

The background of the slide is a light blue gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text is centered on the slide.

**URBAN FLOODING, INFORMAL SECTOR  
IMPACTS AND POLICY IMPLICATIONS :  
*MUMBAI, BANGKOK AND MANILA***

**Archana Patankar**

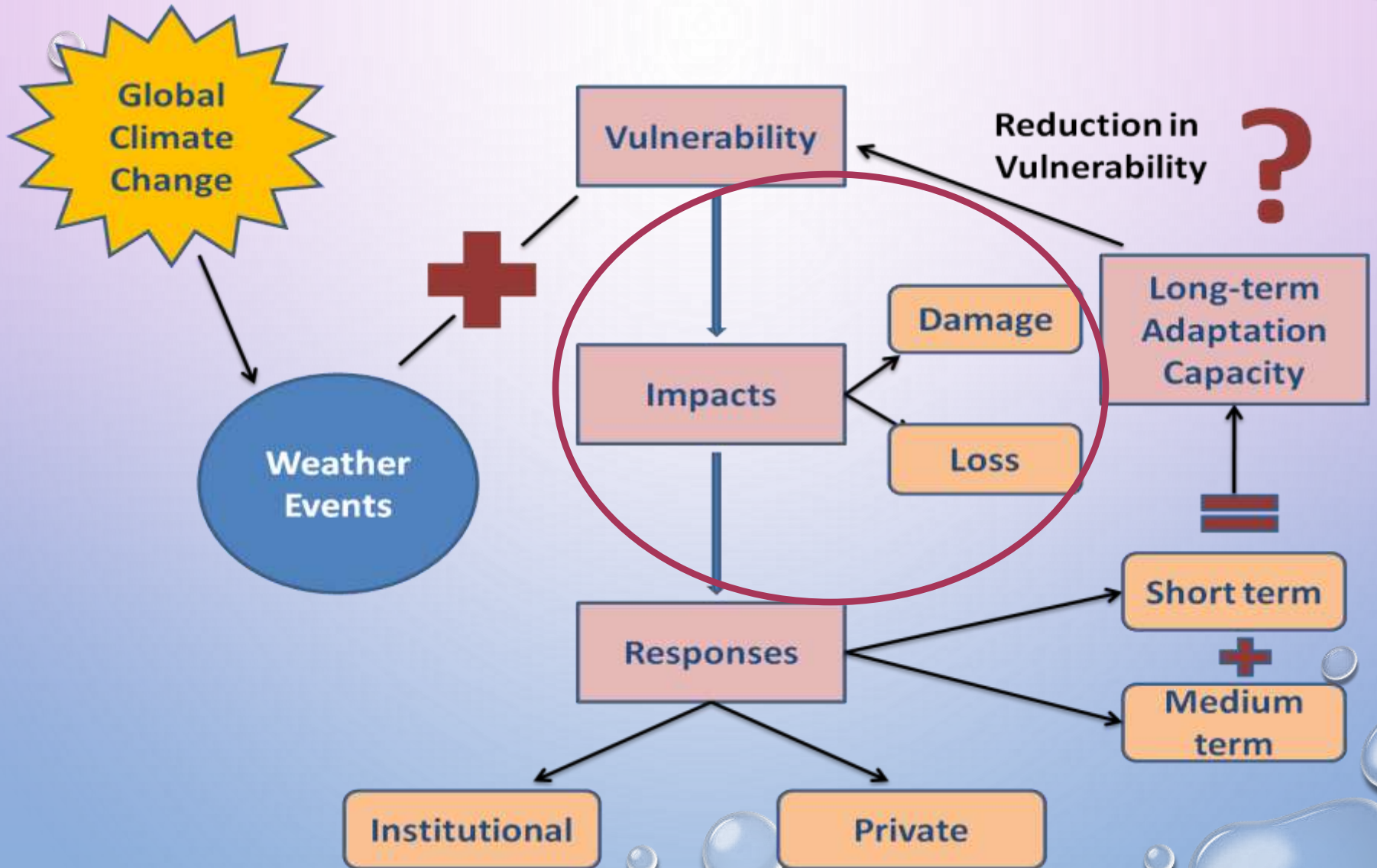
*TERI Workshop*

*April 25, 2014*

# OUTLINE

- LINK BETWEEN EVENTS, IMPACTS, RESPONSE AND ADAPTATION
- CITY PROFILES
- EXTREME EVENTS AND FLASH FLOODS
- METHODOLOGY AND DATA COLLECTION
- IMPACT ASSESSMENT
- POLICY IMPLICATIONS

# LINK BETWEEN EVENTS, IMPACTS, RESPONSE AND ADAPTATION



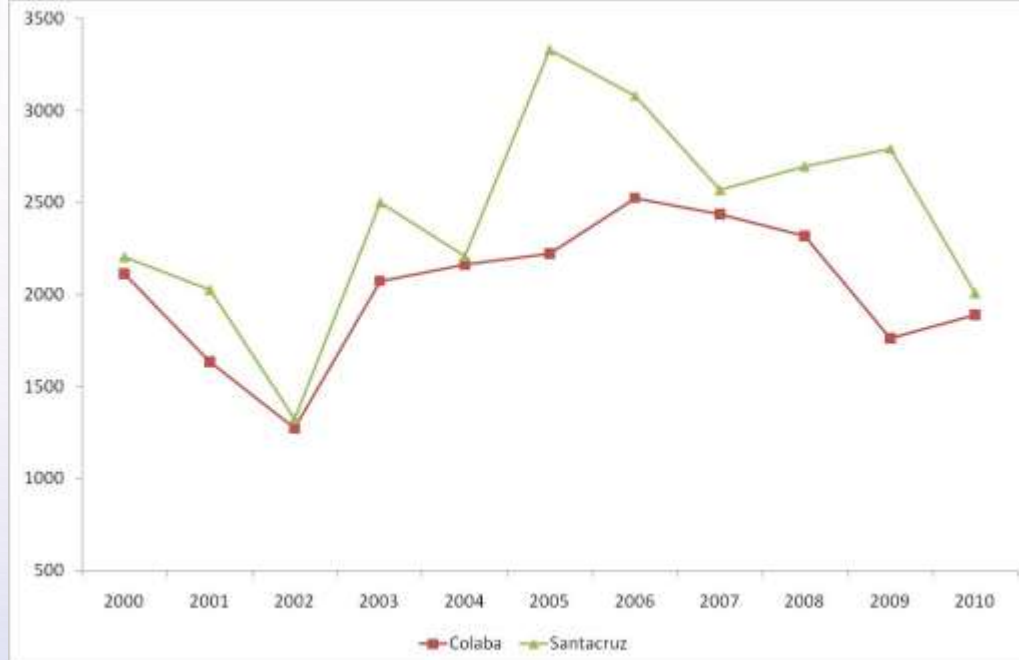
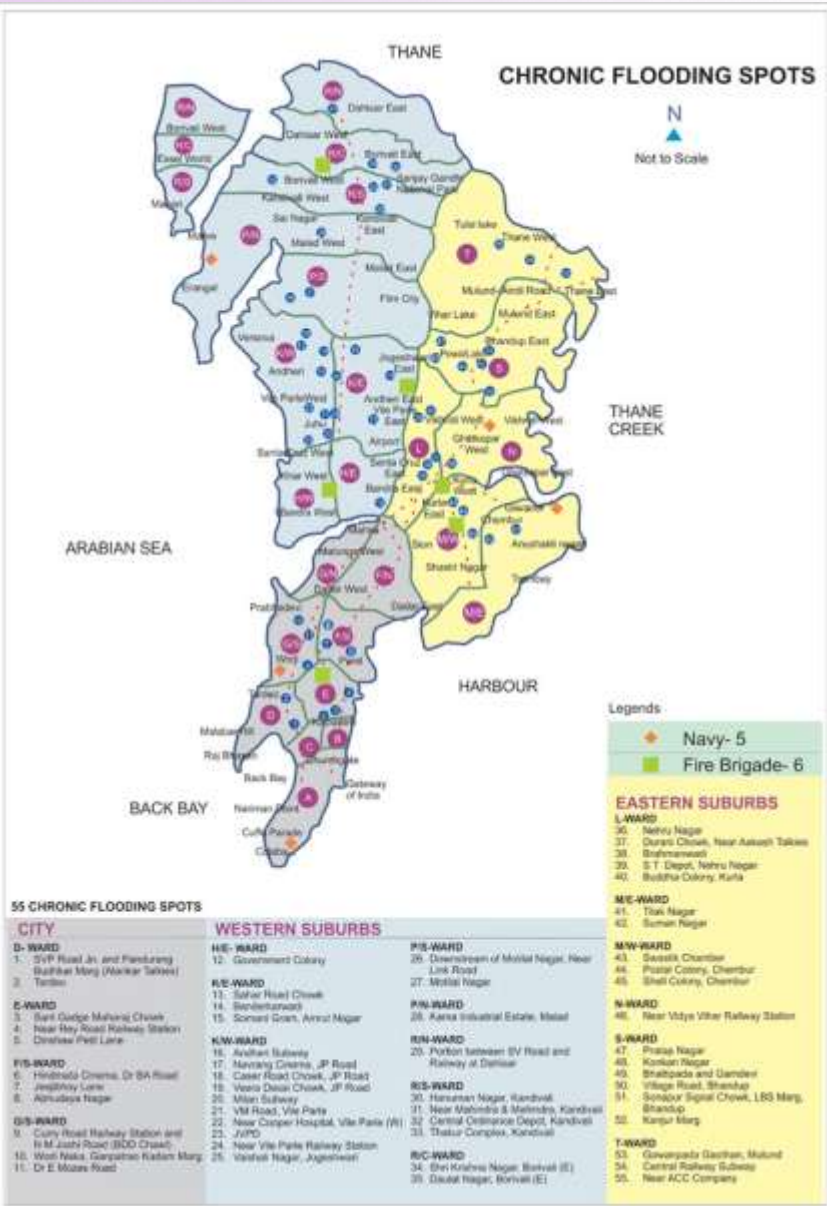
# APN FUNDED RESEARCH PROJECT (2010-12)

- STUDY UNDERTAKEN IN THREE COASTAL MEGACITIES OF ASIA – MUMBAI, BANGKOK AND MANILA
- OBJECTIVE OF ASSESSING THE PHYSICAL AND ECONOMIC IMPACTS OF EXTREME PRECIPITATION EVENTS
- MAJOR PART OF LOCAL ECONOMY IN THESE CITIES IN INFORMAL SECTOR WHERE PREVALENCE OF INSURANCE COVER IS MINIMAL
- FOCUS ON ESTIMATING THE UNINSURED LOSSES OF THE INFORMAL SECTOR – HOUSEHOLDS AND SMALL BUSINESSES
- MEASURING DAMAGE TO PHYSICAL INFRASTRUCTURE, CAPITAL, EQUIPMENT AND INVENTORY AND LOSS OF INCOME, INVESTMENT, EMPLOYMENT AND DISRUPTION IN ESSENTIAL SERVICES
- IMPLICATIONS FOR INFORMAL SECTOR VULNERABILITY, ADAPTATION, DEVELOPMENT PLANNING AND POVERTY ALLEVIATION

# CITY PROFILES

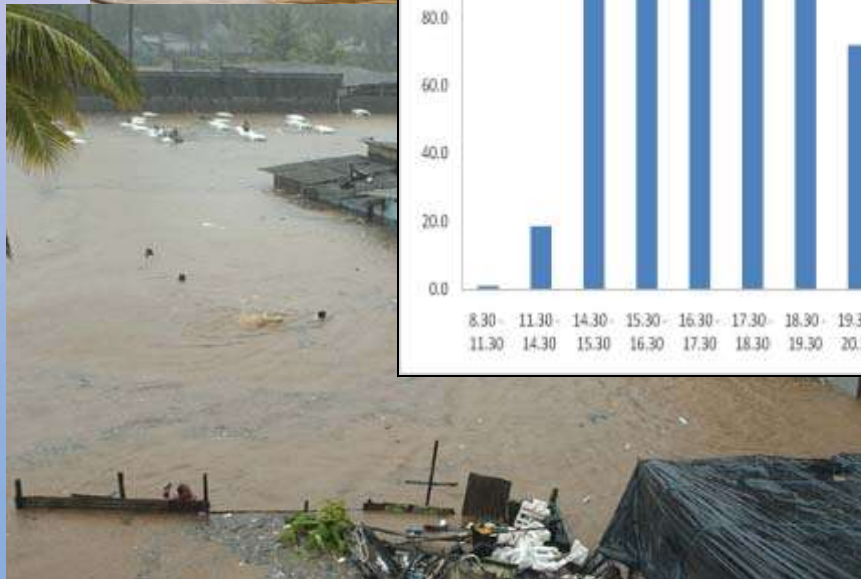
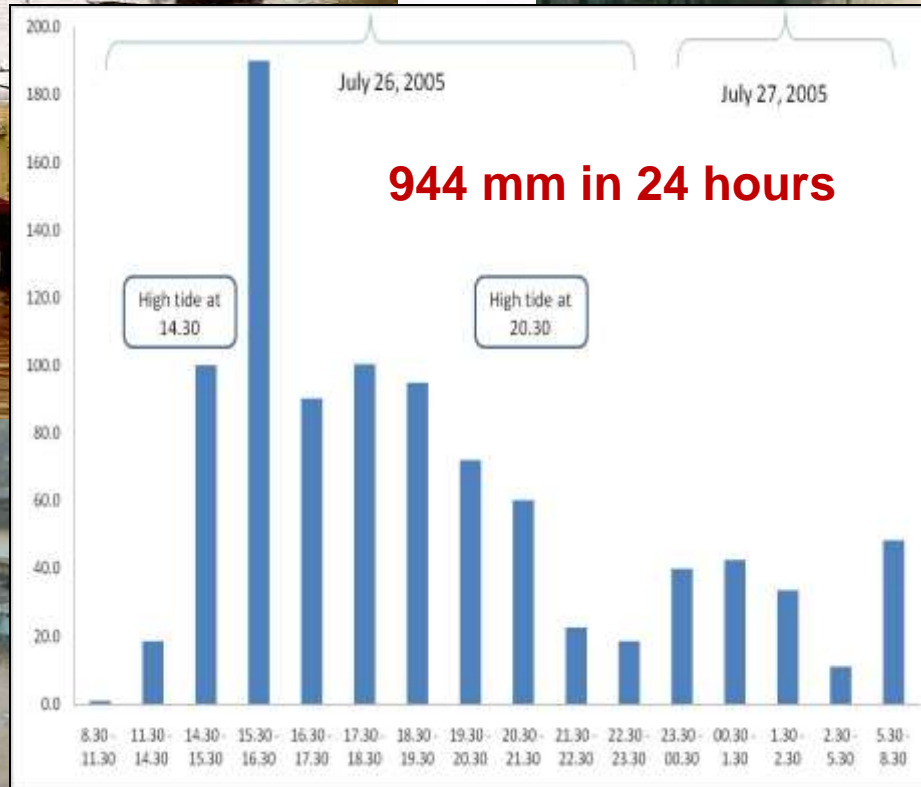
	<b>Mumbai</b>	<b>Bangkok</b>	<b>Manila</b>
<b>Population (in millions)</b>	11.9 (Census 2001)	5.67 (official estimates for 2009)	12.10
<b>Total area (sq.km.)</b>	437.71	1569	636
<b>Population density (per sq.km.)</b>	27209	3617	15617
<b>Extreme weather event</b>	July 26, 2005	Oct 2006	Sept-Oct 2009
<b>Affected regions</b>	Eastern and Western suburbs	Bangkok Metropolitan Region	Metro Manila
<b>Total estimated damages (official estimates of public infrastructure and insured losses)</b>	US\$ 68 million	US\$ 117 million	US\$ 590 million
<b>Study areas for primary survey</b>	Six wards of Mumbai worst affected by floods	Minburi, Nong Jork, Lat Krabang and Klong Samwa	Cities of Marikina and Pasig
<b>Sample size</b>	1168 households 792 commercial	300 households, 50 farms and 30 commercial	200 households 87 commercial
<b>Monthly average incomes of households</b>	US\$ 330	US\$ 660	US\$ 380

# MUMBAI CITY PROFILE

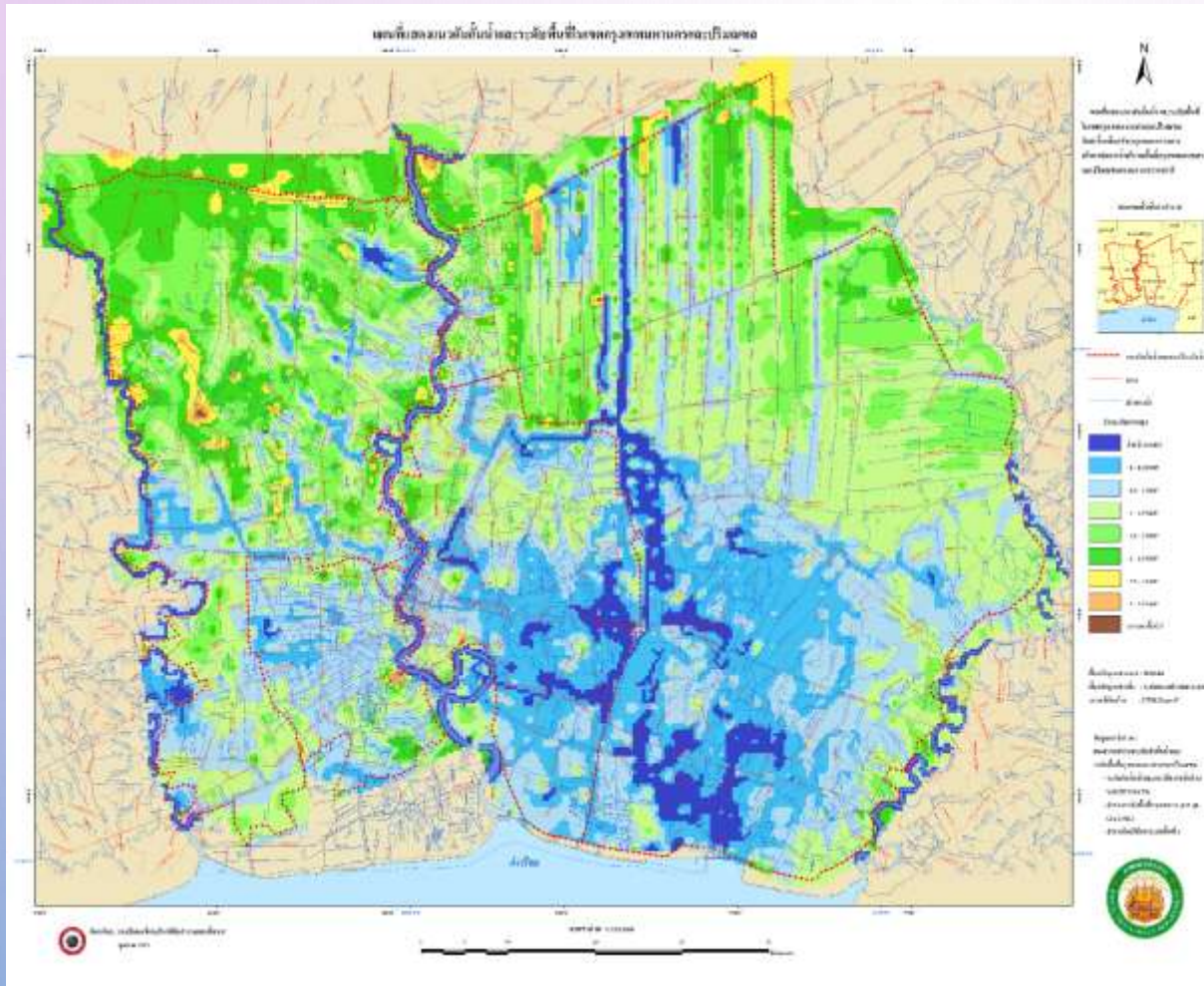


Year	Island city	Eastern suburbs	Western suburbs
2000	55	49	106
2001	85	46	93
2002	86	50	106
2003	86	41	123
2004	56	56	88
2005	90	91	190
2006	107	137	339
2007	66	25	70
2008	60	24	53

# EXTREME EVENT OF JULY 26, 2005



# BANGKOK OVERVIEW

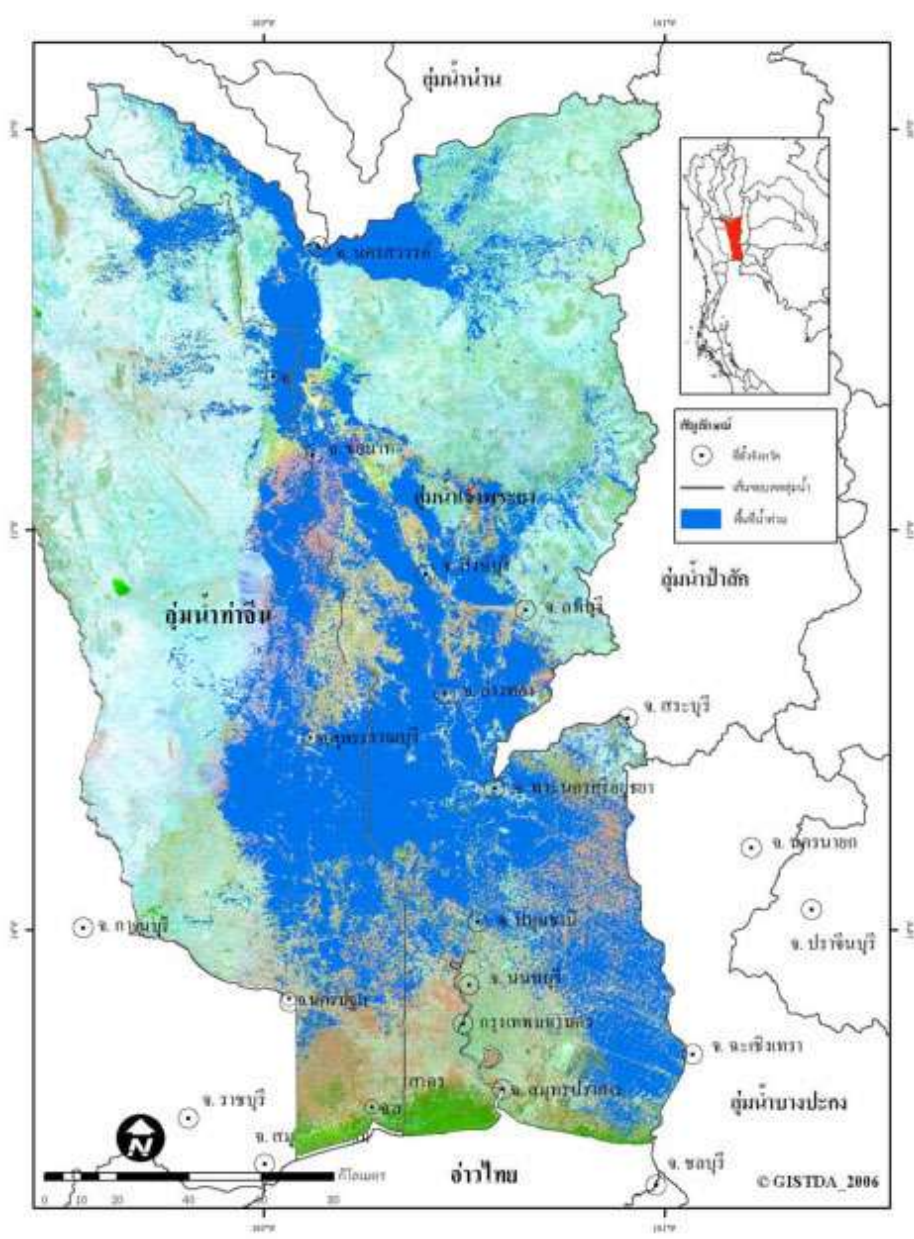


- 15% OF THAILAND'S POPULATION LOCATED IN BMR
- MUCH OF THAILAND'S INDUSTRIAL AND COMMERCIAL CAPACITY AND COMMUNICATION AND TRANSPORT INFRASTRUCTURE LOCATED HERE
- BMR GENERATES MORE THAN 45% OF NATION'S GDP
- ECONOMIC PRIMACY AND EXPANDING POPULATION ARE MAJOR DIMENSIONS OF CITY'S GROWING VULNERABILITY AND EXPOSURE TO FLOODING

- BANGKOK LOCATED IN A LOW-LYING AREA OF THE BASIN, WITH AN AVERAGE GROUND ELEVATION OF ONLY 1.0-2.0 METERS ABOVE SEA LEVEL.



# 2006 FLOODS IN BANGKOK



AS WITH OTHER INSTANCES OF FLOODING IN BANGKOK, THE CIRCUMSTANCES THAT LED TO THE CITY'S INUNDATION IN 2006 WERE BOTH PREDICTABLE AND UNIQUE:

- HEAVY PRECIPITATION
- HIGH LEVELS OF RUNOFF FROM CHAO PHRAYA RIVER BASIN
- SEA LEVEL RISE

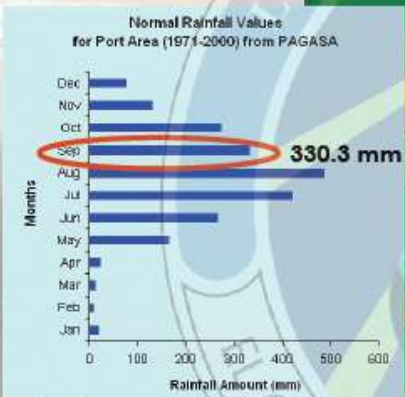
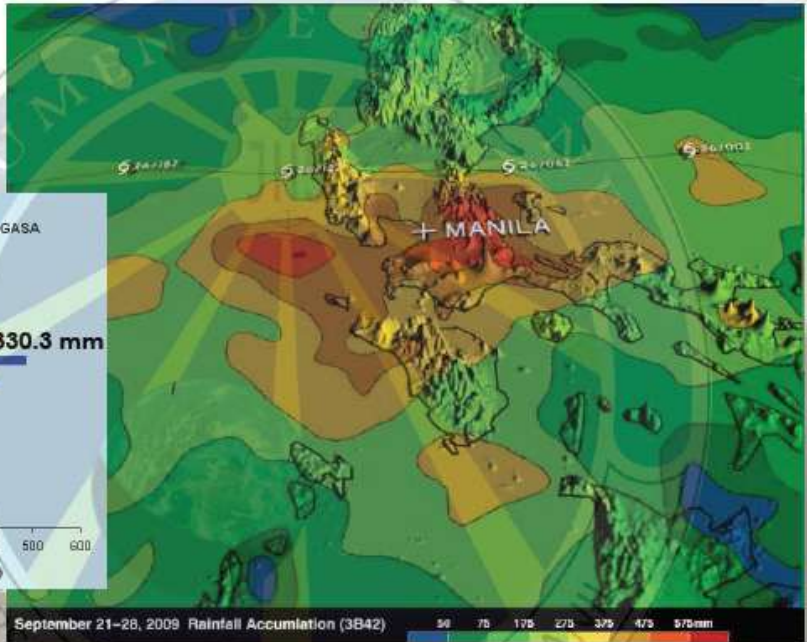
IN RESPONSE, THE FLOODWATER WAS MANAGED BY ALLOWING THE AGRICULTURAL LAND NORTH OF THE CITY TO FLOOD AND ALSO CHANNELLING THE WATER TO THE EAST OF THE CITY, WHERE THE CASE STUDY DISTRICTS IN THIS REPORT ARE LOCATED.

THE CENTRE OF THE CITY WAS PROTECTED BY ITS EMBANKMENTS AND DRAINAGE INFRASTRUCTURE, THOUGH LARGE PARTS OF THE SURROUNDINGS AREAS (IN PARTICULAR, THE CASE STUDY DISTRICTS) WERE INUNDATED

# MANILA FLASH FLOODS: TROPICAL STORM ONDOY 2009



Rain Accumulated in Southern and Central Luzon (21-28 Sep 2009)

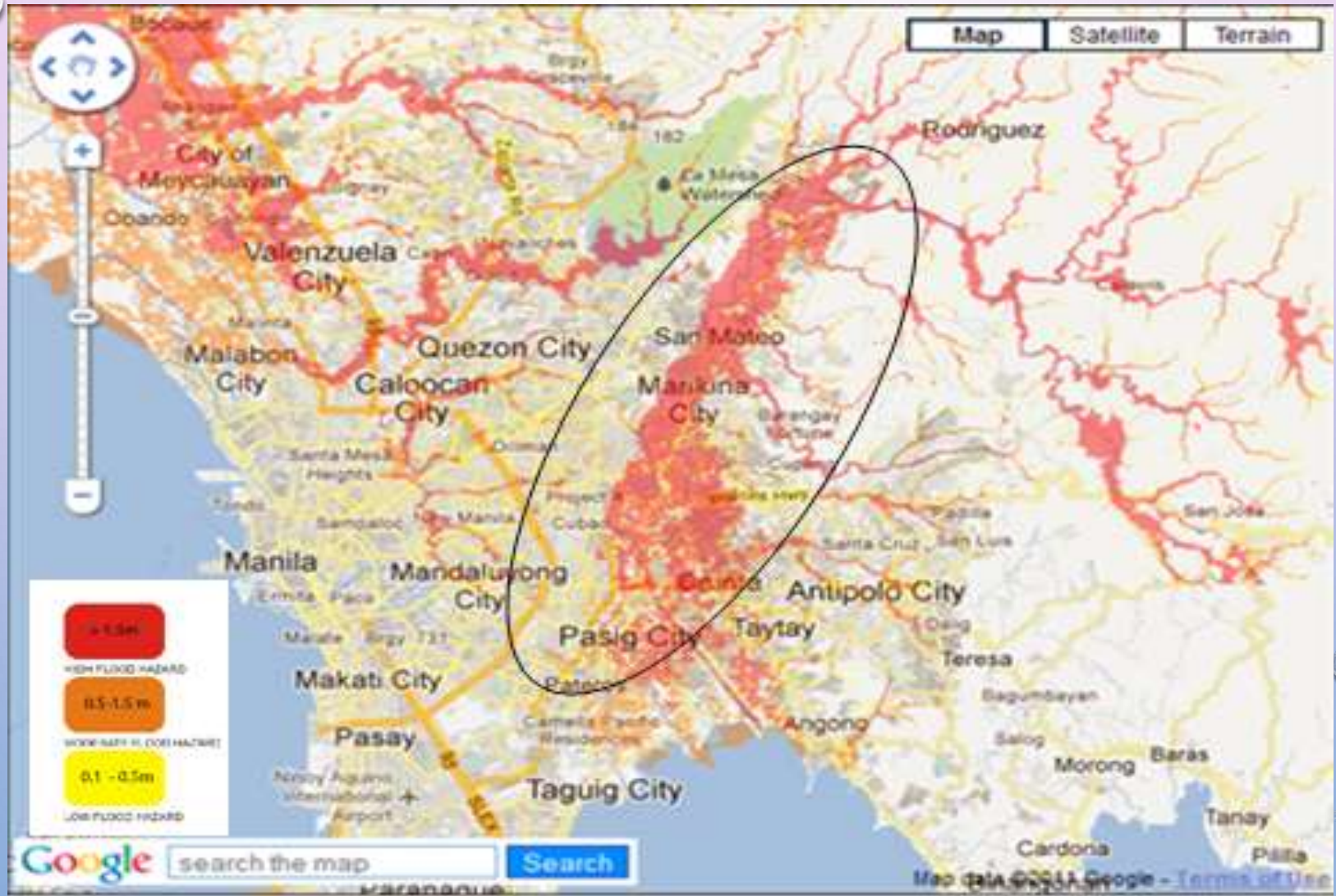


[http://www.nscb.gov.ph/headlines/StatsSpeak/2009/030909\\_fav\\_climatechange.asp](http://www.nscb.gov.ph/headlines/StatsSpeak/2009/030909_fav_climatechange.asp)

September 21-28, 2009 Rainfall Accumulation (3842) [http://trmm.gsfc.nasa.gov/trmm\\_rain/Events/manila\\_rainfall\\_perspective\\_21-28sep09](http://trmm.gsfc.nasa.gov/trmm_rain/Events/manila_rainfall_perspective_21-28sep09)

- Accumulated rainfall over a week measured by TRMM was over **500 mm** in Metro Manila. This value is higher than the monthly normal.

# FLOOD MAP OF METRO MANILA AND APN STUDY SITES



# IMPACT ASSESSMENT METHODOLOGY

- WHAT IS BEING ASSESSED - DIRECT AND/OR INDIRECT IMPACTS
- L + D AS ONE OF THE MOST IMPORTANT EMERGING AREAS IN GLOBAL CLIMATE CHANGE NEGOTIATIONS
- EXTREMELY IMPORTANT FOR RECOVERY AND RECONSTRUCTION
- DAMAGE ASSESSMENT
  - PHYSICAL ASSETS AND INFRASTRUCTURE – PUBLIC AND PRIVATE
  - REPLACEMENT / DEPRECIATION /REPAIR VALUE TO BE CONSIDERED
- LOSS
  - EFFECT ON ECONOMIC FLOWS LIKE LOSS OF INCOME, PRODUCTION, INVENTORY, INCREASED OPERATING COSTS, LOSS OF TAX REVENUE
  - USE OF PROXY VARIABLES
- DATA SOURCES
  - OFFICIAL ASSESSMENT
  - SAMPLE SURVEYS IN AFFECTED AREAS

# METHODOLOGY AND DATA



Wards	Type of area	Population	Flooding spots	Average Flooding Depth (ft)	Selected Sample	
					Households	Businesses
KEast	Retained area	8,10,002	7	10.36	241	139
HEast	River flood plane	5,80,835	14	08.60	176	98
FNorth	Lowlying area	5,24,398	10	10.30	177	102
FSouth	Lowlying area	3,96,122	12	20.40	108	149
LWard	River flood plane	7,78,278	15	10.40	231	204
FNorth	Retained area	7,98,775	8	10.26	210	100

Source: MCGM (2010), Flood Preparedness Guidelines 2010, [www.nontarain.org.in](http://www.nontarain.org.in)

# DAMAGE ASSESSMENT FOR HOUSEHOLDS (IN INR)

	K East	H East	F North	F South	L Ward	P North
<b>(Figures in bracket as % of average household monthly income)</b>						
<b>Average Income loss due to floods</b>	10474 (69.8)	8543 (57.0)	5164 (25.8)	8323 (41.6)	22578 (112.9)	14894 (74.5)
<b>Average Amount spent on repair/rebuilding of house/premises</b>	22270 (148.5)	26191 (174.6)	34335 (171.7)	42967 (214.8)	22457 (112.3)	27118 (135.6)
<b>Losses due to damage to household appliances (TV, refrigerator, music system, desktop, laptop, washing machine, stove)</b>	13190 (87.9)	15469 (103.1)	13442 (67.2)	10081 (50.4)	11325 (56.6)	23923 (119.6)
<b>Losses on account of damage to household assets (Furniture and utensils)</b>	9735 (64.9)	11061 (73.7)	11756 (58.8)	6602 (33.0)	7121 (35.6)	10417 (52.1)
<b>Losses due to damages to vehicles (Car, Motorcycle, Bicycle)</b>	12974 (86.5)	9153 (61.0)	11833 (59.2)	1250 (6.3)	5478 (27.4)	7232 (36.2)
<b>Source: Authors' calculations based on primary data</b>						

# DAMAGE ASSESSMENT FOR BUSINESSES (IN INR)

	K East	H East	F North	F South	L Ward	P North
<b>Losses on account of damage to premises (Ground fences, walls, doors and windows)</b>	39928	16262	28052	5302	32529	40869
<b>Losses on account of damages to equipments (machine tools, wiring, heating, AC)</b>	10410	12883	15824	-	3633	3776
<b>Losses due to damages to materials (Machine tools, inventory, raw material, finished products)</b>	25183	21760	112571	8544	5368	2285
<b>Source: Authors' calculations based on primary data</b>						

	K East	H East	F North	F South	L Ward	P North
<b>Disinfecting premises</b>	29938	12351	30485	12063	77933	30060
<b>Clearing debris and damaged items</b>	8581	6938	5938	4000	28200	39906
<b>Loss of income due to business interruption</b>	18158	11488	15024	5765	43308	32833
<b>Increased alternative operating costs</b>	10396	8537	7167	5896	21000	26929
<b>Loss due to suspended production</b>	104809	22313	252500	128619	14450	85000
<b>Emergency expenses during floods</b>	47500	10100 0	12000	24200	186667	75000
<b>Source: Authors' calculations based on primary data</b>						

# EXTRAPOLATION OF COSTS

Item	Average cost of repairs/replacement per household (in INR)	% of households reporting these costs in survey	Estimated number of households affected by floods	Estimated costs of damage in INR million
Income loss	5000	84	352800	1764
Reconstruction of house	15000	86	361200	5418
Stove	1500	57	239400	359.1
Electric Fans	1000	35	147000	147
TV	7000	42	176400	1234.8
VCR/VCD	2700	7	29400	79.38
Music System	3000	1	4200	12.6
Motorcycle	8000	13	54600	436.8
Refrigerator	7000	30	126000	882
Washing Machine	6000	8	33600	201.6
Furniture	5000	31	130200	651
Wardrobes	4000	32	134400	537.6
Utensils	3000	38	159600	478.8
<b>Total Estimated costs</b>				12202.68 (US\$ 267 million)

Source: Authors' calculations based on primary data

Assumptions for extrapolation based on Census data and municipal records

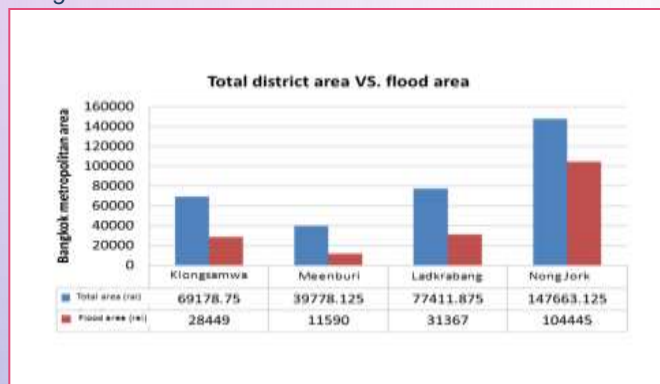
Item	Average cost of repairs/replacement per establishment (in INR)	% of establishments reporting these costs in survey	Estimated number of establishments affected	Estimated costs in INR million
Grounds and fences	40000	48	46080	1843.2
Walls	11000	26	24960	274.56
Windows	5000	4	3840	19.2
Doors and mouldings	6000	18	17280	103.68
Electrical wiring and switches	10000	28	26880	268.8
Heating	10000	1	960	9.6
Air conditioning	14000	1	960	13.44
Machine tools	15000	25	24000	360
Finished products	24000	28	26880	645.12
Raw materials	20000	13	12480	249.6
Inventory	24000	13	12480	299.52
<b>Total Estimated costs</b>				4086.72 (US\$ 90 million)

Source: Authors' calculations based on primary data



# BANGKOK IMPACT ESTIMATION

Total inundated area in Klong Samwa, Minburi, Ladkrabang and Nong Jork districts



## - Damage to property and infrastructure

Physical damage by district: settlement, education, religious and transport (October 5, 2006)

District	Settlement	Education	Religious	Transportation
Nongjork	0	13 schools	3 temples 4 mosques	22 roads
Minburi	4 villages	0	1 mosque	4 roads
Ladkrabang	30 communities 6 villages	12 schools	6 temples 3 mosques	12 roads
Khlongsamwa	10 communities 1 village	2 schools	3 temples	11 roads

## - Loss of agriculture produce

Damage to agricultural land and crops, Bangkok

Bangkok	Total land (km <sup>2</sup> )	Affected land (km <sup>2</sup> )	Damaged land (km <sup>2</sup> )	Crop losses (tons)	Cost (Baht, millions)
In-season rice	92,590 km <sup>2</sup>	90.6 km <sup>2</sup>	27.2 km <sup>2</sup>	12,742.20	84.099

Agricultural compensation by product, 2006 and 2010

Compensation (Baht)	Compensation (Baht), 2006	Compensation (Baht), 2010
<b>Farm produce</b>		
Rice	414/rai	2,098/rai
Crops	579/rai	2,921/rai
Others	786/rai	4,908/rai
<b>Livestock</b>		
Chicken	27.5/each	27.5/each
Layer chicken	20/each	20/each
Duck	20/each	20/each
Sheep/Goat	1,400/each	1,400/each
Cow (6-24 months)	3,600-15,800/each	3,600-15,80/each
<b>Fishery</b>		
Fish pond/field	3,406/rai	3,406/rai
Fish floating basket/cement pond	257/m <sup>2</sup>	257/m <sup>2</sup>
Shrimp/Crab/Shellfish	9,098/rai	9,098/rai

Flood-related agricultural impacts and compensation, 2006 and 2010

District	Total flooded area (rai)		Total flood-affected farmers		Total compensation (Baht, millions)	
	2006	2010	2006	2010	2006	2010
Khlong Samwa	14,254	494	772	47	7.259	1.269
Minburi	5,877	464	441	54	1.891	1.278
Ladkrabang	14,826	410	325 inland fisheries	32	4.377	0.987
Nongchok	16,817	1,010	672	52	7.090	2.129

# FLOOD COSTS IN BANGKOK

HOUSEHOLD SECTOR					
Proxy variables	Sub-proxies				Total
<i>Loss Incurred</i>	<i>Food and utilities</i>	<i>Transportation</i>	<i>Repairs</i>	<i>Flood prevention</i>	
	15,000	600	25,000	5,000	44,400
<i>Work absence</i>	<i>Daily income</i>	<i>Day (s) absent</i>			
	300	3			900
<i>Health</i>	<i>Medication</i>				
	300				300
					<b>45,600</b>

BUSINESS SECTOR					
Proxy Variables	Sub-Proxies				Total
<i>Loss Incurred</i>	<i>Lost customers</i>	<i>Stock damage</i>	<i>Repairs</i>	<i>Flood prevention</i>	
	15,000	5,000	5,000	5,000	30,000
<i>Work absence</i>	<i>Expenses (workers)</i>	<i>Day(s) absent</i>			
	300	3			900
					<b>30,900</b>

AGRICULTURAL SECTOR			
Proxy Variables	Sub-Proxies		Total
<i>Loss Incurred</i>	<i>Field damage</i>	<i>Flood prevention</i>	
	30,000	12,000	42,000
<i>Work Absence</i>	<i>Daily income</i>	<i>Day(s) absent</i>	
	500	30	15,000
			<b>57,000</b>

# **SPECIFIC IMPACTS OF FLOODING: MANILA**

- **DAMAGE/REPAIR TO HOUSING STRUCTURES**

- FLOOD WATERS REACHED AN AVERAGE OF 20-30 FT (2009)
- FULLY OR PARTIALLY DAMAGED DWELLING STRUCTURES 75% (MARIKINA) & 35% (PASIG)

- **MAJOR REPAIRS AND RECONSTRUCTION**

- 81% CONCENTRATED ON ADDING & REPAIRING/REPAINTING FLOORS, WALLS, & ROOFING; 19% CONSTRUCTED A NEW HOME, FIXED THEIR PLUMBING, DRAINAGE SYSTEM & TOILETS
- LENGTH OF TIME TO REPAIR: 30 DAYS; 10% UNABLE TO RECONSTRUCT (NO RESOURCES OR PREVENTED BY AUTHORITIES DUE TO DANGER ZONES)
- REPAIR COSTS: P1 41,000-4 MILLION (MARIKINA: UPPER-MIDDLE INCOME); P1 2,000-1 50,000 (PASIG: LOW-MIDDLE INCOME)

# **SPECIFIC IMPACTS CONTD....**

- **ASSETS**

- 45% LOST SEVERELY (EG. APPLIANCES/ ELECTRONIC GADGETS), 30 % LOST MILDLY, 16 % NEGLIGIBLE LOSSES (EG. UTENSILS)

- **LOSS OF WORKDAYS/SCHOOLING DUE TO DAMAGE/ INTERRUPTION OF BASIC SERVICES**

- 30 MAN-DAYS WERE LOST DUE TO FLOOD DAMAGE TO THEIR HOMES, BASIC SERVICES, AND INFRASTRUCTURE (ROADS, BRIDGES AND WATER CHANNELS)
- WATER SUPPLY INTERRUPTED FOR 22 DAYS IN 2009; NO ELECTRICITY FOR 1 MONTH (MARIKINA) & 14 DAYS (PASIG)
- 70% UNABLE TO SEND CHILDREN TO SCHOOL
- INCOME LOSS: P21,000-500,000 PER HOUSEHOLD (AVERAGE SALARY OF PUBLIC SCHOOL TEACHER IS P10,000)

# HEALTH IMPACTS OF FLOODS

## • SICKNESS/DISEASES DURING FLOODS

- COUGHS/COLDS/FEVER (80% ); DIARRHEA & STOMACH AILMENTS (40% ); SKIN DISEASES/ALLERGIES (32%); LEPTOSPIROSIS (18%); DENGUE (15%); INCREASE OF CLIMATE/FLOOD-RELATED DISEASES SUCH AS DIARRHEA, DENGUE, AND LEPTOSPIROSIS (84%)
- TREATMENT COSTS: P35,000-P60,000 (DENGUE); P10,000-P50,000 (LEPTOSPIROSIS)
- MEDICAL EXPENSES: P6,517-70,000
- MEDICAL SERVICES BY THE GOVERNMENT & NGOS (50%); MAJORITY RECEIVED FREE MEDICINE, FIRST AID KITS AND SERVICES LIKE WATER CHLORINATION AND DENGUE-INFESTED AREA FUMIGATION OR DEFOGGING

## Summary of Costs/Losses Due to Floods (monthly)

	Pre-Ondoy		Ondoy Period		Post-Ondoy	
	Men HH	Women HH	Men HH	Women HH	Men HH	Women HH
Absences from school	6	8	14	17	6	7
Number of workdays lost from sickness due to flood	5	7	9	10	5	8
Number of work days lost due to flood	6	8	20	22	6	9
Average income loss due to floods	P1,715	P3,250	P7,250	P6,450	P2,750	P3,400
Average amount of spent on medicine	P300	P400	P3,200	P3,000	P500	P450
Average losses (appliances, etc.)			P25,000	P20,000		
Average income	P6,250	P5,000	-	-	P6,500	P4,200

SOURCE: PORIO (2011)

## Summary of Costs of Basic Needs/Services (in pesos, monthly, US\$ 1=P43)

	Pre-Ondoy		Ondoy Period		Post-Ondoy	
	Men HH	Women HH	Men HH	Women HH	Men HH	Women HH
Food	P6,000	P5,800	P2,500 + relief goods	P2,000 + relief goods	P6,500	P6,000
Water						
• Drinking	P50	P45	P240	P240	P60	P50
• Cooking/washing utensils	P80 (well) P500 (piped)	P80 (well) P550 (piped)	P80 (well, long lines) P1,500 (piped)	P80 (well, long lines) P1,500 (piped)	P80 (well) P740 (piped)	P80 (well) P700 (piped)
Energy/electricity	P2,000	P1,800	P5,000	P4,500	P2,000 (wet) P3,000 (dry)	P1,800 (wet) P2,500 (dry)
Sanitation/Laundry (mud, waist deep; cleaning – 2 weeks – one month)	P300	P310	P2,000	P2,000	P360	P320
House repair			P1,500 – P15,000	P1,000 – P8,000		

Source: Porio (2011)

# KEY FINDINGS

- DAMAGE/IMPACT ASSESSMENTS OF EXTREME WEATHER EVENTS FOCUS MAINLY ON INSURED AND DIRECTLY MEASURABLE LOSSES. THERE ARE A NUMBER OF STOCK AND FLOW IMPACTS THAT DO NOT GET CAPTURED IN THE ABSENCE OF A WELL DEFINED METHODOLOGY TO CAPTURE THEM.
- MARGINALIZED PEOPLE AND LOSSES SUFFERED BY THEM OFTEN DO NOT GET ACCOUNTED FOR IN FORMAL IMPACT ASSESSMENTS
- LACK OF INSURANCE OR SOCIAL SECURITY PUTS A HUGE BURDEN OF SUCH EVENTS ON THE COMMON CITIZENS. THE REPAIRS/REPLACEMENT COSTS ARE DIRECT OUT-OF-POCKET EXPENSES FOR THEM.
- IN THE ABSENCE OF A SOCIAL PROTECTION MECHANISM, POOR AND MORE VULNERABLE SECTIONS END UP BEARING SIGNIFICANT MONETARY BURDEN.



# FINDINGS CONTD...

- CIVIC AUTHORITIES HAVE TAKEN EFFORTS IN THE AFTERMATH OF SUCH EVENTS TO IMPROVE THE EARLY WARNING AND COPING CAPACITY. HOWEVER, RECENT FLOOD EXPERIENCES SHOW THAT SOME RESIDUAL IMPACTS WOULD REMAIN EVEN IF THIS CAPACITY IS SIGNIFICANTLY ENHANCED.
- THERE ARE SOCIO-POLITICAL DYNAMICS THAT OFTEN DEFINE THE PRIORITIES AND REQUIRE A LONGER TIME FRAME FOR INFRASTRUCTURE IMPROVEMENTS TO HAPPEN
- TOO MUCH FOCUS IS GIVEN TO REACTIVE MEASURES WITH LIMITED ATTENTION GIVEN TO PREPARATION FOR AND ANTICIPATION OF FUTURE EVENTS
- THERE IS AN URGENT NEED TO DEVELOP A CULTURE OF DISASTER PREVENTION, ADAPTATION AND SAFETY BEHAVIOR. FUTURE STRATEGIES ALSO NEED TO BE MORE PEOPLE CENTRIC AND TRANSPARENT.

# FINDINGS CONTD...

- CURRENTLY DEVELOPMENT PLANNING LOOKS AT ENVIRONMENT AT A GENERIC LEVEL. THERE IS A NEED FOR STRONGER SCIENTIFIC AND TECHNICAL KNOWLEDGE BASE TO INTEGRATE CLIMATE RISKS INTO PLANNING
- LONG TERM ADAPTATION CAPACITY ALSO REQUIRES SIMULTANEOUS IMPROVEMENT IN LAND-USE PLANNING, DEVELOPMENT PLANNING, ZONAL STRATEGIES AND EFFECTIVE RELOCATION MEASURES (IF REQUIRED)
- THERE IS ALSO A NEED FOR BOTTOM TO TOP PROCESS WHERE LOCAL ENVIRONMENTAL AND SOCIO-ECONOMIC-POLITICAL VULNERABILITIES ARE ADDRESSED THROUGH LOCAL CLIMATE ACTION PLANS WHICH ARE THEN INTEGRATED INTO MUNICIPAL/CITY ACTION PLANS

***THANK YOU***