



Demonstration Site on
“Enhancing Resilience to Disasters of
Urban Water Systems of Mindanao”
in the Philippines




HELP Davao Network

Davao City was chosen by UNESCO as
Demonstration Site for Sustainability
Science

- Focus on **resilience** of urban water
systems to **disasters**



Typhoon Bopha (Pablo) 2012



Total Estimate Cost of Damage: PHP36,949,230,987.07
(agriculture, infrastructure, properties)
Total Individuals Affected: 711,682 families
Total Casualties: 1,607 Filipinos
Reported Missing: 834 Filipinos
Other immediate problems:
WASH, Food Security, Health and Safety, Shelter,
Logistics and Communication, Education



Infrastructure and Communication



Industries, Businesses, and Private Properties



Agriculture



Education



Health and Safety



Livelihood



Environmental Integrity



Lives

The impact of Typhoon Bopha (Pablo)



Total Estimate Cost of Damage:

Php 11,000,000

(infrastructure, private properties)

Total Individuals Affected: 14,726 families

Total Casualties: 30 Individuals

Reported Missing: 1 Individuals

Other immediate problems:

WASH, Food Security, Health and Safety, Shelter,



**Flash Flood Incident
In Davao City
(Matina Pangi River) - 2011**

Davao City Flooding In 2011



Thousands of families in 4 Barangays (Ma-a, Matina Pangi, Matina Crossing and Talomo Proper) were submerged in 10 feet high flash flood for several hours due to heavy rain that poured on June 28, 2011, forcing families to seek for higher and safer grounds.



Damages of the Flash Flood Incident In Davao City (Matina Pangi River) - 2011



Infrastructure, Private Properties, and Businesses



Health and Sanitation, Safety, Households, Livelihood

What do we want to find out?

Focus on 4 of 8 river systems in Davao City

- Davao River Basin
- Lasang Watershed
- Lipadas Watershed
- Talomo Watershed

in the event of a 100 year return flood, and determine which barangays are most vulnerable to the **big flood**.



Increase in precipitation may cause rivers to overflow...



This study assessed and mapped flood vulnerabilities of the WSS *vis-à-vis* the vulnerabilities of the communities to 100-year return floods in 67 riverine and floodplain barangays located in 4 of 8 river systems in Davao City.

Disaster risk reduction and management plans were examined and dynamics analyzed in order to strengthen planning and coordination towards resiliency of the UWS and its management.

Initial efforts were also exerted to raise awareness on climate change adaptation among stakeholders by demonstrating resilience.



METHODOLOGY



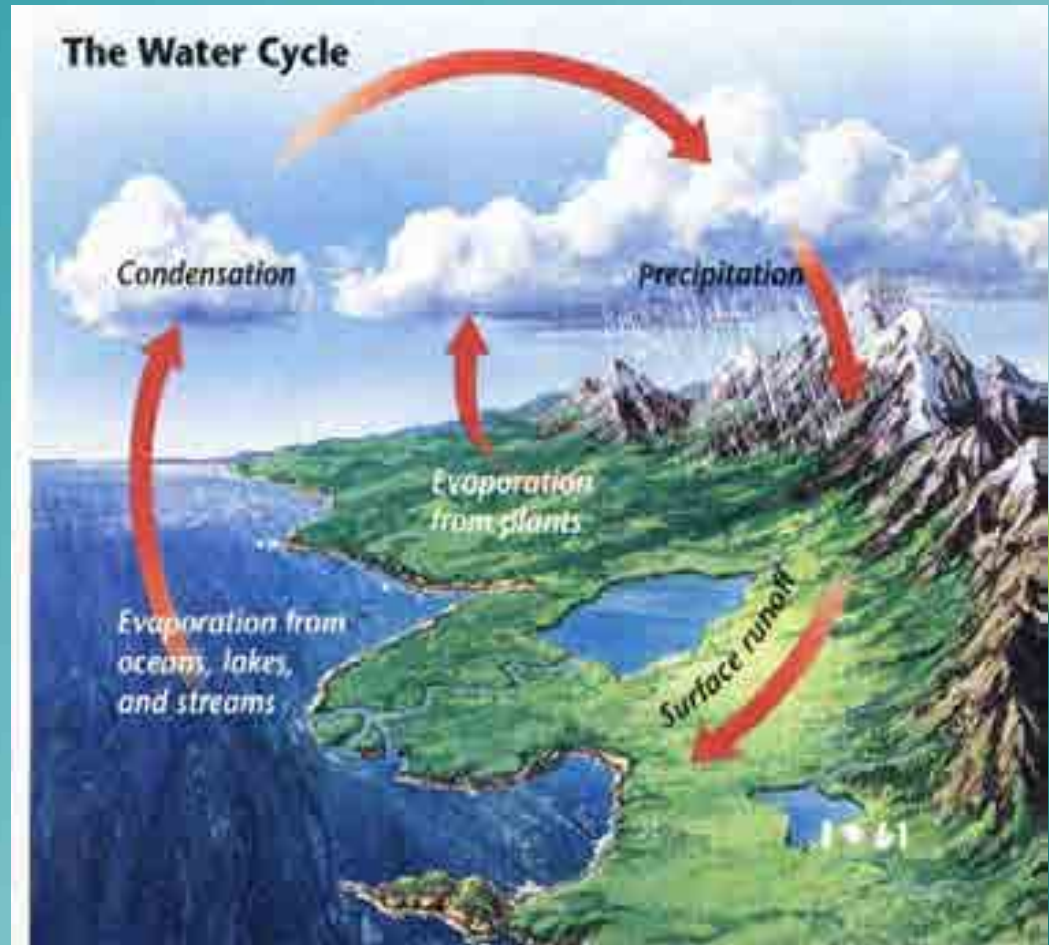
Data processing and analysis involved 5 steps

1. Desk review of secondary data
2. Selection of vulnerability indicators
 - Exposure
 - Sensitivity
 - Adaptive capacity
3. Focus group discussions, key informant interviews
4. Database development & data integration using GIS
5. Link database with other websites



Climate change manifestations will involve alterations in the water cycle

The urban water system (which includes water supply, wastewater and storm water) has been identified to be particularly at risk to climate change (Loftus, 2011).



If the urban water system is at risk, then impacts on the system infrastructure are anticipated



Source
(1)



Treatment
(2)



Distribution
(3)



Customer

Level 1 System



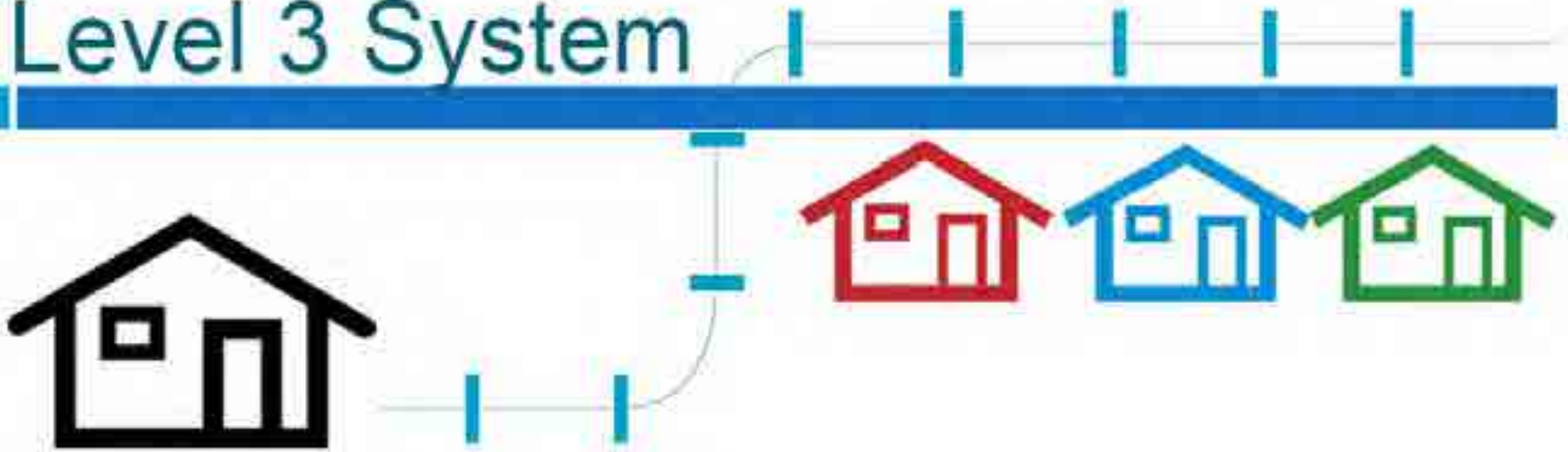
- ❑ A protected well or developed spring with an outlet but without a distribution system.
- ❑ The farthest user is not more than 250 meters from the source.

Level 2 System



- A system composed of a source, a reservoir, a piped distribution network, and communal faucets.
- The farthest user is not more than 25 meters from the source.

Level 3 System



- ❑ Waterworks system or individual house connections
- ❑ A system with a source, a reservoir, a piped distribution network and household taps.

Source: Presentation from the 2008 World Water Week



In Davao City, Level III WSS is served by DCWD in 110 of 182 (60%) barangays

- DCWD serves 62% of the City's 1.656 million population
- 99.9% of DCWD production comes from groundwater sources extracted through production wells



RESULTS:

BASELINE ASSESSMENT



- ❑ 48% (32 of 67) of the barangays covered in the study are prone to 100-year return floods
- ❑ 41% (13 of 32) of identified flood-prone barangays rely solely on DCWD's Level III water supply
- ❑ 17 barangays are identified as recharge areas



Various WSS infrastructures were found located in the flood-prone barangays

DCWD

- ❑ 12 pipe bridge crossings
- ❑ 9 production wells
- ❑ 6 reservoirs
- ❑ 4 water treatment facilities



Non-DCWD

- ❑ 221 Levels I and II systems, regardless if private or public

RESULTS:

EXPOSURE ASSESSMENT



3 indicators for assessing exposure were selected

(1) Area prone to flooding, %

- | | |
|------------|-----|
| 1. 1-A | 91% |
| 2. Calinan | 79% |
| 3. 8-A | 67% |

(2) Area prone to flooding, has.

- | | |
|------------|----------|
| 1. Calinan | 681 has. |
| 2. Tigatto | 496 has. |
| 3. Maa | 469 has. |

(3) Potentially affected population

- | | |
|------------|--------|
| 1. Maa | 27,639 |
| 2. Tigatto | 23,435 |
| 3. Calinan | 18,174 |
| 8. 8-A | 7,463 |
| 10. 1-A | 2,826 |

RESULTS:

SENSITIVITY ASSESSMENT



3 indicators for sensitivity of water supply system were selected

Infrastructure damage due to location in flood-prone area of barangay:

(1) No. of DCWD WSS infrastructure

(2) No. of other built structures

(3) Potential for system dysfunction

- No. of DCWD service connections/households/population to be affected

❑ DCWD WSS
infrastructures located
in flood-prone areas
are concentrated in 6
barangays

❑ 221 non-DCWD
infrastructures are
spread in 21 of
32 flood-prone
barangays



- ❑ Functional disruption of DCWD pipe bridge crossing in Talomo will affect the most number of households/ population
- ❑ Access to 12 hospitals can be restricted as a result of severe flooding



RESULTS:

ADAPTIVE CAPACITY ASSESSMENT



3 indicators for adaptive capacity of water supply system were selected

(1) Internal Revenue Allotment

(2) Environmental sanitation

- Access to safe water
- Access to sanitary toilets
- Satisfactory solid waste disposal
- Access to complete basic sanitation facilities

(3) Flood disaster preparedness

- Early warning system
- Barangay DRRMC
- Evacuation centers

- ❑ 81% (26 of 32) of the barangays have Internal Revenue Allotment of PhP10M and below
- ❑ Environmental sanitation can still be improved
- ❑ Disaster preparedness can still be increased
- ❑ Nearly half of the identified evacuation centers are covered courts/gyms/halls



VULNERABILITY FINDINGS



Assessing the vulnerability of the WSS to climate change impacts, such as flooding, is necessary to determine the system's resilience

Vulnerability = exposure + sensitivity - adaptive capacity

Final equation used:

$$VI = EI + SI + ACI$$



5 stages of vulnerability were defined

Vulnerability index (VI)	Classification
$0.0000 < VI < 0.3187$	Less vulnerable
$0.3187 < VI < 0.3481$	Moderately vulnerable
$0.3481 < VI < 0.3758$	Vulnerable
$0.3758 < VI < 0.4113$	Highly vulnerable
$0.4113 < VI < 1.0000$	Very highly vulnerable

Water supply system and communities in 4 barangays are very highly vulnerable to 100-year return floods

River system	Flood-prone barangay	VI	Ranking	Classification
DRB	Mandug	0.48252	1	Very highly vulnerable
LipW	Lubogan	0.46684	2	
DRB	Tigatto	0.45417	3	
TW	Calinan	0.41768	4	
LasW	Pañalum	0.40480	5	Highly vulnerable
LipW	Crossing Bayabas	0.40431	6	
DRB	1-A	0.39672	7	
DRB	Ma-a	0.39303	8	
DRB	2-A	0.37973	9	
DRB	8-A	0.37657	10	

Water Supply System Vulnerability Map of 32 Barangays in Davao City

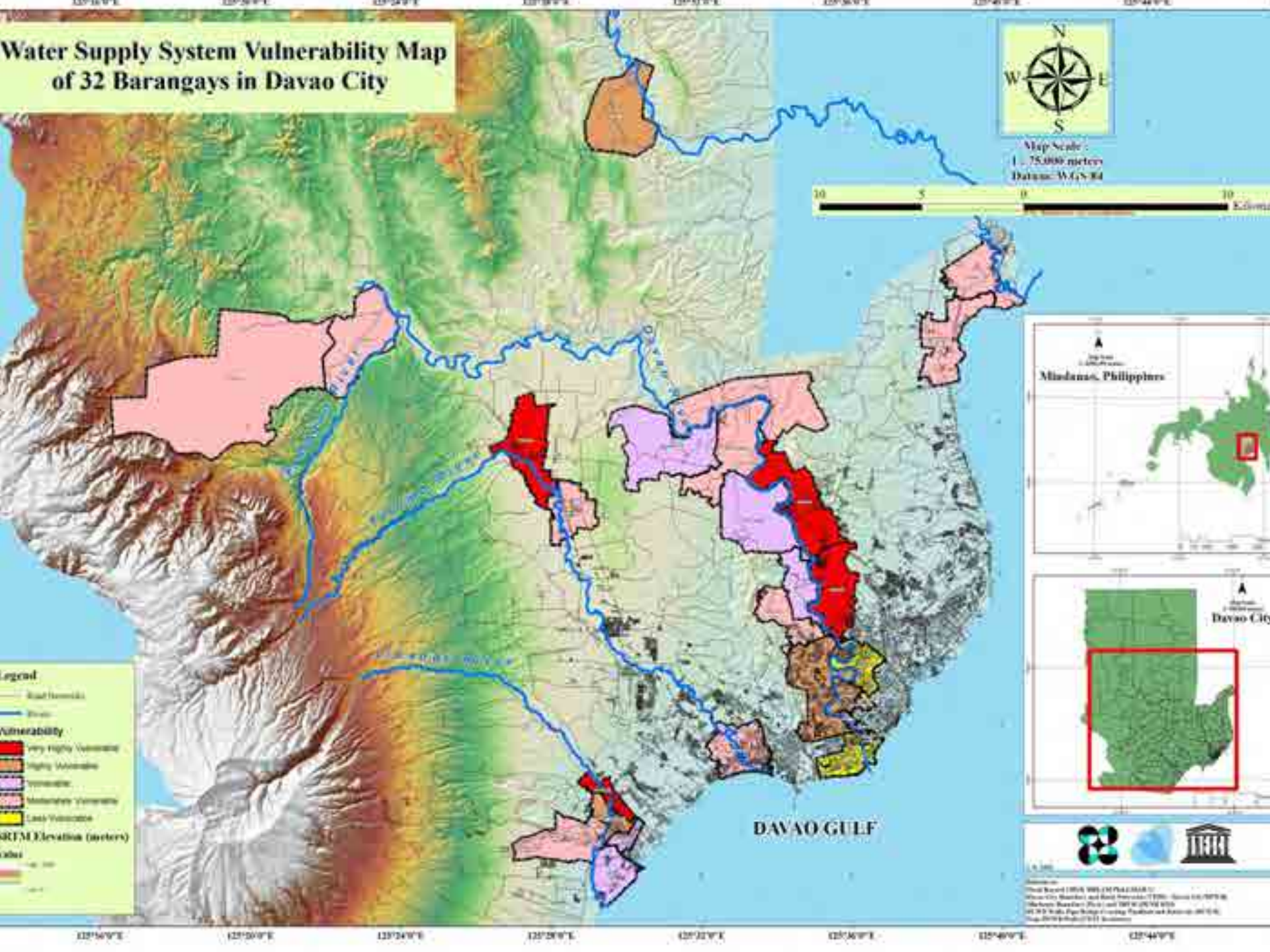


Map Scale :
1 : 75,000 meters
Datum: WGS 84



Legend

- Road Network
- River
- Vulnerability**
 - Very High Vulnerable (Red)
 - Highly Vulnerable (Orange)
 - Vulnerable (Light Purple)
 - Intermediate Vulnerable (Dark Purple)
 - Low Vulnerable (Yellow)
- DEM Elevation (meters)**
 - 0 - 100
 - 100 - 200
 - 200 - 300
 - 300 - 400
 - 400 - 500
 - 500 - 600
 - 600 - 700
 - 700 - 800
 - 800 - 900
 - 900 - 1000
 - 1000 - 1100
 - 1100 - 1200
 - 1200 - 1300
 - 1300 - 1400
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 - 3400 - 3500
 - 3500 - 3600
 - 3600 - 3700
 - 3700 - 3800
 - 3800 - 3900
 - 3900 - 4000
 - 4000 - 4100
 - 4100 - 4200
 - 4200 - 4300
 - 4300 - 4400
 - 4400 - 4500
 - 4500 - 4600
 - 4600 - 4700
 - 4700 - 4800
 - 4800 - 4900
 - 4900 - 5000



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 Date: 2018-08-15

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IS DAVAO CITY'S URBAN WSS RESILIENT?



Resilience relates to the ability of the system to absorb disturbances while retaining the same ways of functioning

Resilience characteristics of DCWD WSS:

1. Functional redundancy
2. Flexibility
3. Responsiveness



DCWD's responsiveness to flood emergencies was best demonstrated in 2012

- ✓ Vulnerability of pipelines and service lines are addressed by DCWD's conformance with materials standards
- ✓ As a reactive measure, affected water lines can be isolated through valve management



How resilient are the organizations (region, city, barangay) to disasters in terms of management of Urban Water System (UWS)?

Sadly, Disaster Risk Reduction Management Plans are focused on peoples' safety ...

without regard to UWS management,

and with the agencies' involvement anchored on their respective institutional mandates.



CONCLUSIONS AND RECOMMENDATIONS



There are 4 areas that need intervention

First. Disaster Risk Reduction and Management Plans must address needs related to management of urban water systems

Second. Regular maintenance of all DCWD pipelines and timely rehabilitation or replacement of ageing pipelines

Third. Environmental sanitation must be improved

Fourth. Environmental preparedness needs to be increased





At the heart of planning and implementation strategies to enhance resilience of communities and urban water systems to disasters are people.

We envision resilient communities even in very highly vulnerable flood-prone areas, where people are assured of water supply system to support domestic and commercial consumption for population wellness and economic development.



HELP Davao Network

Partners:

UNESCO

Department of Science and Technology XI

Department of Environment and Natural Resources XI

Davao City Government

Davao City Water District

University of the Philippines – Mindanao

University of Immaculate Conception

Ateneo de Davao University

Southern Philippines Agri-Business and Marine and Aquatic School
of Technology

Mindanao Development Authority

Davao River Initiatives

