.5. MATARAM

2.5.1. General

(1) Urban Condition

a. Orientation Geography, Administrative Boundary

Mataram known as the capital of Lombok Island lays on the west coast of the island. Joining with the town of Ampenan and the port, they together make up the largest urban complex on the island. Lombok strait plays an important role in the province not only due to the location of the harbour but also the location of Wallace line that ecologically border between western and eastern part of Indonesia. Mataram city is located on the 116°42' of east longitude and 18°33'-18°42' of south longitude. The area covers about 6130 Ha surrounded by:

- Gunungsari district,
- Northern part of west Lombok sub-district,
- Narmada district,
- Eastern part of west Lombok sub-district,
- Labuapi district,
- Southern part of west Lombok district and
- Western part of Lombok strait.

Administratively it consists of 3 districts and 21 sub-districts as shown in Table 2.5.1.

Table 2.5.1. District and sub-district of Mataram

District	Sub-district	Area (km²)
Ampenan	1 North Ampenan 2 Central Ampenan 3 South Ampenan 4 Tanjung Karang 5 Karang Pule 6 Pejeruk 7 Pagutan	23,59
Mataram	1 Rembiga 2 Sayang-sayang 3 Karang Baru 4 Monjok 5 Dasan Agung 6 Pegesangan	
Cakranegara	1 North Cakra 2 West Cakra 3 East Cakra 4 South Cakra 5 Selagalas 6 Bertais 7 Babakan 8 Dasan Cermen	

Source : Dinas PU Kota Mataram & BPS

Defining as mixed functioned city, Mataram continues to grow that is shown by the increase of built-up areas. Vacant land is developed mostly for housing to meet the needs caused by the

increase of population. Regarding limitation resource and budget, this leads to less ability of the local government to provide sufficient infrastructure.

b. Topography, Geomorphology and Hydrology

Generally, Mataram city lies on 0-60 meter above sea level. Its 3 districts lay on different level i.e. Ampenan district lays on 5 meter above sea level, Mataram district is above 15 meter and Cakranegara district is above 25 meter above sea level while the highest area is sub-district of Sayang-Sayang that is 57 meter above sea level. The land having slope 0-2% is about 4,652 Ha (76%), 2-8% is about 1,300 Ha (21%), 8-15% is about 174 Ha (3%) and 15-25% is about 4.3 Ha (0.1%). This condition causes the low velocity of water in river, drainage and other surface water and also the increase of inundated areas. Locations of inundated areas are shown in Table 2.5.2.

Table 2.5.2. Location of Inundated Area in Mataram in 1992

Location of inundation	Parameter of inundation				Frequency (Time/ year)
	Area (Ha)	High above sea level (M)	Time (Hour)	Reason	
North Ampenan and South Ampenan	44	0,5-1	168	Bad drainage condition and sea level rise	6
Gatep Neighbourhood	6	0,3	48	Bad drainage condition and sea level rise	10
Senior High School area and Museum	30	0,75	48	Bad drainage condition	10
HUDC Housing area	30	0,4	120	Bad drainage condition	6
Surrounding area of Regent's Office	4	0,3	7	Bad drainage condition	4
Cilinaya Area (Karang Jangkong)	5	0,2	5	Bad drainage condition	4
Karang Sukun	30	0,4	48	Bad drainage condition	7

Source : PT.Properindo Jastama dan hasil pengamatan

The rainfall around Mataram city varies depending upon land level mentioned above. Average temperature is around 25-27 Celsius degree and humidity level is around 77-82 %. Clean water is partly supplied by four big rivers that are also directly used by the residents to fulfil their daily needs mainly by those who live in the riverbanks. The water in river always flows during dry season from the upstream in Rinjani Mountain. Data shows that the ground water area is mostly shallow (about 5-7 m below the surface).

c. Development policy

Based on the policy of regional development and hierarchy of cities, Mataram is categorized as the first order city that generally functions as governmental centre. The area accommodates activities such as agro industry, trading centre and location centre of public facilities and communication. Referring to RUTRK (Master Plan) of Mataram year 1994/1995, the allocation of population density of Mataram City is divided into four categories i.e.:

1. Low Density : < 20 person/ha
2. Middle Density : 20 – 50 person/ha
3. High Density : 50 – 80 person/ha
4. Very High Density : > 80 person/ha

In 1999 total population occupied the 6,130 Ha was 303,441 persons, meaning that the population density was approximately 49.5 person/Ha, while the population growth per year is about 3.27%. To anticipative this growth, the construction activities on spatial planning function to serve daily needs and job opportunities. Depending on potency of the area and the policy objectives, main activities, which will be developed, are:

- Trading and services
  The location of trade and services for regional and local scope are developed on the current location along Pejanggik Street, Selaparang Street, North Ampenan and South Ampenan sub-districts.
- Industry
  Home industry such as handicraft is concentrated on housing area; while middle industry is located in the south-eastern part of the city called Dasan Cermen that close to the market where raw materials are sold.
- Office and public facilities
  The governmental office is developed on the basis of administrative level, while private offices and public services are directed to city centre.
- Terminal
  Current location of the bus terminal is not suitable with city condition and it moved to a strategic area called Bertais sub-district in eastern part of Mataram.

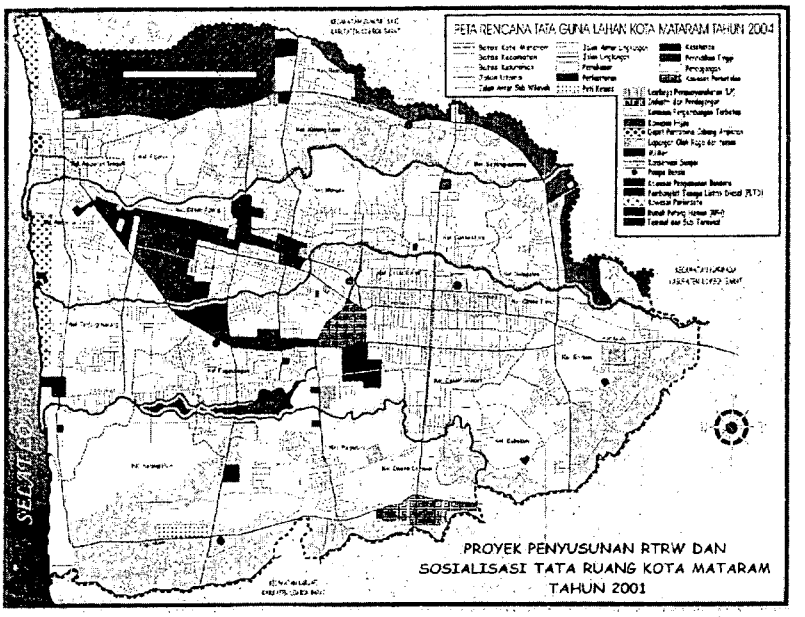
d. Land Use Intensity

The regulation on land use and building intensity covers as follows:

1) Building density
   - In the city centre: maximum BCR = 80%,
     maximum FAR = 2.4
     maximum building density = 20 building/ha.
   - In transition area (area between city centre and fringe area) and in the sub centre:
     maximum BCR = 60%,
     maximum FAR = 1.2
     maximum building density = 15 building/ha
   - In the fringe area: maximum BCR = 40%,
     maximum FAR = 0.4
     maximum building density = 10 building/ha

2) Building height
   Building height is regulated, based on BCR and physical carrying capacity of the area.
   - In the city centre, maximum height is 3 – 4 floors
   - Maximum height in transition area and sub centre is 2 floors
   - In the fringe area, maximum height on the area which slope is high is 1 floor while maximum height on the slightly slope area is 2 floors

Figure 2.5.1. reveals the land use planning map of Mataram city on 2004



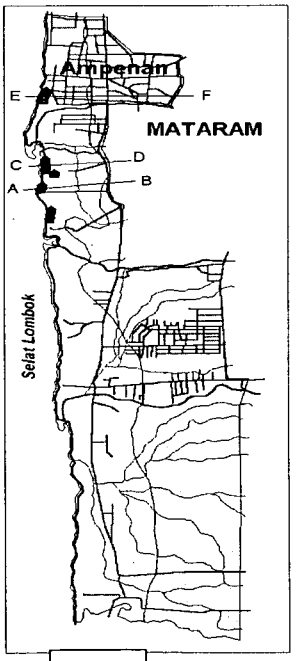
Source: Dinas PU Kota Mataram

Figure 2.5.1. Land Use Planning Map of Mataram - 2004

(2) Inundated Area

Survey area is selected, based on the following characteristics:

- Located in coastal area which is lower than 1M above sea level
- Mostly utilized for housing area
- Regularly inundate caused by water tide



= Coastal area which elevation is lower than about 1M above sea level

High tide regularly arises every month within 3 days (date 14, 15 and 16) while the highest level occurs every 5 yearly. On 1996 and January 2002 the high tide has caused flooding and inundation on most area and destroyed part of infrastructure and houses. The huge damage on physical structure was not only due to the increase of sea level but also the over-flow of the two rivers during heavy rainfall. There are two big rivers flow the area namely Jangkok river in northern part and Ancar river in southern part. However drainage mostly causes flooding because its estuary is blocked by sand embankment.

Coastal line of Ampenan beach is most likely to move to inland, that is indicated from the location of wreckage old harbour that currently far away from the sea shore. Some local residents also informed that since 1970s they have had to move their houses twice due to coastal line movement as effect of high abrasion. Environmental characteristic, building and drainage condition bring about the area having high risk of inundation.

Figure 2.5.2. Coastal Area of Amnan District

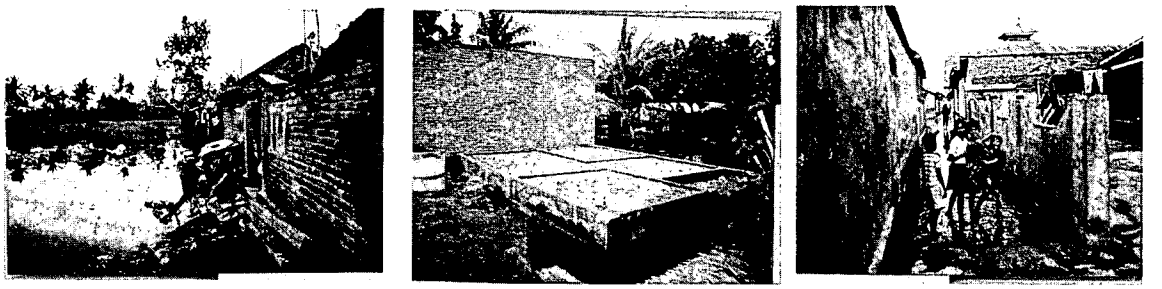


Photo 1: Inundation around the houses

Figure 2.5.3. shows the elevation of coastal area in the survey location.

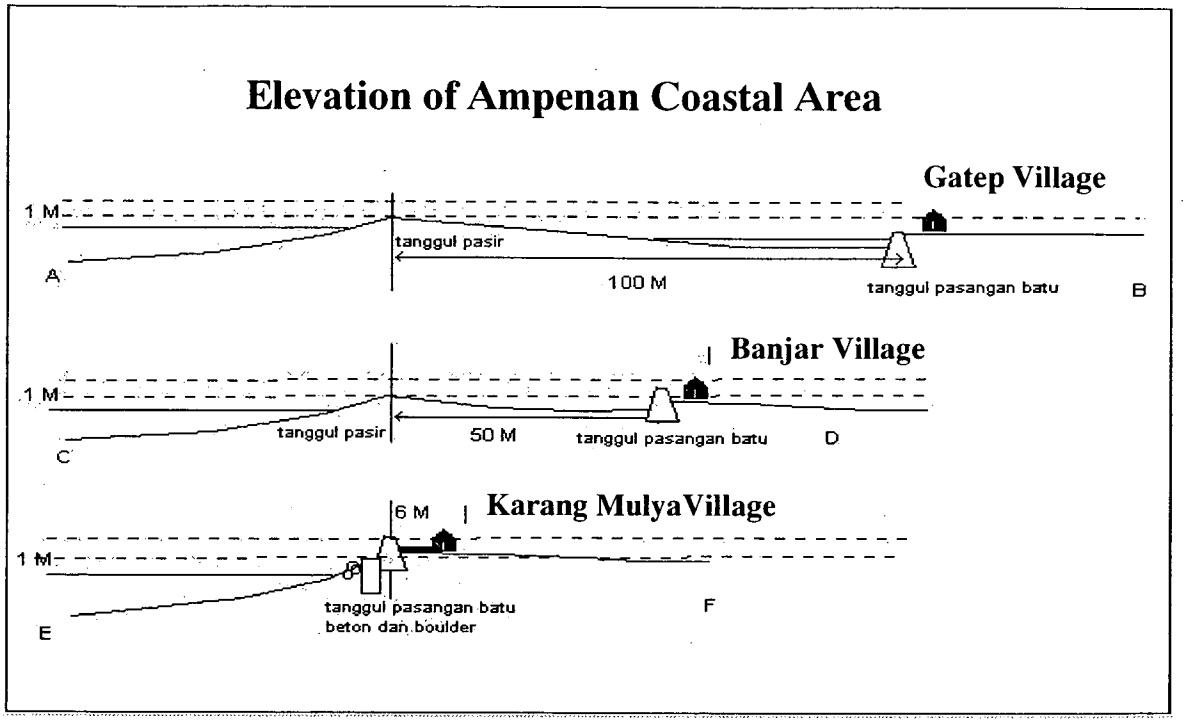


Figure 2.5.3. Elevation of Ampenan coastal area

Elevation A – B (Gatep village) (Photo 2.5.2.)

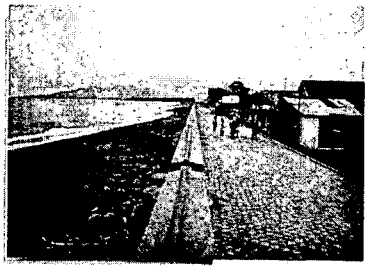
Housing area is located about 100M away from coastal line. Urban drainage passes through this area but its estuary is often clogged up by sand embankment brought about flooding in the adjacent areas. In order to reduce inundation, the residents have done small dike construction and demolishing of sand embankment. However, the problem remains since sedimentation in the gulf is much faster than

abrasion. The huge wave and storm in January 2002 had destroyed the infrastructure and many houses in adjacent coast that need refurbishment afterwards.

Part C – D (Banjar village) (Photo 2.5.3.)

Housing area is located about 50M away from coastal line. Inundation very frequently occurs during high tide and many houses are partly submerged. Sand Embankment makes sedimentation likely faster. In one way the bank it clogs water flow from the river, but blocks the huge wave during high tide. After the huge flooding in January 2002, dike about 1 M height has been constructed to reduce house damages.

Elevation E – F (Karang Mulya village) (Photo 2.5.4.)



Houses are located in a cave that is about 5 – 6 meter away from the beach. The wave on January 2002 caused huge damage on the houses, its content and infrastructure. In order to prevent the next damages, local government has built concrete dike about 5 M in high along the beach and paving block road was also build. The dike and the road have been successful in reducing abrasion and tide.

(3) Study Area Condition

a. Administrative Boundary

The study area is in north Ampenan sub-district located of west coast Mataram, along Ampenan Beach with three villages i.e. Karang Gatep and Banjar Villages in South Ampenan Sub District and Karang Mulya Village in Centre Ampenan Sub District. The boundaries of the area are

- Northern part : Old Harbour of Ampenan
- Eastern part : Ampenan City
- Southern part : Police Area
- Western part : Lombok Strait

The slope of land is mostly between 0 – 1 % and some locations are below sea level. Therefore, the area having level below contour line 1 meter is about 1 – 2 km away from the beach, except the area belongs to the army and chicken husbandry. The characteristics of study area can be described as follows:

- Part of sub-district of North Ampenan and Centre Ampenan
- Area : 38.40 ha
- Number of houses : 1298 unit
- Building density : 34 unit/ha

- Population : 6510 persons
- Population density : 170 persons/ha
- Most type of occupation : worker, fisherman, and trader.
- Main economic activities : Trading, commercial services and fishery.
- Social and public facilities
  a. Local Health Center : 1 unit
  b. Religion : 6 unit
  c. Trading/services : 21 unit

Figure 2.5.4. shows the survey location.

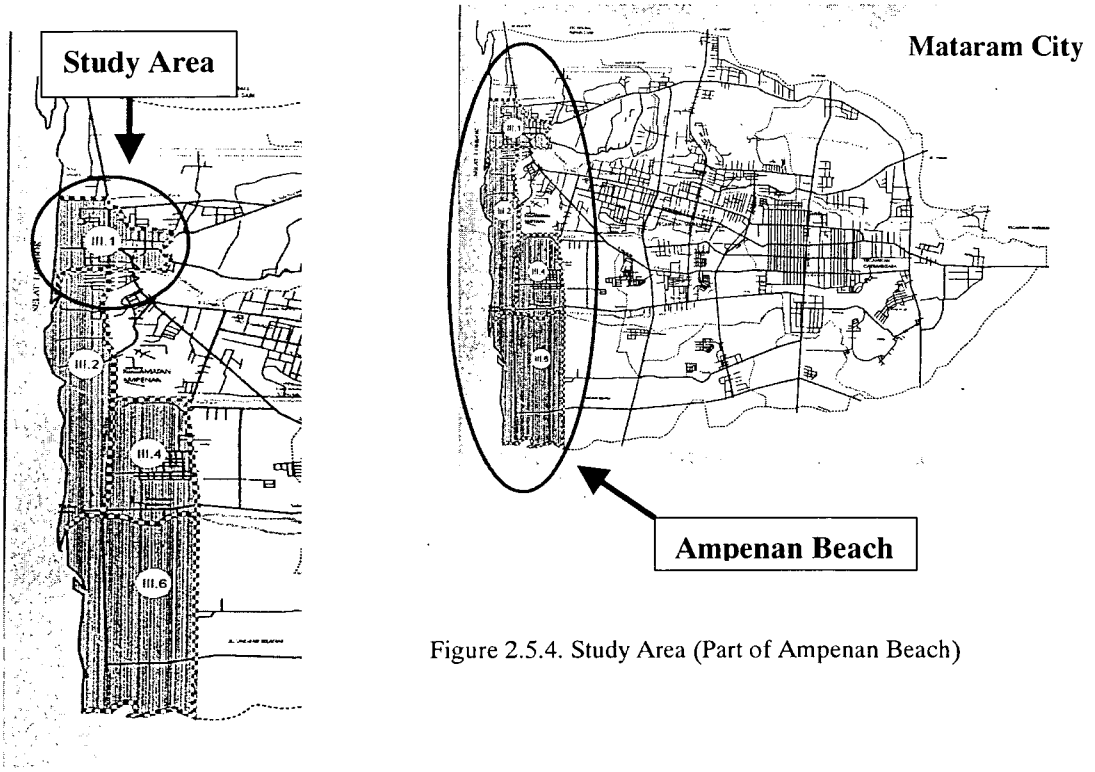


Figure 2.5.4. Study Area (Part of Ampenan Beach)

b. Socio-economic Profile

In 1999 number of population residing in the two sub-districts is approximately 6510 persons. The working age involves in various job such as shown in Table 2.5.3. Data reveal that only few people involve in formal job and it also indicates that most people have unclear job. While the neighbourhood is located in the coast, but plenty of them are not being fishermen. This may reflect no relationship between location of living and type of occupation.

Table 2.5.3. Composition of Residents Job

No.	Type of occupation	Number of household	Percentage

1.	Farmer	83	2.5
2.	Worker	794	21.6
3.	Fisherman	224	6.1
4.	Industry worker	4	0.1
5.	Carpenter	50	1.4
6.	Trader	945	25.6
7.	Government Official	95	2.6
8.	Other	1487	40.2
	Total	**3697**	**100**

Source: Master Plan Mataram City

c. Infrastructure and Facilities

Table 2.5.4. describes types and number of infrastructure existing in the area.

Table 2.5.4. Type of infrastructure

No	Location	Kinder garden	Primary School	Junior high school	Senior high school	Local health centre	Chemist	Shop & small shop	Market
1	**South Ampenan**	6	8	3	2	2	-	49	-
2	**Centre Ampenan**	3	7	1	-	-	2	450	1

Number of educational facilities especially for senior high school is rather limited. Then they have to go out to finish the highest of basic education, this means that most residents spend much money for transportation. The immense number of shops/small shops in the survey area may indicate the residents' preference of being trader.

d. Housing

In immediate seashore the houses are linearly plotted orienting to the shore. However in next line and further, pattern of houses is more disordered and scattered. In spite of the high risk for flooding and inundation of coastal areas, the existing building are not concerned with the environment condition, that is indicated by types of houses, mostly made of organic material.
Landed houses are the only type available in the survey area. Most houses are constructed in one storey building, while the others are two storeys one is constructed for other than houses. Building materials utilized for a building component are various, for instance, wall component in a building is a combination of masonry, bamboo-mat and plywood.
In term of land ownership, the residents explained that their land and house are privately owned although they do not always get land certificate as a legal ownership. Informal transaction of land has been likely occurred within residents that reside near coastal line. Some houses are constructed on yearly rented land that rented yearly.

2.5.2. The Effect of the Inundated Area on Building and Inhabitants' Lives

(1) Building Deterioration

The twelve building cases observed in the two sub-districts in Ampenan coastal area show general condition of residents' houses. For building components and facilities the houses can be described as follows:

a. Building Type: seven houses are individual house while the other five buildings are classified as physically collective/cerious/raw of house however the land and the building are splits -up in term of ownership. This condition makes irregular house lay out.
b. Building Construction: most buildings are classified into permanent buildings with masonry brick wall and small concrete column. In some of those, wooden frame covered by bamboo mat or/and plywood or wooden frame with brick masonry is used.

Photo 2.5.5–7. Types of Construction

c. Foundation: brick masonry (about 20 cm thicknesses) is the only material type utilized for foundation and brick masonry wall is directly constructed on top of it. According to the residents the foundation is about 30-40 cm in depth, while part of the foundation above land surface varies depending upon inundation height that some are exposed.

Photo 2.5.8-9. Deterioration of Foundation

d. Floor: in most house cases portland-cement plaster is used for flooring, whilst the other two are covered by ceramic tile in the main building only. Narrow or wide cracks are found on the plastered flooring that seems it is frequently submerged during inundation and low quality building materials are used.

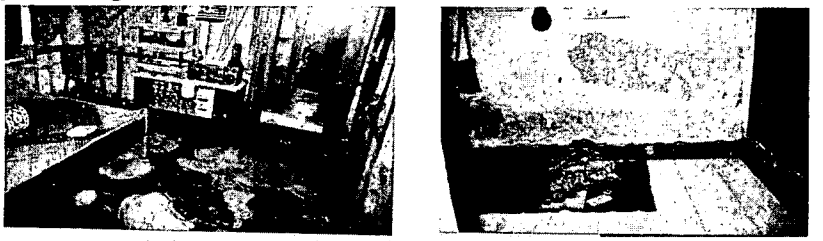


Photo 2.5.10-11. Deterioration of Floor

e. Wall: materials utilized for building wall are brick masonry, bamboo mat, plywood or combination of them. Internal side of brick masonry in the main building is mostly covered by plaster while the external side remains exposed. Vertical cracking about 0.5-2 cm in width was found, that may be predicted due to foundation settlement. Some external plaster was also peeled-off due to coastal condition.

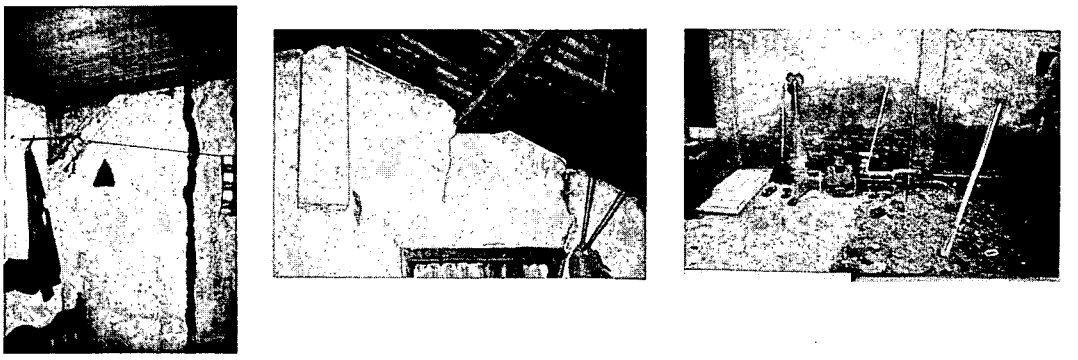


Photo 2.5.12-14. Deterioration of Wall

f. Ceiling: basically all building cases are not wholly completed with ceiling. In some building the ceiling only exists in living room and bedroom. The frame is very simple structure where the beam is only tied into the other beam. Then building materials usage are bamboo mat, plywood, knitted plastic or even thick fabric.

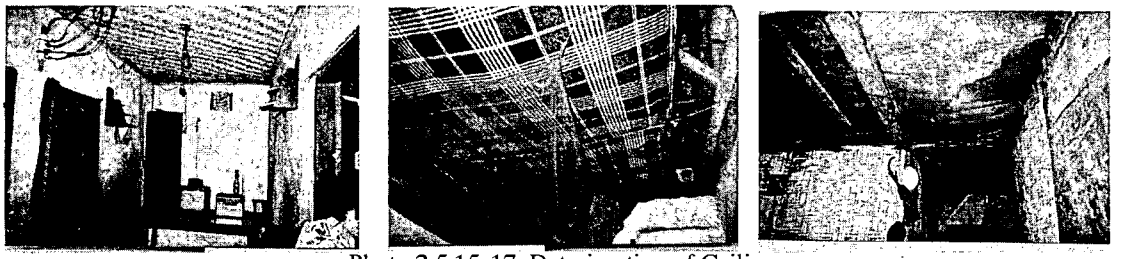


Photo 2.5.15-17. Deterioration of Ceiling

g. Roof: gabled-house is popular type of the eleven within the twelve building cases. Most structures do not follow the standards and material usages are wood, coconut wood, bamboo or combination of wood and bamboo. Part of the trusses is in decay that is possibly due to improper work of construction or delayed renovation. Clay tile is mostly used for roof cover the other is the combination of clay tile, corrugated zinc and corrugated asbestos cement.

Photo 2.5.18-20. Deterioration of Roof

h. Door and window: timber is familiar to be used for door and window frames. Some part is decayed because of high humidity and fungus. Doors are made of timber frame covered by plywood.

Photo 2.5.21. Deterioration of Door and Window

i. House facilities: clean water for bathing and washing is gained from deep well provided in each house while drinking water is daily bought from vendor or public water tap. Houses located in adjacent to the shore are not provided with toilet unless the residents use near communal toilet. House garbage is unwell managed to throw away into the river, and it is bringing about clogging in the estuary. Shared electrical supply is a common system in the study area. Each house has been limited supply to only enough for low lighting of 2 bulbs and for operating a black and white television set.

The neighbourhood is regularly inundated about 20-80 cm in height within three days in each month or minimally 36 days in a year. The normal condition will be back to normal in around 2 days. The mostly damaged building components that are mostly damaged are foundation, floor, lower part of wall, doorframe, and door. However the damage is most likely influenced by building lifetime and type/kind of building materials usage. Generally the damage part is improved after several occurrences.

(2) The Daily Activities

Generally, the respondents work in private sector as labor, fisherman and coachman. The inundation time more than 24 hours and its height is about 50 cm, it hinders the respondents' activities.

Data on respondents' activities are presented in table 2.5.5. and table 2.5.6. From Table 2.5.5. there are three outdoor activities hinderd by inundation, namely: 'Go to the school'; 'Go to the work' and 'Go to the House of Worship'.

Table 2.5.5. Outdoor activities

Activities	Disturbed	%	Not disturbed	%	Sometimes	%	Total	%
To The School	31	66.0	16.0	34.0	-	-	47	100
To The Office	1	2.1	27.0	57.5	19.0	40.4	47	100
To The Work	43	91.5	1.0	2.1	3.0	6.4	47	100
To The House of Worship	40	85.1	7	14.9	-	-	47	100

Source: field data processing,

Besides that, the indoor activities were hinfderd, as shown on table 2.5.6. There are 7 indoor activities hinderdby inundation.

Table 2.5.6. Indoor activities

Activities	Disturbed	%	Not disturbed	%	Sometimes	%	Total	%
Eating	35	74.5	12	25.5	-	-	47	100
Drinking	35	74.5	12	25.5	-	-	47	100
Cooking	42	89.4	5	10.6	-	-	47	100
Washing	44	93.6	2	4.3	1	2.1	47	100
Playing	46	97.9	1	2.1	-	-	47	100
Chatting	44	97.9	1	2.1	-	-	47	100
Sleeping	38	80.9	8	17.0	1	2.1	47	100

Source: field data processing

Various infrastructure was stopped in inundation as shown on table 2.5.7

Table 2.5.7. Infrastructure

Activities	Hinderd	%	Not be disturbed	%	Sometimes	%	Total	%
Water Resource	25	53.2	22	46.8	-	-	47	100
Sanitation	45	95.7	2	4.3	-	-	47	100
Bedroom	39	83.0	8	17.0	-	-	47	100
Dining-room	41	87.2	6	12.8	-	-	47	100
Kitchen	44	93.6	3	6.4	-	-	47	100
Children play ground	46	979	1	2,1	-	-	47	100

Source: field data processing,

(3) Adaptation

a. Physical Adaptation

Adaptation to inundation done by the residents is not only to construct dike in main entrance of the house or the site but also to increase the floor.

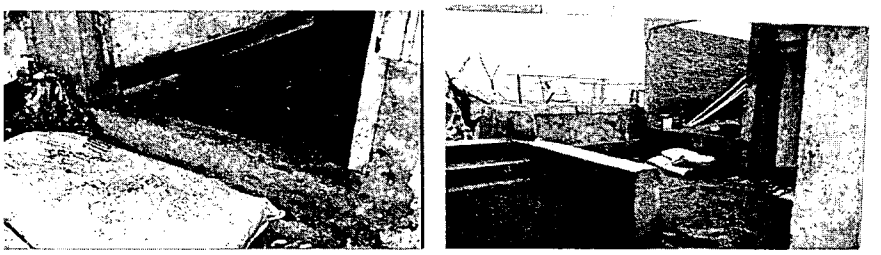


Photo 2.5.22-23. Raised Floor

Each house is equipped with very limited furniture and electronic items to avoid problems during flooding and/or inundation that regularly occur.

Photo 2.5.24-26. Furniture and Electronic items

b. Inhabitant Adaptation

Because of frequent inundation (1 – 3 times in a year), the respondent have their adaptation. They know well that flood will subside in a day, so their daily activities will continue in the next day. Although the inundation disturbs (see table 2.5.8.), mostly of the respondents want to stay in flood area because they have no other choice and their houses are near the work area.

Table 2.5.8. Disturbance

Disturbance	Frequency	%
Inundation	41	87.2
Security	-	-
Others	6	12.8
Total	47	100

Source: field data processing,

Data on respondents' effort to prevent water invading their houses are presented in table 2.5.9, table 2.5.10. and table 2.5.11. For some kinds of efforts, they used to like elevating floor but some only stay and do nothing.

Table 2. 5.9. Effort to prevent water entering the house

Effort	Frequency	%
Elevating floor	5	10.6
Fencing the yard	5	10.6
Doing nothing	37	78.7
Others	-	-
Total	47	100.0

Source: field data processing,

After flood, each household will clean up their house by their own family members like ud cleaners, it will be more economical than using others (see table 2.5.10 and 2.5.11).

Table 2.5.10. Effort on house cleaning

Effort	Frequency	%
Cleaning the mud	34	72.3
Repairing the damage	4	8.5
Cleaning and Repairing the Damage	2	4.3
Others (cleaning the Well)	7	14.9
Total	47	100

Source: field data processing,

Table 2.5.11. . Person cleaning house

Person	Frequency	%
Inhabitant	47	100
Others	-	-
Total	47	100

Source: field data processing,

2.6. BANJARMASIN

2.6.1. General Condition

(1) Urban Condition

Banjarmasin is the capital city of South Kalimantan which has a total area of about 72 square kilometers . The city is surrounded by Barito River on the west side and Martapura River on the east side. It lies between 3°15′ -3°22′ southern latitude - and 114°98′ -114°38′ eastern longitude. It is 0,16 meters under the sea level with flat surface or its slope is 0,13%. Some part of the land is swamp. Very high sedimentation may cause the uprising of bottom of the estuary of Martapura and Barito rivers around 1 m per year. While huge exploration of forest in the upper stream of the Martapura River may cause river erosion.

- Geology of the Island.
  The soil surface layer consists of thick peat soil. The type of soil is alluvial and dominated by clay structure that according to soil sounder it consists of very soft, soft, firm, stiff and very stiff soil.
- Geology of the River.
  The shape of Bedrock is concave consisting of metamorphosis of rock. The soil is covered by gravel, pebble, sand and clay.

The humidity of Banjarmasin during dry season is 40-90% and on rainy season is 81- 90%. The average temperature is between 17° C and 36,2° C.

Land use zoning in Banjarmasin city can be identified as follows :

- Housing area
  The growth of housing area is influenced by the activities of road and river transportation. It forms two orientations, river and land orientation. Floating market is commonly found along the Barito and Kuin rivers. Its growth of commercial activities on floating markets (pasar terapung) results in changing the function of houses which is located in the side of both river to be mixed used for residential commercial. The Barito is the main river in Banjarmasin, which is about 100 m in width.

- Commercial Area
  Typical commercial activities in Banjarmasin city are floating markets. Based on the interview and the field observation, there are many visitors who take a tour and shopping. The floating market is now jostled by storing bunch of wood in the river that makes the area of floating market getting smaller.

- The Mosque and Grave Area of Sultan Suriansyah.
  The role of the Mosque and Grave Area of Sultan Suriansyah is dominant in developing the Banjarmasin city . This archeological site located on the north side of Kuin Street is known as a main element space of the city and is able to form the landmark of this area. The distance between the mosque and the Grave Area is about 500 meters, and housing area is

placed between them. The two should be preserved in order to increase the value of the area particularly for tourism value. There are many ways to improve this area and one is converting the function of housing into more economical function.

The pattern of housing provision in Banjarmasin is influenced by the existence offacilities and infrastructure. Development of facilities and infrastructure such as road, clean water, electricity, and telephone has transformed housing areas from cluster pattern to the linier pattern. However, the relatively high population growth causes the increasing of housing density. It is found that not all of houses in this area have courtyards even the wall of their houses attaches the side of street. Many houses (usually old houses) are in bad condition and only a few (usually a new one) is in good condition. The housing density along the Barito river side is higher (between 4 to 10 rows) than that along the Kuin river side that only consists of 1 layer.

Building lines control, as one of the government rules for building construction, is not successful d in all of the houses located along the riverside and along the street. The distance of all houses to the street are not uniform and the houses along the Kuin Street are located very close to the street. Mostly, each unit house is occupied by 4 – 7 persons while the occupant of houses nearby street is less than 4 persons. Almost all inhabitants are house owner and only little number are renters.

Most of the buildings have one floor and some are two or more floors particularly in the street side area. The function of building in this area is houses and others are public buildings such as school, office and mosque.

Since Banjarmasin is largely surrounded by rivers, the typical of housing construction is platform system. This system is adapted to avoid tide particularly which are located along the river side, because the land is flat and below the sea level. Timber is main building material mostly used for housing construction. The construction system of all housing is very simple based on the traditional technique which is passed from generation to generation. The traditional technique hardly changed is found at old houses.

Tabel 2.6.1. Building Type

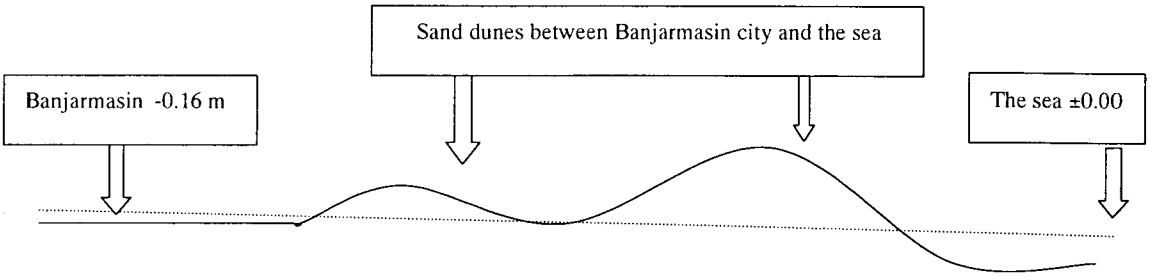
No	Building Type	Along main street	Along River side	Total (unit)
1	Mosque	1	-	1
2	Musholla	8	1	9
3	Elementary School	1	-	1
4	Military offices	1	-	1
5	Timber shop	4	2	6
6	Telephone kiosk	4	-	4
7	Workshop	1	-	1
8	The second hand materials shop	2	3	5
9	Small shop	10	52	62
10	Hotel	-	1	1
11	Handy craft industry	1	-	-
12	Floating houses	112	596	708
13	Landed houses	-	9	3
	Total number	144	661	802

Resources; Result data of Technical report of Northern Kuin ,2001

(2) Inundated Area

As mention earlier, the city of Banjarmasin lies on about 0.16 meters below the sea level, and the land surface is flat which slope is 0.13%. However, the city does not completely lie in the inundated area, because there are some sand dunes between Banjarmasin city and the sea shore, that are able to hold up sea water. The distance from Banjarmasin to the sea is about 20 km (see figure below).

Some land area close to the river is not interfered by river water because it has been risen up as high as 0.5 – 1.00 m from the surface of river water. Beside that, retaining walls have been built along Barito river and others small rivers to avoid abrasion and inserting to the land.



(3) Study Area Condition

Kuin Utara Sub-district lies in the Banjar Utara District of administratively part of Bamjarmasin City. This area is bordered by sub-district of Alalak Utara in the north side, Jembatan Putih in the east side, the Barito and the Kuin river in the west and south side. The land level is flat, hence there isn't any significant differences relief between areas of Kuin Utara Sub-district and Banjarmasin city. The highest land is located on the side of the main street which deference level is about 30 – 50 cm. The Barito river and the Kuin street are the two accesses to this area.

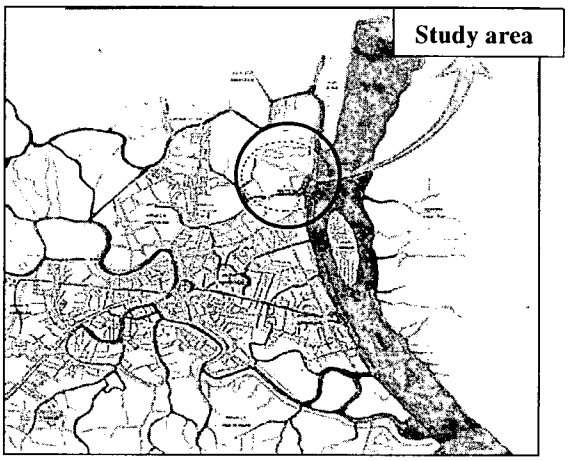


Figure 2.6.1.:
The location of Kuin Utara Sub-district

- River Accessibility

  The Barito River is the main transportation in Kuin Utara sub district. This sub district is located at the estuary of the Barito river. The existence of the quay is a entrance to external

areas, particularly to the Barito Kuala district and the west gate. This is the regional accessibility for Banjarmasin, particularly for Kuin Utara sub district.

- Road Accessibility.
  External access through road transportation can only be reached through two streets. Alalak Utara road is the internal access from the north side while Kuin and Alalak streets are another access from east side. Kuin street is very important for traffics which connects the external area with north side of Alalak sub district and the central city. The width of the street is only 5 m, so it is not capable to support the heavy traffic flow. There are also many wooden platform footpaths as a corridor, that has two functions. The first is connecting the rivers bank areas with the main Kuin street which its length is about 25 – 100 m and its width is about 2 m. The second is connecting among inhabitants' houses which are located in the river banks which its width is about 1 m and the distance of every pole is 10 – 25 m. The wooden platform footpath system is typical internal access in the inundation areas. Supplementing this transportation mode, there is also a bus terminal near the local district office.

Photo 2.6.1:
River is the important transportation mode mainly for people living at houses along the river

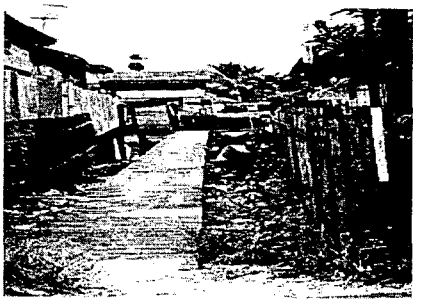


Photo 2.6.2:
Wooden footpaths made of ulin timber

Location of Kuin Utara is important for commercial and tourism activities and strongly influences the function of houses that are used not only for a shelter, but some also accommodate commercial activities like shops, small shops, restaurants, and workshop, particularly the houses located at the riverside and along the Kuin street.

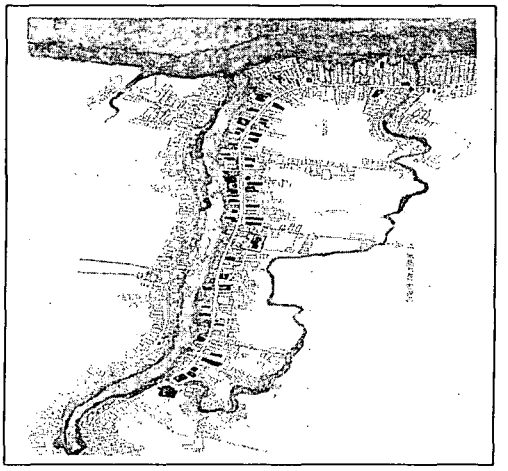


Figure 2.6.2.
The location of cased houses
(the black dottted are the cased houses)

- Water supply
  The main pipe of water supply is set in Kuin Utara sub district along the main street. The water is only distributed to houses located in the left and right side of the main street. And the local government provides four water tanks especially to fulfill the demand that cannot be provided with these above water pipes. The water is distributed to the inhabitants through either the main pipe or vendors who sold it Rp. 200,- per container. Some people still uses the river water for bathing and washing.

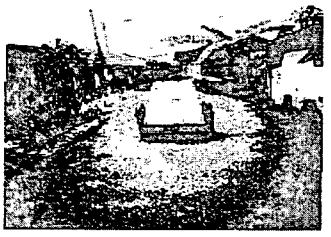


Photo 2.6.3 :
Water sold in container (20 liter/container)

Photo 2.6.4 and 2.6.5 :
Water supply from PDAM

- Waste Disposal
  Few houses that are located on the left and right side of Kuin street are provided with septic tanks. Most people directly dispose the waste to the river.
- Garbage
  All kind of garbage are mostly thrown away into the river. This may cause decreasing water quality. There is no garbage disposal.
- Electricity Network.
  Some houses on the side of the Kuin street, the Barito and the Kuin river are served by electricity, while the rests are not. The electricity network is provided along the north side of the Kuin street. The distance of each electric pole is about 50 meters. But there are only few street lamps.

2.6.2. The Effect of Inundation on Building and Inhabitant's Live

(1) Building Deterioration

Whilst Banjarmasin city is not influenced by the sea level, but it is at risk of inundation caused by river tide and rain. During the full moon comes, up rising of river tide can reach about 5-10 cm from the ground. The inundation will even worse when rain comes that can increase about 10 – 20 cm from the ground level on the landed house. Commonly, water tide occurs every night (17.00 pm– 05.00 am) and the highest tide occurs once in a year on the full moon of April.

Timber is the main building material. Most utilized kinds of timber are Ulin (for pile foundation and column), Meranti (for wall frame, ceiling and roof trusses) and Galam (for pile foundation and wall frame). The exploitation use of timber, known as local materials, influences the availability and quantity of this material. Ulin timber is characterized with has

very well durability compared to other timber such as Meranti, Galam and other of low quality timber, but it is difficult to be found and very expensive. Then Meranti, Galam and other of low quality timber are used as alternative kind of timber. This may reduce the lifetime of buildings against humidity. The building easily deteriorated component is the bottom parts of building covering pile foundation, bottom beam, floor and wall at around 10 – 20 cm in height.

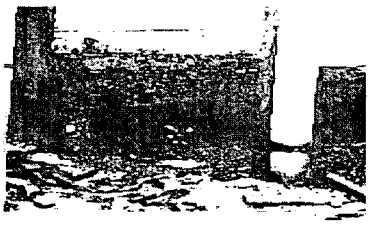


Photo 2.6.6 and 2.6.7:
Bottom beam is decayed because of the quality of wood

Photo 2.6.8:
Pile foundation of the platform house without bracing beam

Photo 2.6 9:
Normal condition of the pile beam and mark of the height of water tide

Pile foundation is the most easily deteriorated component since it is always immersed and during the tide it is often bumped by floating logs that finally changes the position of the construction. The damage of bottom beam, floor and wall is commonly caused by decay and fungi of the low quality of timber. The other reason is the connection of the structure and construction system, for example pile foundation is installed without bracing beam.

(2) The Daily Activities

The flooding hours is between 1 and 12 hours with about 11- 50 cm in height that occurs in the evening 16.00 – 20.00 pm. However this inundation does not disturb the activities of the inhabitants who mostly work on private sector. According to the respondent, sleeping is the most activity that disturbed during flooding (see table 2).

Table 2.6.2 :Data of others daily activities

Various	Disturb	%	Non disturb	%
Eating	7	20,4	40	79,6
Drinking	5	13,6	42	84,4
Cooking	4	8,4	43	75,6
Washing	11	24,4	36	75,6
Playing	10	22,2	37	77,8
Chatting	37	77,8	10	22,2
Sleeping	47	100	-	-

Source : field data processing,

Other social and economic activities that are not disturbed are going to the office, to the working places, to the religious place and to the school, as shown on the table 3 :

Table 2.6.3. Data of social economic activities

Various	Disturb	%	Non disturb	%
To the school	5	13,6	42	86,4
To the office	7	15,5	40	84,4
To the work	24	51,6	23	49,4
To the religious service	41	86,7	6	13,3

Source: field data processing,

There are no infrastructure that disturbed by the flooding, as shown on the table 4.

Table 2.6.4 : Data of infrastructure

Various	disturb	%	Not disturb	%
Clean water	7	15,5	40	84,4
Sanitation	10	22,2	37	77,8
Bed-room	5	13,6	42	82,4
Dining-room	11	24,4	36	75,6
kitchen	44	97,8	3	2,2
Children play ground	4	8,4	43	91,6

source : field data processing,

(3) Adaptation

a. Building Physical Adaptation.

The building platform system, that height of the floor is around 50 – 1.00 cm above the land surface, is a very suitable structure in inundated areas like Kuin Utara sub district. This system has been recognized within generation to anticipate living in the wetland and it is appropriate not only houses but also for public facilities such as offices, hotel, shops. Even footpath is made of platform system of wooden structure.

b. Inhabitant Adaptation

The frequency of flood is between 1-12 times in a year. When flood occurs the height of the water will flood the land and/or the street about 5 - 10 cm in depth. This condition is likely not being problems for the inhabitants as it is already familiar for them.

Platform footpath is able to help the inhabitants to keep of making access with other activities out side their living areas. During flooding some inhabitants work in surrounding areas and some stay in their houses. They do not need to adapt themselves to tide or flood, because the platform building and the platform footpath are able to keep them being comfortable to stay and dwell their houses, as well as work outside their home as usual.

2.7. MAKASSAR

2.7.1. General Condition

(1) Urban Scope

a. Geography and Administration

Makassar is the capital city of the Province of South Sulawesi that is located in the left "foot" of Sulawesi Island. Geographically, Makassar Municipality is located on 119°24'17.38" east longitudes and 5°8'6.19" south latitudes. Administratively Makassar is located in the west part of Sulawesi Island and it is border with:

- Gowa Regency : south side.
- Pangkajene Regency (archipelagos) : north side.
- Maros Regency : east side.
- Makassar straits : west side.

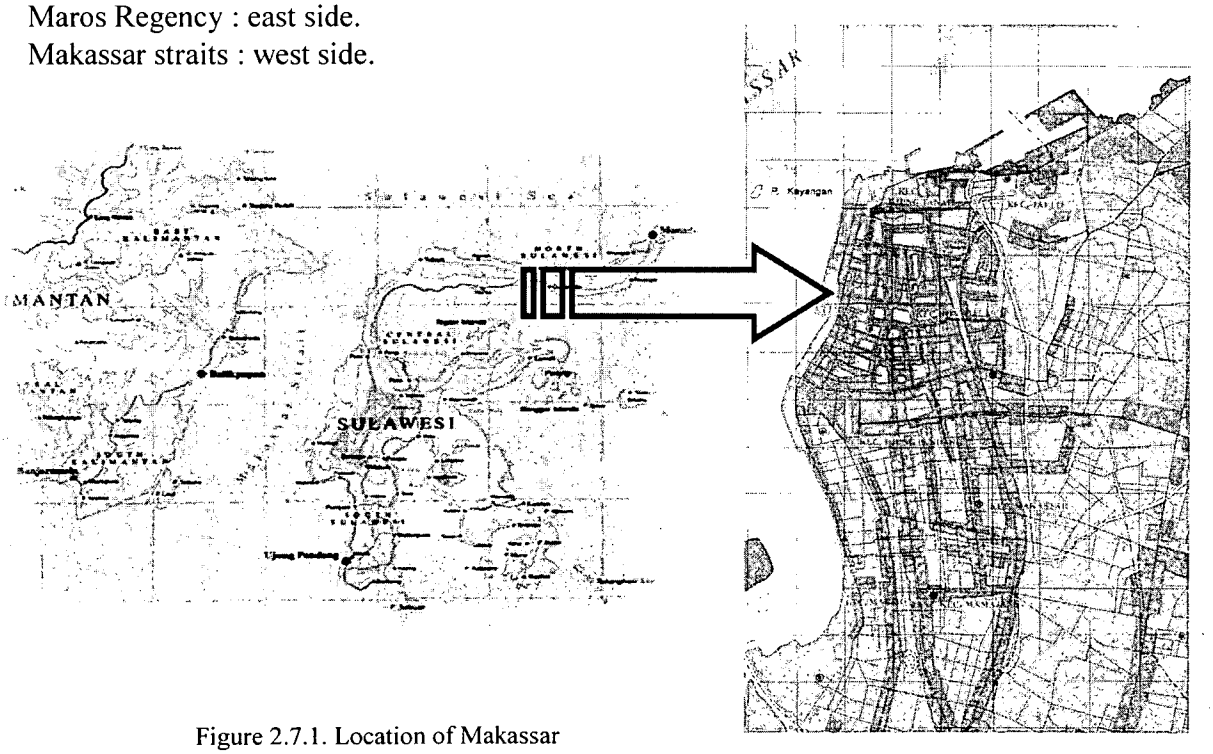


Figure 2.7.1. Location of Makassar

Makassar covers 17.577 ha consisting of 17.437 ha land and 140 ha islands, also ± 4 nautical miles area measured from coastal line (Central Government Act. No.22/1999). Around 1,282,918 persons live in Makassar and most of them concentrate in Tallo district.
Makassar, administratively, consists of 14 districts that cover 142 sub districts, 801 groups of neighborhoods and 4221 neighborhood units. The characteristic of Makassar is described on Table 2.7.1.

Table 2.7.1. Coverage Area and Population of each District

No	District	Coverage area (Km^2)	Percentage of its area to Makassar Municipality (%)	Number of Population
1.	Mariso	1.82	1.04	80,963
2.	Mamajang	2.25	1.28	90,100
3.	Tamalate	20.21	11.50	122,346
4.	Rappocini	9.23	5.25	123,110
5.	Makassar	2.52	1.43	105,753
6.	Ujung Panandg	2.63	1.50	52,593
7.	Wajo	1.99	1.13	57,667
8.	Bontoala	2.10	1.19	89,465
9.	Ujung Tanah	5.94	3.38	67,791
10.	Tallo	5.83	3.32	139,207
11.	Panakkukang	17.05	9.70	130,566
12.	Manggala	24.14	13.72	79,675
13.	Biringkanaya	48.22	27.43	65,902
14.	Tamalanrea	31.84	18.13	77,780
	Total	175.77	100 %	1,282,918

Source : Makassar in Number 2000

Makassar is classified as tropical area, because it is located near to the equator.

- Humidity: 73% - 93%.
- Rainfall per year: 268(マヽ) mm, the highest rainfall is on January and the average is 660 mm/month. The lowest rainfall is on August with its average is 14,4 mm/month. The amount of rainy day is about 149 day/year.

c.f. Rainfall: Average around 1,000-1,500 mm per year.
(http://www.geocities.com/makassar_tourism/)

- Average temperature : 25°C - 32°C.
- Average wind speed : 2 - 4 knot/hour.
- Average sunshinefut: 68.5%.

b. Geomorphology

Figure . 2.7.2. Aerial photography of Makassar Municipality

Makassar city is in coastal area laid along west to north part of north Sulawesi Island. Generally, land altitude is between 1 and 25 meter above Mean Sea Level (MSL) and its slope is about 0° - 5° from north to west side. There are 2(two) major rivers flow through the city, the Jeneberang and the Tallo Rivers. The Jeneberang River flows through Gowa Regency and run in south part of city and the Tallo river run in the northern of city.

The bottom surface of the upstream part of the two rivers has very slight slope, which is about 1:10,000. Their water flows slowly with high sedimentation that generates meander and bright stream. Based on its formation, Makassar city consists of 3 (three) kinds of Morphology:

1) Plate Form Morphology

The altitude of this type of morphology is about 2-5 meter above MSL, and its slope is about 0% - 2%. The plate area covers about 85% of total area, while 60% of it is urban area. Geo-morphological process consists of lateral erosion and sedimentation.

2) Weak Wave Morphology

The altitude of this type of morphology is about 0-1.75 meter above MSL, and its slope is about 2% - 3%. The weak wave area covers about 10% of total area and land use of its area are for mix plantation, bushes, fishpond and several urban areas. Geo-morphological process consists of lateral and vertical erosion also sedimentation, especially on coastal area.

3) Strong Wave Morphology

The altitude of this type of morphology is about 6-25 meter above MSL, and its slope is about 3% - 25%. The strong wave area covers about 5% of total area and land use of its area are for plantation, few of urban area and education area. Geo-morphological process consists of physical watering, erosion and sedimentation.

c. Geology

1) Upland Geology

Referring to geological maps of Ujung Pandang, Benteng and Sinjai, Makassar city is covered by tertiary and quarter rock (Sukamto and Supriatna, 1982), which is volcanic and alluvial sediment. Regionally, there are 3 (three) kinds of rocks (classified from old to young creation):

a) Camba Formation

This class can be found in Pampang, Hasanuddin University and industrial areas. Composition of this rock are several layers between sea sedimentation and volcanic rock, several layers between Tufaan sand stone and Tufa, and several layers among sand stone and clay, napal, breksi, conglomerate and lime stone. The colors of these rocks are variously from brown, red and light Grey to black. Generally, these rocks are very strong, have layer thickness about 4 cm and 100 cm and are formed at middle age times and in regional geology it called Camba Formation (Tmc).

b) Baturepe Cindako Vulcanic

This class can be found around Sungguminasa. Compositions of this rock are lava, breksi, and conglomerate with several layers among busalt, several fortir and ferokris pyroxene 1 cm. The colors of these rocks are variously from dark Grey to black. These rocks are formed at the end of pyroxene times and in regional geology it called Baturepe Cindako Volcanic (Tpbr).

c) Alluvial Sedimentation

These rocks are formed at quarter era and can be found in east and south of Makassar city through Gowa Regency. Swamp sedimentation can be found in north and south of Jeneberang River and east and west of Tallo River, while coastal sedimentation in west of Makassar city.

2) Marine Geology

Region of Makassar was influenced by sea hydrodynamics such as wind, sea wave, under sea stream, stream tide, abrasion, accretion and sedimentation that cause unstable vysiography of Makassar city. This condition is because during dry season sedimentation direction from north to south, while during rainy season from south to north. Data of Makassar marine geology elements are described on Table 2.7.2.

Table 2.7.2. Data of Makassar marine geology elements – 1999

No	Marine geology	Notation
1.	Sea temperature	▪ 1 Km from coastal line 30 °C ▪ (1-2) Km from coastal line (30-31) ° C ▪ More than 2 Km from coastal line 31° C and above ▪ Lae-Lae and other islands 32° C
2.	PH	▪ Coastal area 7.5 ▪ Archipelago area (8 – 8.5)
3.	Sea Water Salinity	▪ Coastal area(25-29) ▪ Archipelago area 27 ▪ ± 1 km from coastal line 25 ▪ ± (1-2) km from coastal line (25-26) ▪ More than 2 km from coastal line 26 and above
4.	Stream/wave direction	▪ Dry season (East season) N 270° E – N 360° E ▪ Rainy season (West season) N 180° E – N 270° E
5.	Height of wave/stream	▪ Coastal area (20-40) cm ▪ Off shore area (50-150) cm ▪ Speed/interval (3.77 – 11.57) sec
6.	Coastal stream	(0.03 – 0.5) m/sec
7.	Coastal sedimentation	0.2×10^{-6} m ^{3} /day to 2 x 10 m ^{3} /day
8.	High and low of the tide	Mix type
9.	Off shore sedimentation	28,470 m^{-6} /year
10.	Source of sedimentation material	Jeneberang river, piece of coral, drainage

Source: Dep. P & E Kanwil Sulsera, 1992
Pt.PPK, 1998
Rencana Induk Pengembangan Pariwisata Perkotaan (RIPPP) Kota Makassar, 1999

d. Environment

Master Plan of Urban Tourism Development Document (1999/2000) describes that Makassar region tend to have a highly influence towards disasters, such as:

- Seawater Intrusion
  Seawater intrusion is caused by penetration of seawater into land through pores of stone/sand. If intrusion occurs in large scale, it will cause land subsidence. This case can be found at Tamalate, Makassar, Ujung Pandang, Ujung Tanah, Wajo, Tallo and Biringkanaya districts.
- Abrasion/Erosion
  Abrasion is disappearance of stone/land by seawater while erosion is caused by river water. This will cause unstable of slope/cliff surface. This case can be found in river basin of Jeneberang, Tallo, and Bulurokeng River and in coastal area of Tamalate, Tallo, Makassar, Ujung Tanah, Biringkanaya district and islands areas.
- Sedimentation/Abrasion
  Sedimentation is reclaiming process of sand and lime at river area while acrassion at coastal area. These can be found at Tanjung Bunga, Tanjung Alang, Tanjung Merdeka, Barongbong, Sukarno Hatta harbor, orifice of Jeneberang River and orifice of Tallo River also meander area (river bend) and basin area (swamp).
- Land Crack
  Makassar crack between 1 and 3 cm is categorized as small crack but still need serious attention. Land crack occurred because it consists of lime mineral "minmirolonite". Land crack can be found at Biringkanaya, Panakkukang, Tallo, Tamalate and Ujung Tanah district.

e. Housing

Seen from the land use of Makassar within 10 years (1989 – 1999) the areas of housing are fluctuate, up and down. In the first period (1989 – 1994) it decreased. The area was about 26.81 % (4,712.90 Ha) and in year 1994 it became 25 % (4,395.00 Ha) of total area of Makassar. In the second period (1994 – 1996) there was increasing of the area from 4,395.00 Ha to 7,590.87 Ha (43.18 %) of total area of Makassar. And in the period of 1996 – 1999, it decreased from 7,590.87 Ha to 7,048.86 Ha or only about 40.10 % of total area of Makassar.

The area of housing is spread into each District in Makassar. District of Tamalate is the highest on the percentage of housing followed by District of Panakkukang, while District of Ujung Pandang is the lowest on the percentage of housing.

(2) Inundated Area

Flood/inundated area is caused by huge amount of rainwater volume during rainy season and the uprising of sea water level that occurred at Tamalate, Tallo, Panakukkang, Ujung Tanah and Manggala districts (see Table 2.7.3.)

Table 2.7.3. Flood/Inundated Area in Makassar

No	District	Location	Area (Ha)
1.	Ujung Tanah	Sub District Ujung Tanah, Camba Berua and Cambaya	5.6
2.	Mamajang	Found in 8 Sub-Districts	
3.	Ujung Pandang	Sub District Paru, Maloku,Losari, Lajangiru, and Pisang Selatan	0.86
4.	Makassar	Sub District Maricaya Baru, North Bara-Baraya , and South Bara-Baraya	8.5
5.	Bontoala	Sub District Bungae Jaya, and Malimongan Baru	1.44
6.	Wajo	Sub District Butung RW III	0.2
7.	Tallo	Found in 9 Sub-districts	0.6
8.	Tamalate	Sub District Jongaya, Kasi-kasi, Pa'Baeng-Baeng, Parang Tambung, and Balang baru	1.16
9.	Panakkukang	Found in 17 Sub-districts	222.00
10	Biringkanaya	Sub District Tamalanrea, Tamalanrea Jaya, and Tamalanrea Indah	7.61
11.	Mariso	Found in Sub-districts of Pannambungan Lette, Mariso, Mattoangin, and Mario	6.20
12.	Manggala	Sub District Antang and Borong	140.8
13.	Rappocini	Sub District Karunrung, Ballaparang, and Buakana	1.50
14.	Tamalanrea	Sub District Tamalanrea, Tamalanrea jaya, Tamalanrea Indah and Bira	6.20

Source : Main Data Analysis of Makassar 1999/2000

Almost all of the area of Sub District Cambaya is inundated by the tide of seawater and rainwater. The other cause of inundation is also bad condition of Drainage Network. Inundation occurs about 6 times a year and the maximum height is 50 cm.

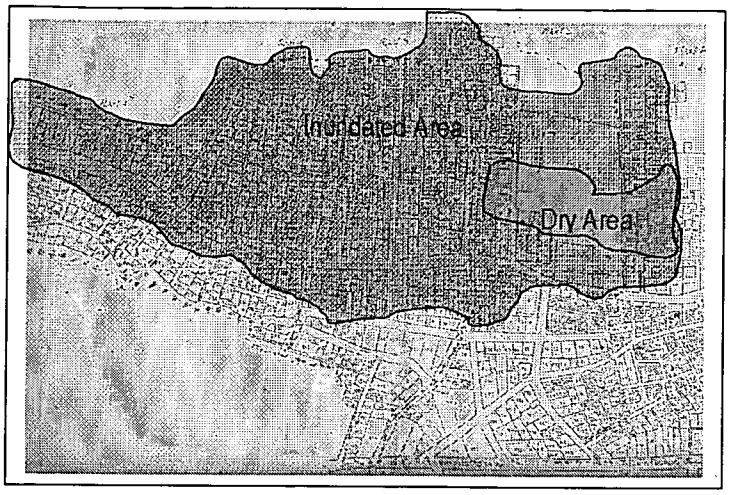


Figure . 2.7.3.
Inundated Area in Sub District of Cambaya

(3) Study Area Condition

a. Administrative Boundary

The location of study area is a Sub district of Cambaya, which is one of Sub districts under District of Ujung Tanah. Sub district Cambaya is located 0 -1.5 meter above sea level and relatively flat. Boundaries of the area are:

- Northern Part : Straits of Makassar
- Western Part : Straits of Makassar
- Southern Part : District Tallo
- Eastern Part : Sub district Camba Berua

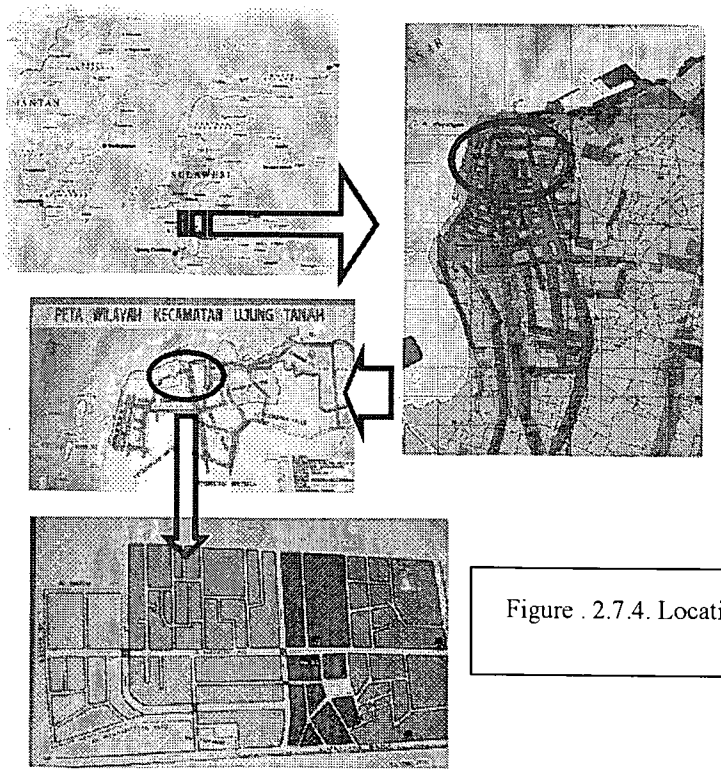


Figure . 2.7.4. Location of Cambaya Sub district

Sub district of Cambaya has an area about 50 ha and is administratively divided into 5 groups of neighborhoods (RW) and 27 smaller neighborhood units (RT). Area for settlement about 49 ha and the rest is for education and other infrastructure.

b. Socio-Economic Profile

The population of Sub District Cambaya is 1,029 households with 5,390 persons and spread into five RWs as listed on the table below. Mostly the occupation of the population is a fisherman, labor or fish seller (see Table 2.7.4).

Table 2.7.4. Population of Sub district Cambaya

RW	Households	Persons
1	212	1,115
2	235	1,287
3	263	1,523
4	227	930
5	92	535
TOTAL	1029	5,390

Source : Data Book of Sub District of Cambaya 2000

c. Infrastructure and Facilities

1). Road Network and Transportation

In this area, there is a main access road for vehicles has about 1,500 meters in length. This main road divides Sub District of Cambaya into 2(two) parts, southern and northern part. Besides this main road, there are road only for motorcycles with length of 400 meters and 4 (four) bridges about 42 meters which are located over 2 (two) big canals.

Photo 2.7.1. Access road to Cambaya from Eastern part

2). Education Facilities

Education facilities in Cambaya are moderate reflected from number of school, teacher, student and the grade of education. For detail, see Table 2.7.5. below:

Table 2.7.5. Education Facilities

No	Education Grade	Number of School	Number of Teacher	Number of Student
1	Kindergarten	1	2	30
2	Elementary School	2	17	427
3	Moslem Elementary School (Madrasah Ibtidaiyah)	1	3	38

Source : Data Book of Sub district Cambaya 2000

Photo. 2.7.2. One of Education Facilities in Cambaya

3). Religion Facilities

There is one mosque as a religion facility in Sub District of Cambaya, which has a renovation in some part at this moment.

Photo. 2.7.3. Mosque in Cambaya

4). Health Facilities

Sub District of Cambaya has 1 (one) People's Health Center with 1 (one) doctor and also Sub Health Center with 1 (one) paramedic.

5). Drainage Network

In Cambaya, there are 2 (two) big canals for drainage that let water flow into the sea. Width of each canal is about ten meters. The existing condition of the canal is full of the garbage that is thrown by the people living in the surrounding area. That condition made the inundation of the area worse.

Photo. 2.7.4. Condition of Canal (Drainage), which is full of garbage

Photo. 2.7.5. Another main canal and seen that the water is overflow

6). Garbage

For garbage collection, there is one fixed container for collecting every 2 – 3 days. Even though there is a container, mostly people still through their garbage near their house, such as underneath their platform house, drainage etc.

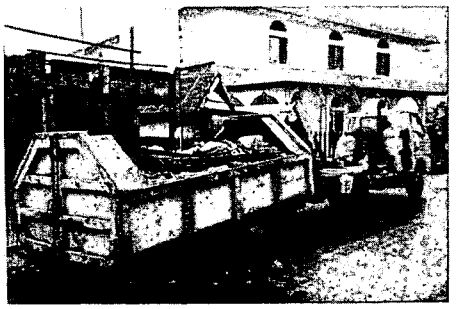


Photo. 2.7.6 Garbage Container

Photo. 2.7.7. Condition of underneath of house which is full of garbage

d. Housing

There are various types of houses in Sub district Cambaya. Wood is used in mostly buildings for both structural and non-structural. The number of houses, character and kind material used are listed on Table 2.7.6.

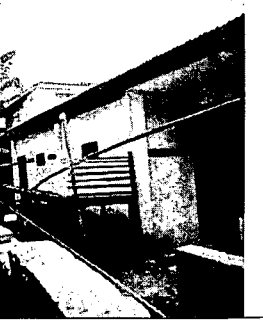
Table 2.7.6. Number of Houses based on Type of Building Material

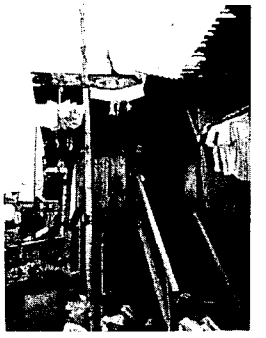
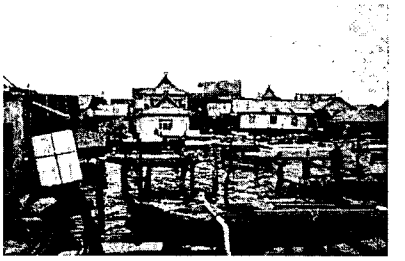
No	Material	Volume
1	Masonry wall / permanent	137 MĂ
2	Partly with masonry wall	201 MĂ
3	Wooden wall	429units
4	Bamboo wall etc.	425units
5	Platform House	0
6	Floating House	323units
	TOTAL	1192units

Source : Data Book of Sub district Cambaya 2000

In Cambaya, there are 5 (five) types of Houses:

Table 2.7.7. Types and specification of existing houses

Type	Type of House	Specifications	Example
A	Single	Detached single house. - continuous foundation - Floor: Cement plaster/Trash/PC Tile/Ceramic - Wall: Brick Masonry/Concrete block Masonry with plaster - Column: Brick/Concrete - Beam: Wood /Concrete - Plafond: Plywood/Plastic - Roof Frame: Wood - Roof Cover: Zinc	

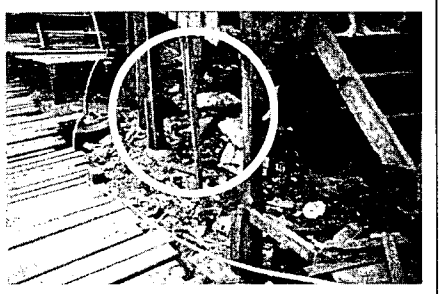
Type	Type of House	Specifications	Example
B	Platform House	House is a single storey lied on the land with the height about 2 meters. - Foundation Wooden Pile - Floor : Wooden board - Wall : Plywood / Zinc - Column & Beam : Wood - Plafond: plywood / plastic - Roof Frame: Wood - Roof Cover: Zinc	
D	Floating House	Platform House located above the sea. - Foundation : Wooden Pile - Floor : Wood - Wall : Plywood / Zinc - Column & Beam : Wood - Plafond : Plywood / plastic - Roof Frame: Wood - Roof Cover: Zinc	
E	Ex Platform House	Previously this house was a Platform House, Then it was changed into two storeys, covering all the lower part. - Foundation : Wooden Pile - Floor : - Lower Storey : Plaster, PC tile, Trash, ceramic - Upper Storey : Wood - Wall : Lower Storey : Red brick masonry, concrete block masonry, Upper Storey : Plywood / corrugated Zinc - Roof Frame: Wood - Roof Cover: corrugated zinc	

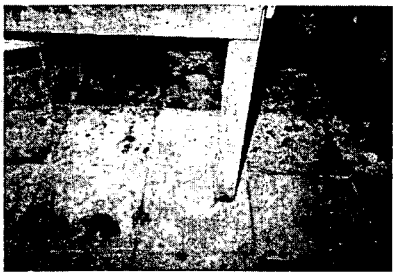
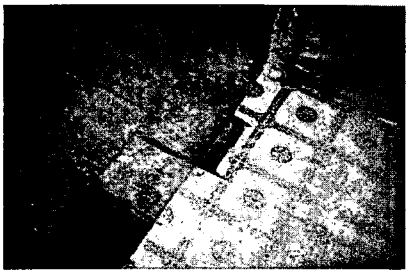
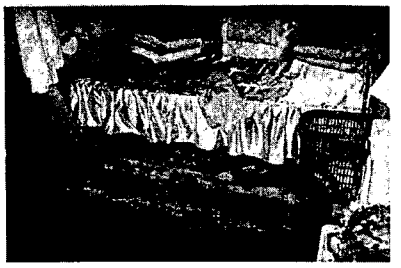
2.7.2. The Effect of the Inundation on Building and Inhabitants' lives

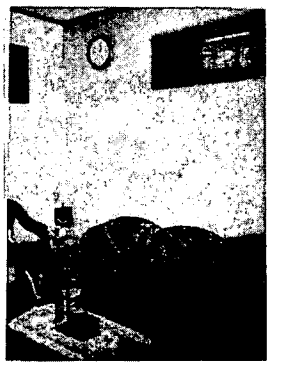
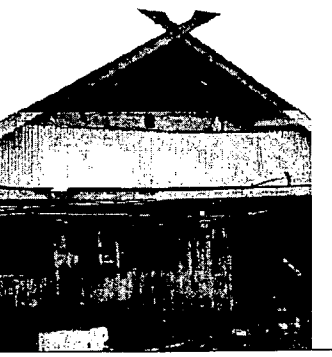
(1) Building Deterioration

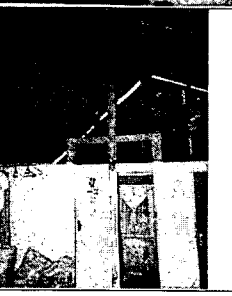
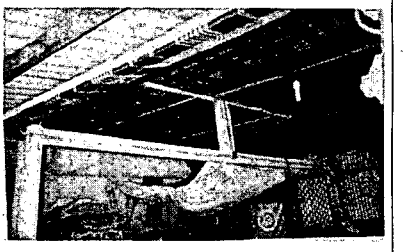
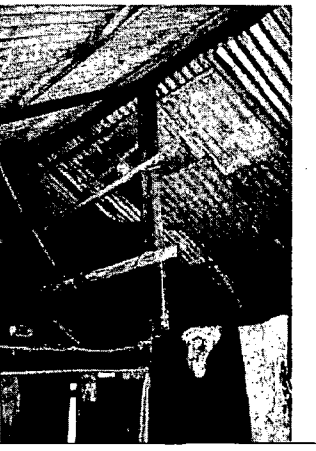
The effect of inundation to the building could be both Architectural and structural that shown in the table listed on Table 2.7.8

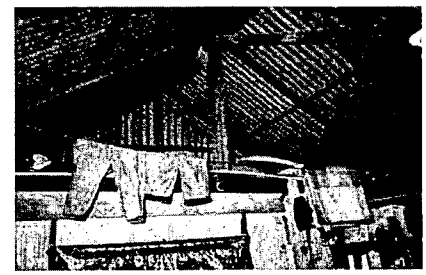
Table 2.7.8. Housing Condition

FOUNDATION				
Type	**Type of House**	**Material**	**Deterioration**	**Figure**
A	Detached	- Continuous, Stone masonry and red brick masonry.	There are unserious problems.	
B	Platform House	- Wooden Pile of 10/10 cm	Wooden piles are started being decayed because of garbage effect.	
C	Two storey House	- Continuous foundation with red brick masonry. - Wooden pile	Good condition	
D	Floating Platform	- Wooden piles of 10/10 cm	Wooden piles are started being decayed because water immerses and it is covered by small shell.	

FLOOR				
Type	**Type of House**	**Material**	**Deterioration**	**Figure**
A	Detached	- Cement Plaster, PC Tile & Ceramic	On the floor with plaster, trash and PC tile, there are some fungus which is caused by the high of humidity	
B	Platform House	- Wooden Board covered by vinyl	Some of houses are not being inundated, so there is no deterioration.	
C	Two storey House	Lower storey : - Cement plaster covered by vinyl. - Trash Tile. Upper Storey : Wooden board covered by vinyl.	Lower storey : Some fungus caused by inundation for a long time Upper storey: No deterioration	
D	Floating House	- Wooden board	There are some broken and decayed part on the wooden board, especially on houses which is inundated frequently	

WALL				
Type	**Type of House**	**Material**	**Deterioration**	**Figure**
A	Detached	- Brick masonry with plaster and painted	There is some infiltration of water into the wall that makes fungus occurs and in other part of wall, the plaster is being peeled.	
B	Platform House	- Wooden frame with plywood or zinc	- There are some peelings on plywood There are some rust on zinc	
C	Two storey House	- Lower storey : brick masonry / wooden board/ plywood / zinc - Upper storey : Wooden board / plywood / zinc.	- There is no deterioration on infill wooden board. - There are deterioration on plywood wall (got peeled) There are damaged on zinc wall (rust) because of humidity from the rain. -	 
	Floating House	- Plywood or zinc.	There are some decayed on plywood and some rust on zinc wall. This is not because of direct soaked water but high humidity	

CEILING				
Type	**Type of House**	**Material**	**Deterioration**	**Figure**
A	Detached	- Wooden frame with plywood as a cover	There are some damage on plywood (got peeled or there are some fungus caused by leakage of roof)	
B	Platform House	- Mostly without plafond	-	
C	Two storey House	- Lower storey : Wooden board which is a floor for upper store - Wooden or bamboo frame covered with plywood / plastic	- No serious damage  upper storey ceiling	 lower storey ceiling
D	Floating House	- Without plafond / ceiling		

ROOF				
Type	**Type of House**	**Material**	**Deterioration**	**Figure .**
A	Detached House	- Wooden frame with zinc	There are some damage on the roof cover because of rust that can make the zinc broken and water that come into the house to damage plafond.	-
B	Platform House	- Wooden frame with zinc	- Ditto -	
C	Two storey House	- Wooden frame with zinc	- Ditto -	
D	Floating House	- Wooden / bamboo frame with zinc	- Ditto -	

(2) The Daily Activities

During the inundation with about 12 hours long and about 50 cm in height (knee level), the disrupted daily activities are as follows: cooking, washing, sleeping, eating etc, for detail it is shown in some tables below: (the data collected from 45 respondents spreading over the Sub District of Cambaya).

Table 2.7.9. Daily Activities disturbed by Inundation

Activities	%
Eating	52.0
Drinking	52.0
Cooking	80.0
Washing	56.0
Playing	47.0
Chatting	22.2
Sleeping	43.0

Source : field data processing,

Other social and economic activities that are also disrupted are going to the office, working places, religious place and the school, as shown below,

Table 2.7.10.Social and Economic Activities disturbed by Inundation

Activities	%
To the school	70.0
To the office	65.0
To the work	65.0
To the religious service	52.0

Source : field data processing,

After the inundations, most respondents (78%) have tried to clean mud out of their house by themselves and about 9% of them repaired the part of their houses. The all family members clean up the house to reduce the expenses.

(3) Adaptation

a. Physical Adaptation

The people adapted themselves to flooding in surrounding their lives depending on their awareness and capability. Residents who are able to renovate their houses will repair it. Since building placed on inundated land, the brick wall as well as floor have become wet, humid leading to deterioration. Moreover, timber frame structures and household furniture are also weak and unsightly. These worse conditions also often seem in the surveyed area, which is occupied by the residents classified as low and middle-income people.

As informed by the respondents, inundation occurs regularly in a year, then the residents try to adapt, raising the floor structure or constructing a small embankment in the entrance and elevating their furniture by putting a piece of brick/wood under the furniture.

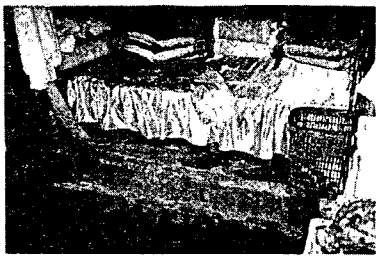


Photo. 2.7.8. Elevated Floor

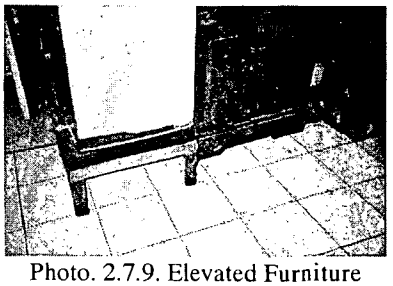


Photo. 2.7.9. Elevated Furniture

Photo. 2.7.10. Elevated Furniture

Photo. 2.7.11. Embankment in entrance

b. Inhabitants' adaptation

The respondents have adaptation as Figured in the Tables below. They realize that the flood occurrs all day long, so their daily activities will be prolonged the next day. Mostly the respondents stay in house because they have no choice. Besides, their houses are located near the working area, and that makes expenses for transportation cheap. According to the respondents, the inundation is the most interference thing to make more comfortable for staying. The interference things are shown in this table.

Table 2.7.11.Interference to People's Comfort

Interference things	%
Water flood	54.0
Security	37.0
Others	9.0
Total	100

Source: field data processing

Some kinds of acts against flood they used to like are elevating floor but some only stay and do nothing like in this table

Table 2.7.12. Kinds of Action against Flood

Kind of action	%
Elevating floor	65.0
Fencing the yard	-
Doing nothing	13.3
Others	11.7
Total	100

Source: field data processing

After inundations, each household will clean up their house by their family members as the mud cleaner. It will be more economical than using others.

Table 2.7.13. Kinds of Action after Inundation

Activities	%
Cleaning the mud	78.9
Repairing the damage	9.0
Doing nothing	12.1
Total	100

source : field data processing.