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AN ASSESSMENT OF WATER SECURITY, DEVELOPMENT, AND CLIMATE CHANGE IN ILOILO, PHILIPPINES AND THE TIGUM-AGANAN WATERSHED

FEBRUARY 2013

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Cover Photo: Family harvesting bamboo in Philippines: Jason Vogel, Stratus Consulting Inc.

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TABLE OF CONTENTS

ACRONYMS

ARG	**Automated rain gauges**
AWIS	**Annotated Water Integrity Scan**
CBOs	**Community-based organizations**
CDI	**USAID/Philippines City Development Initiative**
CIMS	**Chesapeake Information Management System**
CLTS	**Community-led total sanitation**
CLUPs	**Comprehensive Land Use Plans**
DENR	**Department of Environment and Natural Resources**
DPWH	**Department of Public Works and Highways**
E3	**USAID Bureau for Economic Growth, Education, and the Environment**
ENSO	**El Niño Southern Oscillation**
GCC	**Global Climate Change**
GIS	**Geographic Information System**
HEC-RAS	**U.S. Army Corps of Engineers Hydrologic Engineering Center River Analysis System**
IBWQMA	**Iloilo-Batiano Water Quality Management Area**
INECE	**International Network for Environmental Compliance and Enforcement**
IPCC	**Intergovernmental Panel on Climate Change**
IRC	**International Water and Sanitation Centre**
IRDC	**Iloilo River Development Council**
IRRs	**Implementing rules and regulations**
IT	**Information technology**
JICA	**Japan International Cooperation Agency**
LFEWS	**Local Flood Early Warning Systems**
LGUs	**Local Government Units**
LINAW	**Local Initiative for Affordable Wastewater Treatment Program**
lps	**Liters per second**
LWUA	**Local Water Utilities Administration**

MGB	**Mines and Geoscience Bureau**
MIWD	**Metro Iloilo Water District**
NEDA	**National Economic and Development Authority**
NGOs	**Nongovernmental organizations**
NIA	**National Irrigation Association**
NRW	**Non-revenue water**
NWRB	**National Water Resources Board**
NWRMO	**National Water Resources Management Office**
OECD	**Organization for Economic Cooperation and Development**
PAGASA	**Philippine Atmospheric, Geophysical and Astronomical Services Administration**
PFG	**Partnership for Growth**
PPIAF	**World Bank's Public-Private Infrastructure Advisory Facility**
PPPs	**Public-private partnerships**
PREDICT	**Philippine Real-time Data Acquisition and Interpretation for Climate Related Tragedy Prevention and Mitigation**
PSA	**Philippine Sanitation Alliance**
QA	**Quality assurance**
QC	**Quality control**
TAP	**Transparency, Accountability and Participation**
TAW	**Tigum-Aganan Watershed**
TAWMB	**Tigum-Aganan Watershed Management Board**
TAWQMA	**Tigum-Aganan Water Quality Management Area**
TI	**Transparency International**
USAID	**U.S. Agency for International Development**
USGS	**United States Geological Survey**
WASH	**Water, sanitation and hygiene**
WDM	**Water demand management**
WIN	**Water Integrity Network**
WQMAs	**Water Quality Management Areas**
WWT	**Wastewater treatment**

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1. INTRODUCTION

1.1 BACKGROUND

In 2013, the U.S. Agency for International Development (USAID) expects to release guidance on a climate resilient development framework (USAID, 2013a) as well as an annex to that framework specific to climate change and water (USAID, 2013b). This case study is the first to use the concepts in these guidance documents for an on-the-ground assessment of water security. The USAID Bureau for Economic Growth, Education, and the Environment (E3) Office of Global Climate Change (GCC) worked with the USAID Philippines Mission to select the City of Iloilo and the surrounding Tigum-Aganan Watershed (TAW) as the focus of this water security assessment (see Figure 1 for location). Iloilo was selected because the TAW faces significant climate vulnerabilities, and the City of Iloilo is one of three cities participating in the USAID/Philippines City Development Initiative (CDI), which is part of the Partnership for Growth (PFG) initiative.

Figure 1. Map of Panay Island. Provinces are outlined in red island-wide, and municipalities are outlined in grey in Iloilo Province only. Iloilo City is colored deep red and the Metro Iloilo area (municipalities in the TAW and the Iloilo watershed) is shaded grey.

1.2 CASE STUDY OBJECTIVES

The objectives of this field work were to: (1) identify current and future water security and climate risks to Iloilo's economic growth; (2) engage local partners in the assessment, laying the foundation to build capacity and ownership; and (3) identify and analyze a set of options for addressing these risks. An additional objective of this case study was to pilot USAID's climate resilient development framework and the water sector annex (2013a, 2013b) in order to provide feedback on those documents and their approaches.

As part of this assessment, the technical team approached water security using a development and climate change perspective. While many of the issues faced by Iloilo involve basic development challenges, climate variability is already having major impacts on water security and climate change will

most likely have important implications for the long-term sustainability of development projects designed to ensure greater water security. The study considers these issues together.

1.3 ASSESSMENT METHODOLOGY

Field work was conducted between July 9 and July 19, 2012 by a technical team consisting of four technical experts and two USAID representatives. The technical experts included a water resources engineer, a water governance lawyer, and two climate change adaptation and policy specialists. One USAID representative came from the Philippines Mission and the other from the Washington, DC E3/GCC. The technical team read available literature on the region before the assignment; gathered climate, socioeconomic, and other relevant data from knowledgeable sources both within and outside the Philippines; consulted with stakeholders at the national, regional, provincial, municipal, barangay, and household levels; and conducted site visits to water infrastructure projects, reforestation projects, private and government housing developments, and commercial developments. This report is a summary of the research team's assessment of Iloilo water security issues followed by a number of adaptation options identified by the research team in consultation with stakeholders that merit consideration for near-term implementation.

Box 1. What is water security?

USAID is committed to "creating a water secure world in which every society enjoys access to an acceptable quantity and quality of water to meet human, livelihood, production, and ecosystem needs" (http://transition.usaid.gov/our_work/cross-cutting_programs/water/). This report includes flooding risk as an additional aspect of water security.

1.4 ROADMAP

The remainder of this case study report will provide a synthesis of the issues identified in the field. Section 2 addresses the Iloilo context to provide background for the reader. Section 3 defines both current non-climate and climate stressors on Iloilo water resources, as well as the anticipated impacts of climate change on the water sector. Section 4 focuses on water governance issues, which play a particularly important role in water security in the Philippines, Metro Iloilo, and the TAW. Section 5 lays out some principles of adaptation specific to the metro Iloilo area. And finally, Section 6 presents 22 specific actions proposed by the research team to improve water security in Metro Iloilo.

2. THE ILOILO CONTEXT

Iloilo City is the highly urbanized capital of Iloilo Province in the Western Visayas region, on the southeast portion of Panay Island (see Figure 2). A coastal city, it lies on a relatively flat alluvial plain, with a total coastline length of 21.3 km and a total land area of 78.34 square kilometers. Ninety percent of the city's land mass has an elevation of 2.637 meters above mean sea level. There are four bodies of water traversing the city: the Iloilo, Batiano, and Jaro Rivers and Dungon Creek. Iloilo River is an estuary while Jaro River is fed by its tributary rivers, Aganan and Tigum (Iloilo City Socio-Economic Profile, 2004).

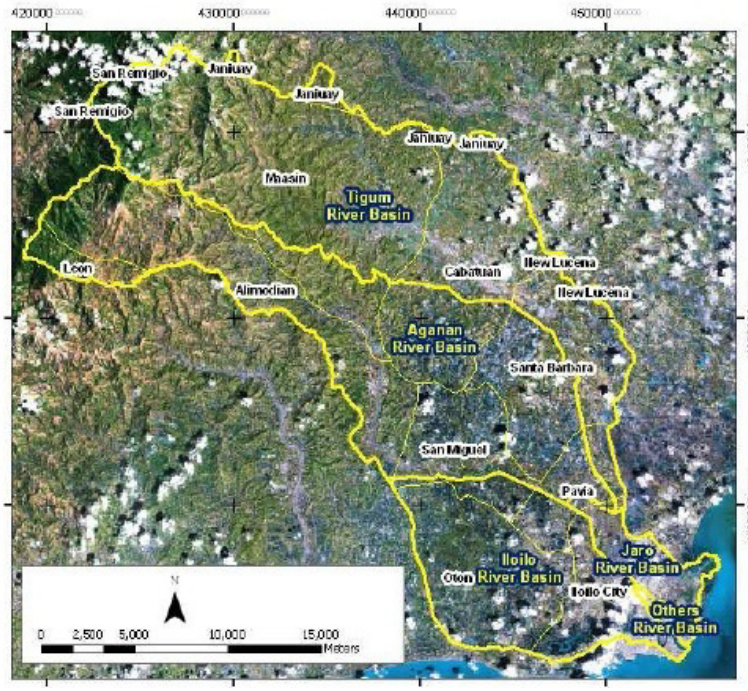

Figure 2. Depiction of the Tigum, Aganan, Jaro, and Iloilo River Basins overlayed on municipalities. Note that the Tigum and Aganan Rivers flow together to form the Jaro River.

Iloilo City is an independent city chartered under the national government, so the provincial government of Iloilo has no authority over the city. Nevertheless, similar water security issues affect both Iloilo City and Iloilo Province, which has prompted coordinated efforts in past years across the city, neighboring municipalities (also known as Local Government Units; LGUs), and the provincial government.

According to the 2007 national census, Iloilo Province had 2,110,588 residents, of which 418,710 (19.8%) lived in Iloilo City. In this report, we will refer to Iloilo City and the surrounding municipalities (Alimodian, Cabatuan, Maasin, Oton, Pavia, San Miguel, and Santa Barbara), which lie within the TAW and Iloilo watersheds, as the Metro Iloilo area.[1] The Metro Iloilo area has 707,771 residents, or 33.5% of the provincial population.

The Tigum-Aganan Watershed's natural topography ranges from mountains to flood and coastal plains, covering a total area of 434 square kilometers. Land use is generally described as mountain environment or upland forest for the municipalities of Maasin, Alimodian, and Leon; lowland area for Cabatuan, Santa Barbara, San Miguel, Pavia, and Oton; and coastal/sea environment for Iloilo City and Oton (Salas, Tigum Aganan Watershed Case Study, No year). Its two major rivers are the Tigum and Aganan Rivers, which combine as the Jaro River before draining into the ocean. The Tigum River is the primary source

[1] Note that the TAW also includes small sections of the municipalities of Janiuay, Leon, and New Lucena. These municipalities are not included in the "Metro Iloilo" area illustrated in Figure 2 because the majority of each of these municipalities lies outside the hydrologic boundary of the TAW.

for 73% of the total water supplied by the Metro Iloilo Water District (MIWD) to its franchise area; while the Aganan River is the major source of irrigation water supplied by the National Irrigation Administration to farmers in the TAW.

This water security assessment initially focused on the TAW (also known as the Jaro watershed) because of its importance to Iloilo City and Iloilo Province (see Figure 3). In the course of research for this case study, it became clear that the TAW cannot be considered alone, but must be considered in the context of both the Iloilo River watershed and the Jalaur River watershed (see Figures 2 and 3). The Iloilo River watershed covers much of Iloilo City and the neighboring municipalities of Oton and Pavia, and consequently has major relevance for water security in terms of flooding and groundwater, even though surface water from the Iloilo River is not a significant source of water supply. Furthermore, a major dam project is planned for the Jalaur River, with planned inter-basin transfers to the TAW, where some of this surface water is expected to supply the Metro Iloilo area. Consequently, this report maintains a focus on the TAW, but also pulls in details about the Iloilo and Jalaur watersheds as necessary.

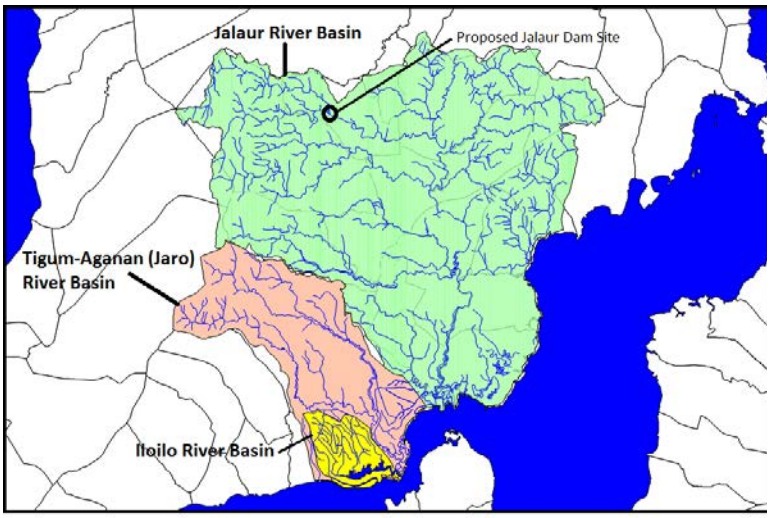

Figure 3. Depiction of the Tigum-Aganan (Jaro), Iloilo, and Jalaur River Basins. The Jalaur River Basin, located to the north and east of the TAW is largely relevant to the current assessment because of a planned dam and inter-basin water transfers that would add water to the MIWD system via the TAW.

2.1 DEVELOPMENT OBJECTIVES AND THE ECONOMY

Municipal, provincial, and regional stakeholders expressed a consistent set of development objectives for the Metro Iloilo area, including promoting tourism, spurring commercial development, and expanding local agriculture (e.g., IBC, 2004; Vice Mayor Jose S. Espinosa III, personal communication, July 12, 2012). These objectives permeated many other local initiatives. For example, the First Philippine International River Summit, held on May 30 through June 1, 2012, proposed a set of actions consistent with these overall development objectives, including prioritizing water resources and river restoration projects under public-private partnerships (PPPs) and developing rivers as eco-tourism and biodiversity sites (Highlights Summit Report, 2012). The Cities Development Initiative objectives of USAID Philippines are consistent with these identified objectives as well.[2]

Initial efforts are under way to promote Iloilo as a tourism and retirement destination. A waterfront walkway has been partially developed along the Iloilo River in downtown Iloilo City, with plans to expand that waterfront. The Iloilo and Guimaras[3] wharves are slated for upgrades and redevelopment to make them more tourist-friendly, and local tourism businesses have worked through the Iloilo Tourism

[2] See http://philippines.usaid.gov/content/partnership-growth-cities-development-initiative.

[3] Guimaras is a neighboring municipality and small island just a few kilometers offshore from downtown Iloilo. Boat ferries take people back and forth from the two destinations regularly.

Council to develop a training and licensing program to enhance historical and cultural knowledge among tourism industry workers (Melanie Ortega, Iloilo Tourism Council, personal communication, July 17, 2012). The first direct international flights from Hong Kong and Singapore to the Iloilo airport were slated to begin in fall 2012,[4] providing easy transportation routes to Iloilo for countries such as China with a growing middle class and increasing interest in tourism. The Metro Iloilo-Guimaras Economic Development Council[5] was recently awarded PHP 10 million grant from the Local Government Support Program to promote sustainable, development-oriented tourism programs. Plans also exist to promote Iloilo as a retirement community, and initial development to support this objective has already begun (Vice Mayor Jose S. Espinosa III, personal communication, July 12, 2012).

Iloilo City as seen approaching the wharf from Guimaras.

Commercial economic activity appears to be expanding in Iloilo as well, as evidenced by the recently opened SM Mall. Work has also begun redeveloping the old Iloilo airport into the Iloilo Business Park.[6] The Iloilo Business Park is in initial construction stages, despite some concern expressed by the investors over both reliability and cost of water and electricity supplies. The business park is expected to cost some PHP 18 billion, to create 200,000 square meters of commercial space, and to support around 35,000 jobs.

Furthermore, expanding agricultural production is a key objective of the recently approved Jalaur dam project.[7] Although some of this water is meant to provide potable water for the Metro Iloilo area, the majority of water will be used to irrigate some 31,840 hectares of currently rain fed agricultural land or fallow land (Jalaur River Multi-purpose Project Stage II, 2011). Although this land is currently envisioned as a rice agriculture area to provide food security locally, a number of stakeholders understood that expanding agriculture to grow higher value crops was an important aspect of improving the local economy.

In summary, significant political will and private and government investment has led to initial progress on tourism, commercial development, and agricultural productivity objectives. Almost all stakeholders interviewed identified inadequate water supply and high energy costs as the two greatest constraints on progress toward the priority development objectives of Metro Iloilo and the rural areas of the TAW. The consensus among the vast majority of community members was that inadequate water supply is the number one constraint and priority (e.g., Vice Mayor Jose S. Espinosa III, personal communication, July 12, 2012; Juan Jose H. Jamora III, Iloilo Business Club, personal communication, July 16, 2012; Melanie Ortega, Iloilo Tourism Council, personal communication, July 17, 2012).

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[4] Although the research team was told that these flights were to begin in Fall 2012, as of February 2013, it does not appear that such flights have started.

[5] The Council was formed in August 2006 by presidential executive order, but it was an evolution of the Metro Iloilo Development Council (established February 2001) and the Guimaras-Iloilo City Alliance (established May 2005).

[6] See http://www.exploreiloilo.com/megaworlds-iloilo-business-park-project-overview.

[7] See http://www.pia.gov.ph/news/index.php?article=931345532874.

2.2 ILOILO CLIMATE

The Philippines has a tropical, humid, maritime climate that experiences monsoonal rain patterns. It is characterized by relatively high temperature, high humidity, and abundant rainfall. Latitude is an insignificant factor in the variation of temperature across the Philippines, so national temperature data provides good insight into the characteristics of Iloilo. Mean annual average temperature for the Philippines is 26.6°C. The coolest month is January at 25.5°C and the warmest is May at 28.3°C. Due to these high temperatures and the maritime environment, the Philippines has a high relative humidity ranging from 71% in March and 85% in September.[8]

The climate of Iloilo Province is relatively dry from December to June and relatively wet from July to November. There is, however, no distinct wet and dry season in the Iloilo-Capiz border – along the Madia-as mountain range. Annual average rainfall is a little over two meters (PPDO, 2011). Typhoons are perhaps the most significant aspect of climate in the Philippines and Iloilo Province. A significant portion of annual rainfall each year is related to typhoons which originate in the region of the Marianas and Caroline Islands of the Pacific Ocean and follow a northwesterly direction, generally passing north of Mindanao and striking the Visayas and Luzon, including Panay Island and Iloilo Province. As discussed below in Section 3, typhoons have caused very destructive flooding. Other climate impacts such as drought are also significant problems for the region. Climate change, also discussed in Section 3, is projected to increase temperatures, intense precipitation events, and introduce new challenges such as sea level rise.

2.3 MANAGEMENT OF WATER RESOURCES IN METRO ILOILO

The Metro Iloilo area already faces significant exposure and vulnerability to water – too much water (i.e., flooding), too little water (i.e., droughts), and degraded water (i.e., low water quality). These vulnerabilities can be affected by climate variability and are expected to be made worse by climate change. Each of these issues is described in more detail in the sections below.

2.3.1 TOO LITTLE WATER IN METRO ILOILO

Despite significant rainfall, potable water is scarce in Metro Iloilo because of inadequate infrastructure, surface water contamination, and under exploitation of available water resources. The Metro Iloilo Water District [9] supplies water to only 20–40% of the population (SWECO, 1997; Engineer Le Jayme Jalbuena, General Manager MIWD, personal communication, July 14, 2012; Hechanova, 2009).[10] To compensate for this low coverage, nearly all residents rely on shallow wells[11] dug on their individual property or shared wells dug at their housing development. While these shallow wells have been a reliable supply of water in the past, this water was reported by local residents and government officials to be low quality in

[8] See http://kidlat.pagasa.dost.gov.ph/cab/climate.htm.

[9] The Metro Iloilo Water District was organized by the government in 1978 and is the official purveyor of water in Iloilo City and seven surrounding municipalities. For a sense of scale, MIWD employed 217 personnel in 2008. They control a reservoir, dam, filtration, and water treatment facilities in Maasin and Santa Barbara municipalities; 10 deep wells in Pavia, Oton, and San Miguel; over 200 km of transmission pipes from Maasin to Santa Barbara; and over 250 km of distribution pipes in their service areas. 73% of MIWD water volume comes from the Tigum River and 27% from wells. The population of the franchise area, including 8 municipalities and Iloilo City, was 721,258 in 2008, with 31,000 connections (Hechanova, 2009).

[10] It is unclear how this figure is measured, but it appears from multiple interviews that most of the people served by MIWD are only served for a few hours each day, and many are technically served but do not receive water at all. Other service problems diagnosed by the World Bank include low water pressure, low water quality, and intermittent supply (Castalia Strategic Advisors, 2009).

[11] These wells were reported and observed to be in the range of 10–20 feet deep.

many areas, especially due to contamination from improper disposal of human and livestock wastewater and to some extent salinization. These shallow wells have been abandoned where water quality has been most severely compromised, although most remain in active use despite poor water quality. Even where the water remains usable, it is typically used only for non-potable purposes such as washing.

Bulk water providers are a second source of water supply. Bulk providers typically are private operations that apply for a permit and then dig one or more deep wells[12] in the Metro Iloilo area and then sell that water, at a higher cost than MIWD rates, especially to hotels, hospitals, commercial operations such as the local malls, and other large facilities. These bulk water supply operators pump water out of the deep wells into cisterns, fill up trucks that carry 10–20 tons (or 10k–20k liters), and then pump that water into storage tanks at private facilities.

A small rainwater harvesting system on a housing development community shelter.

The research team observed a modest amount of rainwater harvesting in the Metro Iloilo area, especially at government-sponsored housing developments, on private homes, and some pilot projects at local schools (see picture). However, the scale of these projects is generally small, the storage tanks are often inadequate to provide a reliable supply, and the captured water is untreated. Many people interviewed expressed concern about contamination from animals living on rooftops, and many large roofs and other appropriate surfaces are not being used to capture rainwater.

In addition to the domestic use discussed above, a large amount of water is used for irrigation in the Metro Iloilo area, particularly in the rural areas in the TAW. Water shortages are a significant issue for irrigation as well. It was reported that in the Aganan River Irrigators Association,[13] only 50% of the service area receives water during the second cropping season. In order to address water shortages, the irrigation association has had to prevent third cropping season planting in upstream areas to ensure that downstream irrigation association members have enough water for their first cropping season. Water is generally not provided for irrigation during the summer (dry season) months of March, April, and May, when insufficient rainfall prevents adequate water deliveries for irrigation. There are no water storage reservoirs along the Tigum or Aganan Rivers.

[12] These wells were reported to be in the range of 120 feet deep.

[13] Irrigation water in TAW is controlled by three entities – the National Irrigation Association (NIA), the Federation of Irrigators Associations (the Federation), and individual irrigation associations (12 in the TAW), such as the Aganan River Irrigators Association. These entities together control the allocation and distribution of water, determine the cropping calendar, maintain irrigation canals, provide training and capacity building for Irrigation Association members, and have even begun looking into more entrepreneurial activities such as microfinancing, provision of post-harvest facilities, plowing services, storage facilities, etc.

2.3.2 DEGRADED WATER IN METRO ILOILO

Water quality is a major concern in Metro Iloilo. MIWD water is treated at a modern, centralized water treatment facility prior to distribution to MIWD customers – the water is desilted, processed, and chlorinated prior to distribution.[14] Nevertheless, many interviewees complained that MIWD water that comes out of the tap is either clearly dirty in color or has an unpleasant smell. Consequently, the entire community – even MIWD customers – largely relies on bottled water for drinking.[15] The cost of bottled water is significant and is paid by virtually the entire community, even the very poor.[16] MIWD water, bulk water, and well water are all used primarily for washing, for sanitation, and for other non-potable uses due to water quality concerns. Even bulk water supplied to commercial outfits is generally used only for non-potable purposes, or it is treated on site prior to use for potable purposes.

Co-location of washing station and shallow well.

Surface source water suffers from significant siltation problems, primarily due to the massive deforestation of the upper part of the TAW and urbanization in the lower reaches. Some progress has been made in recent years to reforest the watershed, particularly at the Maasin Forest Reserve and through a National Greening Program, in which Metro Iloilo LGUs have community tree planting days. Local foresters, however, suggested that residents in the highlands routinely cut down trees to create charcoal for sustenance cooking fires, preventing significant progress on reforestation. Regardless, siltation remains a significant problem for MIWD and irrigators in the TAW.

Groundwater wells, particularly shallow wells, are reportedly suffering from salinization due to saltwater intrusion in the near-ocean areas of Metro Iloilo. Many interviewees expressed concern that this problem had become much worse over the course of their lifetimes. These wells are also often co-located with sanitation facilities and washing stations, which is likely to cause contamination in shallow wells (see picture). Bulk water providers using deep wells and rainwater harvesting systems do not appear to have significant water quality issues. However, the water is not treated, and local residents reported that this water is generally considered unfit for consumptive use. Note that while depletion of aquifers may be the most important cause of saltwater intrusion, sea level rise is likely also contributing to this situation.

There is very little wastewater treatment in metro Iloilo. It was reported that most hotels, hospitals, commercial buildings, and government buildings process wastewater on site. However, most residential development relies on septic systems, which were reported to be poorly designed, neglected, and largely unmaintained. This may contribute to the low water quality in the shallow wells dug by residents on their individual property or at shared housing development wells. Site visits confirmed the co-location of

[14] This water treatment facility was constructed in 2000 as part of a loan package from the Asian Development Bank and has a supply capacity of 37,000 cubic meters per day.

[15] Extensive use of bottled water is prevalent in other areas in the Philippines such as metro Manila.

[16] For example, one Iloilo City resident shared that they pay an average of PHP 600/mo for bottled water for their family. For the 45% of Western Visayan families that live on less than PHP 100,000/yr this translates into a minimum of 7.2% of annual family income.

shallow wells and sanitation or washing facilities. According to the Iloilo River Development Master Plan, the condition of Iloilo River is deteriorating due to domestic and industrial effluents and siltation (IBC, 2004). There is currently no plan for developing a sewerage system in Iloilo.

2.3.3 TOO MUCH WATER IN METRO ILOILO

Metro Iloilo has high exposure and sensitivity to flooding because it is located on a flat alluvial plain below the Madia-as mountain range. Three major rivers – the Iloilo, Tigum, and Aganan – drain through Metro Iloilo, which (at least in the lowland and coastal areas) was largely built on filled marshlands. This creates a situation of extremely high exposure to floods, especially from large rainfall events and typhoons. Upland areas of the TAW have suffered from landslides due to heavy precipitation events in conjunction with poor land use practices, such as widespread deforestation.

JICA funded Phase I flood control project.

Typhoon Frank is the most severe recent example of flooding in Iloilo. Heavy rainfall from the typhoon brought an estimated 195–234M m^3 of runoff water through Iloilo City on June 16–23, 2008. In the Maasin Watershed alone, 2.2 million m^3 of soil was eroded in landslides that still cause siltation problems, and some 70,760 trees were uprooted and washed downstream. This caused significant damage to infrastructure, agricultural production, and businesses, with costs estimated at PHP 1.3 billion (US$28 million; Mabilog, 2010).

Flood risk has been partially addressed through the Iloilo Flood Control Project funded by the Japan International Cooperation Agency (JICA; see picture). The completed Phase 1 of this project included floodway improvements to the Tigum, Aganan, and Jaro Rivers and construction of the Jaro Floodway to divert floodwaters prior to them reaching Iloilo City. Future improvements to the Jaro River and Dungon Creek are planned for Phase 2 of this project, which has not yet been funded (see Figure 4). Reforestation initiatives have the potential to address upland landslides, but it is not clear how effective reforestation has been outside of the Maasin Forest Reserve.

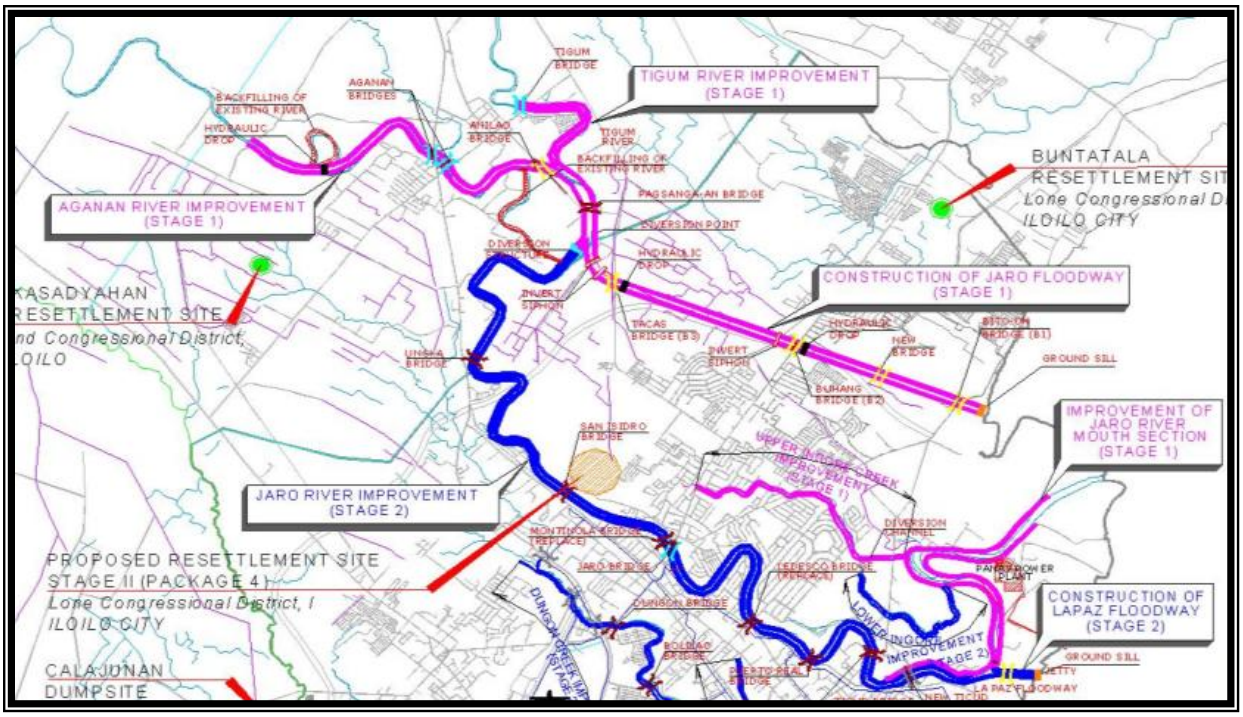

Figure 4. Diagram of the Iloilo Flood Control Project.

3. STRESSES ON WATER SECURITY

Metro Iloilo and the TAW suffer from a number of stresses that affect water security. Several major stressors are identified below and discussed in more detail. Following the organization of *Climate Change and Water: An Annex to the USAID Climate Resilient Development Framework* (USAID, 2013b), we discuss climate and non-climate stressors separately below.

3.1 NON-CLIMATE STRESSORS

Low service levels for municipal water supply. Metro Iloilo has an abundance of water, but very low service levels for residential, commercial, or industrial use (e.g., Yap, 2011). It was reported that a common problem among water districts is the dual challenge of shrinking supplies and increasing demand. Most water districts rely on wells, which were reported to be down approximately 40% in water yield (Engineer Remus P. Braganza, General Manager Dumangas-Barotac Nuevo Water District, personal communication, July 17, 2012). The evidence for inadequate water supplies is extensive, including the widespread use of shallow wells for residential water; the need for hotels, hospitals, malls, and other large facilities to contract with private bulk water providers to ensure an adequate supply; and MIWD's reported coverage of between 20% and 40% of the population in the MIWD service area. While the planned Jalaur Dam project is expected to provide additional water supply for MIWD (up to 31.5 million cubic meters per year), there is not a clear plan for treatment or transmission of this water.

Low service levels for agricultural water supply. Despite ample rainfall and streamflow, insufficient water is made available for productive agricultural use. Irrigation Associations are forced to implement spatial and temporal restrictions on providing irrigation water to active agriculture operations. Of the many Irrigation Associations in the TAW, several reported restricting water use and agricultural productivity to ensure downstream users some water supply. Water is also generally not provided during the dry season months of March, April, and May, when natural flows are not sufficient to support agriculture.

Poor distribution infrastructure. MIWD water is treated at a modern water treatment facility constructed in 2000, and water leaving the treatment facility meets international standards for quality according to both onsite and contracted quality assurance (QA)/quality control (QC) laboratories. However, the water that comes out of household and commercial taps is reported as muddy-colored and not safe for potable use, suggesting problems in the reticulation system and/or storage tanks. MIWD reports that some 38% of water is reported as non-revenue (Engineer Le Jayme Jalbuena, General Manager MIWD, personal communication, July 17, 2012; Castalia Strategic Advisors, 2009). These facts imply

MIWD distribution system in a wealthy Iloilo City neighborhood.

significant problems with MIWD's distribution infrastructure. Although MIWD spent PHP 887 million (US$19.1 million) from 1987 to 2008 to improve facilities, construct additional pipelines, and rehabilitate some wells, the World Bank indicated that this level of investment was insufficient to improve services to a satisfactory level (Castalia Strategic Advisors, 2009).

Inadequate tariffs to support infrastructure investments. MIWD's current water tariff is insufficient to support existing services, reduce non-revenue water, or fund improvements to the water system according to the World Bank (Castalia Strategic Advisors, 2009). According to MIWD General Manager Jalbuena, the current MIWD tariff is PHP 15.90/m^3, compared to a Panay island-wide average tariff of approximately PHP 25/m^3 (Engineer Le Jayme Jalbuena, General Manager MIWD, personal communication, July 17, 2012). Although there appears to be a desire by MIWD management to increase the tariff to fund service improvements, all tariff increases must be approved by the Local Water Utilities Administration (LWUA), a national government agency, and it was reported that such increases are politically unpopular. MIWD has received no response back from LWUA about its request for a tariff increase.

No sewerage system. There is no sewerage system in the Metro Iloilo area. It was reported that individual households often use septic systems. Hotels, hospitals, and large commercial establishments often have onsite wastewater treatment facilities and even reuse some of that water. But large populations of "informal settlers" that have taken up residence on undeveloped land in the Metro Iloilo area, often close to the river, dispose of their wastes directly into the river. The Iloilo River receives untreated sewage from 120 of 180 barangays in Iloilo City and 50 additional barangays outside the city limits. There are currently no plans to provide a sewerage system, and existing septic systems were reported to be poorly maintained.

Inadequate information and/or information distribution regarding water resources. People involved in local government decisions about water resources cited a poor understanding of the watershed and water resources in the area as a major impediment to informed decision-making. Iloilo has received five automated rain gauges (ARG) and a number of automated water level sensors as part of its weather and flood monitoring programs.[17] It is our understanding that there are two water level monitoring sensors currently in operation. One is located at the Imelda Bridge, Cabatuan, Iloilo and the other is on the Jaro Bridge, Pavia, Iloilo.

However, reports such as the SWECO (1997) and Castalia (2009) have extensively studied local water resources. This points to another aspect of this problem – namely, the failure to manage data in a way that makes it available to local water resources decision-makers.

Poor water governance. Water is subjected to a highly fragmented system of authority and control. National, regional, and local entities all play a role in water governance, but in many circumstances it appeared that local level control of the resource was hindered by conflicting authorities and mandates at the national level, lack of enforcement capability, local and national level politics, and opaque decision-making processes. In most cases, critical stakeholders at the watershed level, including a variety of councils and boards appointed by local government officials to address specific issues, such as regional development or watershed-level planning councils, face the challenges of effective coordination and limited ability to affect decisions made about water. See Section 4 below for a more detailed description of water governance issues in Iloilo.

High population growth and migration. In Iloilo Province (Iloilo City excluded) 44.5% of the population is 19 years of age or younger and there is a 1.13% population growth rate between 2000–

[17] http://loqal.ph/nation-and-world/2012/02/16/iloilo-gets-hi-tech-flood-monitoring-equipment-2/.

2007 (PPDO, 2011). Iloilo City experienced a growth rate of 1.86% over that same period (NSO, 2007) likely due to in-migration from neighboring municipalities in the province. High population growth will put added pressure on an already inadequate water supply system by increasing the number of people who should be served by the water resource system, and put a greater number of people at risk of floods over time.

High unemployment and poverty. In Iloilo Province (Iloilo City excluded) 26.8% of the population is in poverty (19.9% of families).[18] Unemployment rates for the age group 15 years and older available for the Western Visayas indicate approximately 6–10% unemployment depending on the season, although labor force participation rates hover around 64%, indicating a significant population not participating in the labor force (PPDO, 2011). According to the National Statistics Office, some 45% of families earn income under PHP 99,999 (US$2,153) per year and 85% of families earn income under PHP 249,999 (US$5,385) in the Western Visayas (Region VI). This lack of economic resources contributes to a system whereby water supply and treatment strategies are underfunded, and adaptation capacity is generally low due to resource constraints.

3.2 CLIMATE STRESSORS

Warming temperatures. Observations across the Philippines indicate that minimum night time temperatures have increased by 1.0°C and maximum daytime temperatures have increased by 0.36°C over the last 60 years (1951–2009). An analysis of extreme daily temperatures indicates an increase in the number of hot days and a decrease in the number of cool nights. PAGASA projects that average temperatures in Iloilo will rise just over 1°C by about 2025 and about 2 to 2.5°C by 2050. Continued warming can have significant effects on water supply as evapotranspiration will increase significantly. Warmer temperatures also lead to increased water demands for crops and domestic use. Warmer air temperatures also lead to warmer water temperatures, which can reduce water quality by lowering dissolved oxygen content, increasing algal blooms, and other impacts that can harm freshwater fisheries as well as making water treatment more expensive.

Drought and increased dry season. Water security is affected by the dry season in March, April, and May, when agricultural and residential water deliveries are often restricted. By increasing temperatures, climate change can make that period drier which can reduce soil moisture and water supplies in that critical season and increase water demand for crops and domestic uses (PAGASA, 2011). A potential lengthening of the dry season would exacerbate these impacts. Low stream flow can have adverse consequences for water quality and environmental flows that support freshwater fisheries. ENSO also has significant impacts on water security on the Iloilo area. It was reported that during the 2010 El Niño event, the Iloilo area went eight months without rain, with severe consequences for the ability of water districts to provide water (Engineer Remus P. Braganza, personal communication, July 17, 2012). According to the World Bank, MIWD operations during a severe El Niño were reduced to covering only approximately 5% of the population in the service area (Castalia, 2009).

Precipitation changes. There is too much variability to identify any statistically significant trends in precipitation in the historic record in the region (PAGASA, 2011). To be sure, the effects of climate change on precipitation are complex, but the summer months (March to May) are projected to become drier and the rest of the year is projected to have somewhat wetter, but mixed results (PAGASA, 2011). Precipitation intensity is also projected to generally increase (Tebaldi et al., 2006) with one rough rule of thumb being that intense precipitation could increase 7% for each 1°C increase in temperature (Trenberth et al., 2003). More intense precipitation will increase flows during floods, thus increasing the risk of flood damage. The climate models project rainfall increases in the monsoon months of June, July,

[18] The annual per capita poverty threshold is PHP 16,584 (US$357).

and August as well as the September, October, and November season (PAGASA, 2011). More intense rainstorms, particularly very extreme storms, will result in larger amounts of precipitation falling in short timespans. Nevertheless, typhoons are anticipated to have higher winds and more precipitation. In addition, sea level rise will most likely cause storm surges from typhoons to be higher and thereby inundate a larger area. In the past three years, the Philippines have notably experienced weather events with record-breaking rainfall that caused massive flooding, claimed thousands of lives, and caused billions of pesos in damages. This includes Tropical Storm Ondoy (international name "Ketsana") in September 2009, Tropical Storm Sendong ("Washi") in December 2011, and an eight-day period of intense rains during the August 2012 monsoon season.

Typhoons. Typhoons are quite common in the Iloilo area and cause extensive flooding and subsequent risks to water security. Typhoons cause most of their damage from intense rainfall that concentrates in runoff in the Tigum, Aganan, and Iloilo Rivers, all of which pass through Metro Iloilo and Iloilo City. One likely outcome of climate change is that typhoons will become more intense. There is too much variability, however, to identify any statistically significant trends in tropical cyclone occurrence or intensity in the historic record (PAGASA, 2011). Anecdotally, Typhoon Frank, in 2008, destroyed the main water pipeline from Maasin to Metro Iloilo. According to the Castalia report (2009), before Frank, MIWD supplied 450 liters per second (lps) to 26% of the district's service area population, and the water quality was compliant. After Frank, MIWD supplied 146 lps to 5% of the district's service area population, and the water quality was not compliant (Hechanova, 2009). This water shortage lasted for several months. Water quality, public health, and all aspects of water security were affected by Typhoon Frank. In its trends analysis of tropical cyclone occurrence within the Philippine Area of Responsibility, PAGASA observed that there is a "very slight increase in the number of tropical cyclones with maximum sustained winds of greater than 150kph and above" during El Niño Southern Oscillation (ENSO) periods (DOST-PAGASA, 2011). PAGASA also noted a slight increase of tropical cyclone crossing over the Visayas from 1971–2000 compared with the 1951–1980 and 1960–1990 periods.

Sea level rise. Sea level has already risen by 0.2 meters over the last century and that rise is projected to accelerate substantially (Solomon et al., 2007). The Intergovernmental Panel on Climate Change (IPCC) projected that sea level rise will be roughly 0.2 to 0.6 meters by 2100 (Solomon et al., 2007). However the IPCC study did not fully account for the potential of rapid melting of major ice sheets such as Greenland and Antarctica (Oppenheimer et al., 2007). A recently released study by the U.S. National Academy of Sciences estimates that on average, global sea levels will increase by about 20 to 50 cm by 2050 and 50 to 140 cm by 2100 over 1990 levels (NRC, 2012). Sea level rise will increase the salinity of groundwater and could inundate low-lying facilities or put them at greater risk of inundation from storm surges.

4. WATER GOVERNANCE

One of the most critical issues facing the Philippine water sector is the lack of an integrated and coordinated governance framework. Currently, more than 20 government policies and legal instruments grant authority over some aspect of water management to more than 30 institutions at the federal, regional, and local levels (Salas, 2011). This regulatory fragmentation was cited by both national and local stakeholders as a key impediment to achieving water security in Metro Iloilo and the TAW. The status quo of water governance in Iloilo can be characterized as a large number of institutional actors with overlapping and sometimes unclear mandates and authorities (see Figure 5).

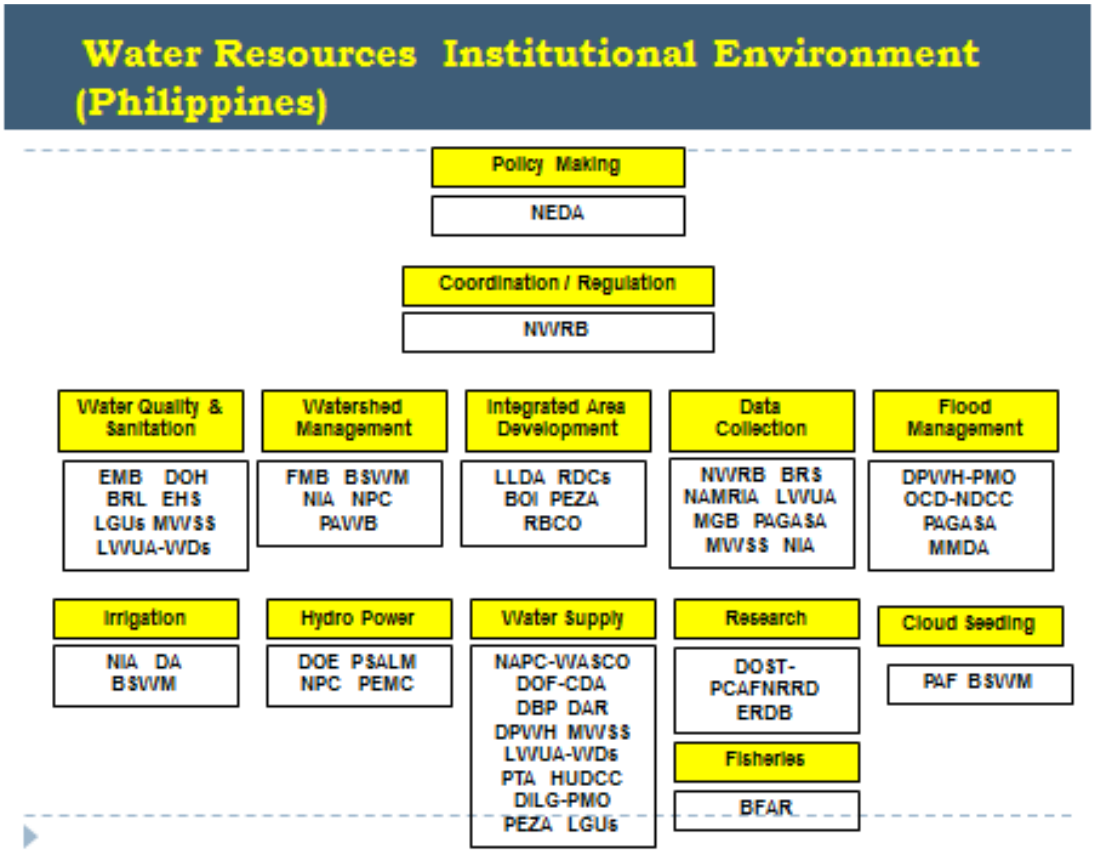

Figure 5. Chart from the Philippine National Water Resources Board indicating the crowded institutional landscape for water management. See, for example, the seven different entities involved in water quality and sanitation or the 12 different entities involved in water supply. Also note how there is no overlap in the agencies tasked with watershed management and those tasked with managing water supply.

At the national level, the Water Code of 1976 remains the framework legislation governing water allocation and management, prescribing a system for permitting allowable, beneficial uses of both surface and groundwater throughout the country. The Water Code created the National Water Resources Board (NWRB) to "coordinate and integrate activities related to water resources development and management." In the decades since, additional legislation by accretion has left a number of critical gaps and created conflicting and overlapping mandates for the relevant government institutions at the local,

regional, and national levels. While some progress towards additional reforms is being made at the national level, it is difficult to project how much influence they would have at the local level in Metro Iloilo and TAW.[19]

At the watershed level in the TAW, local activism led to coordination across local government units under the auspices of the Tigum-Aganan Watershed Management Board (TAWMB), which was formed in 2000. On water issues at the city level, the Iloilo River Development Council (IRDC) was established in 2005 to implement the Iloilo River Development Master Plan (IBC, 2004) and promote inter-agency coordination. After the national Clean Water Act was passed in 2004, both the Iloilo-Batiano Water Quality Management Area (IBWQMA; formed November 2009) and the Tigum-Aganan Water Quality Management Area (TAWQMA; formed December 2006) were established to improve river conditions and promote sustainable development in their respective watersheds. Unfortunately, this proliferation of governance bodies focused on water management has led to overlapping mandates and unclear lines of authority. Coordination remains a significant challenge.

In October 2011, Executive Order No. 62 mandated the creation of an Inter-Agency Committee on Water under the Department of Public Works and Highways (DPWH), tasking the Committee with developing a Water Sector Master Plan and recommending an appropriate organizational structure for implementation of that Plan. The framework plan developed by DPWH and National Economic and Development Authority (NEDA) proposed to strengthen the leadership and capacity of NWRB and transform the Agency to become a more effective management authority for the sector and to focus on more effective decentralization of resource management to the basin level (Tabios and Villaluna, 2012).

The Local Government Act (1991) devolved regulatory oversight of water supply and sanitation services onto LGUs. However, within Iloilo, the mandates for both water services and water resource management are unclearly delineated among the city; province; regional offices of the Department of Environment and Natural Resources (DENR), the Department of Interior and Local Government, and the Department of Agriculture; and the watershed management entities set up at the local level (Tabios and Villaluna, 2012). Under the Clean Water Act (2004), LGUs also have the authority to oversee permitting, monitoring, and enforcement of water quality and to raise the necessary fees to establish sewage treatment and septage facilities. MIWD continues to have a mandate for monitoring water quality within its service area, while the local DENR office has the mandate to act as the

A small water treatment plant operated by the Metro Iloilo Water District.

[19] In October 2011, Executive Order No. 62 mandated the creation of an Inter-Agency Committee on Water under the Department of Public Works and Highways, tasking the Committee with developing a Water Sector Master Plan. DPWH and NEDA have proposed to transform NWRB and to focus on more effective decentralization of resource management to the basin level (Tabios and Villaluna, 2012). In addition, at least two Bills brought before Congress propose the creation of a new Water Resources Management Authority.

primary agency overseeing implementation and enforcement (in partnership with LGUs) of the Clean Water Act. This convoluted regulatory landscape has led to significant confusion and has exacerbated funding constraints. While local actors recognize the difficulties in this fragmentation and overlapping authority, representatives of the Water Quality Management Areas (WQMAs) and the basin management authorities noted that they lack a legal mandate or any guidance on how best to harmonize their respective plans, or to ensure that the priorities in those plans are then embedded in local and regional development plans and investment priorities (Sherwin Bering, Alimodian Municipal Disaster Risk Reduction and Management Officer, presentation at the consultative workshop, July 13, 2012).

The fragmented nature of water governance in Iloilo also undermines accountability and transparency in planning, decision-making, and implementation of water and sanitation programs and projects. There are few incentives and mechanisms to hold the various institutions and stakeholders within the sector accountable and ensure that decisions are being taken in the public interest and in line with the stated public objectives or policies. For example, local stakeholders reported a high level of unregulated water abstraction and effluent discharges, with some stakeholders noting that even permitted users eventually stop complying with their permit requirements because there is no oversight or enforcement.

Of particular concern to many local stakeholders is the apparent inability of MIWD to provide effective services and to expand its coverage. Some of the relevant constraints, however, stem from issues at the national level. For example, MIWD officials have applied for changes in tariff rates to facilitate stronger cost-recovery to finance network improvements, but have received no response from LWUA (Engineer Le Jayme Jalbuena, General Manager MIWD, personal communication, July 17, 2012). Improving accountability in the water sector in Iloilo will require improved government coherence and coordination. It will also require more effective oversight by higher levels of government, civil society, and/or the private sector to ensure that sector institutions are effectively and efficiently meeting policy objectives, as well as managing and allocating funding appropriately.

5. PRINCIPLES OF ADAPTATION FOR ILOILO

Below is provided some strategic-level advice for managing the impacts of climate change in Iloilo. This advice is provided in the form of "principles of adaptation." These are meant to provide different ways of approaching climate change adaptation that have been successful in other sectors, in other regions, and at various levels of government, but tailored to the Iloilo context.

Focus on water security for economic growth. The key to taking action to address climate change in Iloilo is to focus on the primary objectives of stakeholders in the area – promoting tourism, commercial development, and agriculture. The purpose of considering adaptation is to ensure that climate change will not significantly impede efforts that are essential to Metro Iloilo's development.

Promote "no-regrets" decisions. Resources are extremely limited in Metro Iloilo. Given such resource scarcity, water security strategies for adapting to climate change must provide benefits today as well as under future climate conditions. Leveraging limited resources to address climate change and long-term water security will be most successful if an adaptation action provides benefits today as well as in the future.

"Mainstream" adaptation proposals. Metro Iloilo already faces a fragmented and uncoordinated system of laws and institutions involved in decisions on water security. At a minimum, climate change should be integrated into the decision-making process of existing institutions. If possible, climate change could form the basis for enhancing coordination among the disparate actors involved in water security.

Relate climate change impacts to the personal experience of Illonggos. Most actions that can address climate change in Metro Iloilo also address other non-climate stressors and natural climate variability. Grounding the justification for an adaptation action in the experience of Illonggos is an effective communication strategy. For example, the impacts of Typhoon Frank provide a timely and sensible justification for many actions that also provide water security benefits under a changing climate. But the community experience with Typhoon Frank provides a more compelling justification for taking action than uncertain or longer-term risks from climate change.

Promote sustained attention to climate adaptation projects. Many of the existing vulnerabilities of Metro Iloilo require a sustained focus of attention and resources over a period of many years. In some cases, good long-term vulnerability reduction is not currently pursued in Metro Iloilo because it is difficult to explain, justify, and take credit for in the near-term. Despite the difficulty, especially in the political arena where elected officials serve 3-year terms, of taking a long view, it is none-the-less necessary to meaningfully address many of Metro Iloilo's climate vulnerabilities.

6. OPTIONS FOR IMPROVING WATER SECURITY

Based on our analysis of the water security situation in Metro Iloilo and the TAW, the technical team developed a number of preliminary options for the Metro Iloilo community and funding partners to consider in attempts to improve water security. The options as a group address the various aspects of the water security situation that we found needed attention. The options have been organized according to major topics or concerns, but often include several more specific actions. For example, augmentation of water supplies includes both expanded rainwater harvesting and improving the MIWD distribution system to reduce water loss. It is worth noting that these options are not mutually exclusive; indeed, many of these options can actually reinforce one another.

Each option described below is organized along six aspects: (1) the category, or categories, of the option being described [this is taken from the categories described in the USAID (2013a) climate resilient development guidance; see Figure 6], (2) a *description* of what the option is and how it works, (3) the *effectiveness* of the option with regards to addressing stresses on water security under current condition as well as under climate change, (4) the *feasibility* of the option according to technical, data, financing, policy, or social considerations, (5) the *cost* of the option, primarily in financial terms, but also social and environmental costs when appropriate, and (6) the *implementation timing*, measured as short, medium, or long-term. These aspects are also categories suggested in USAID's climate resilient development guidance (2013a). Section 6.7 presents two proposed case studies in which the adaptation options are integrated to address an existing vulnerability in a comprehensive fashion.

Category	Description	Pros	Cons
Infrastructure	Changes or additions to physical structures that are manmade (e.g., water storage basins, coastal defenses, irrigation canals) or natural (e.g., mangroves, wetlands, riparian buffers). Can occur at a variety of scales, ranging from large-scale road projects to small-scale irrigation facilities. Weather and climate monitoring and communication infrastructure such as rain gauges and cell phone transmittal facilities can play an important role in improving adaptive capacity.	• Can be priced • Potentially highly effective • Visible (in the case of physical and not natural infrastructure)	• Inflexible • Can be costly to implement and maintain • May interfere with the natural environment • Only single-site impact
Capacity building	Used to build awareness, provide education and training to government officials, NGOS, and other partners to improve planning and management. Can be carried out at various levels, from training at the household and community level to larger scale institutional capacity strengthening at the national or regional level.	• Can help to obtain support • Can help promote sustainability • Flexible • Lower-cost	• Requires a longer-term investment • Difficult to measure impacts
Policy/ governance	Includes strengthening policies and regulations, supporting institutional cooperation, improving governance, removing disincentives to good resource management, enhancing flexibility of resource management to enable changes in anticipation of or response to climate change; supporting research and development for technology development.	• Can be designed to be flexible and adaptive • Potential for large-scale impact	• Complex • Slow to design and implement • May be driven by special interests • Effectiveness depends on enforcement • Legislation may require multi-year process • Effectiveness depends on implementation and enforcement
Good management practices	Management practices and strategies to reduce vulnerability, such as less destructive fishing practices, reforestation, controlling siltation and runoff, water reuse, requiring wind- and storm-resistant building techniques, effective flood warning systems, disaster recovery planning and preparedness, and water conservation measures.	• Leverage existing capacities to enhance vulnerability reduction • Build on and leverage indigenous and other forms of knowledge	• Transfer of technology, skills, and resources may be difficult to learn or to adopt • Behavioral change can be difficult and can take a long time

Figure 6. Approaches to adaptation and their pros and cons.

The options are:

1. Evaluate Resources
    - A Develop a Long-term Water Security and Climate Change Monitoring Program
    - B Evaluate and Enhance Groundwater for the Metro Iloilo Area
2. Improve Knowledge Management
    - A Enhance Monitoring Network for Supply, Quality, and Flooding
    - B Develop an Information Clearinghouse for All Water-related Data in Metro Iloilo and the TAW
    - C Develop Capacity for Information-based Management Decisions among Municipal and Provincial Resource Managers
3. Augment Water Supplies
    - A Community-based Options
        - 1 Implement Rainwater Harvesting in the Metro Iloilo Area
        - 2 Develop Community-based Potable Water Supplies
        - 3 Pursue Demand-side Management in the Metro Iloilo Area
    - B MIWD Options
        - 1 Reduce MIWD Non-revenue Water
        - 2 Conduct a Feasibility Study of MIWD Treatment of Jalaur Water
4. Improve Water Quality and Sanitation
    - A Evaluate Point-of-Use Source Water Treatment for Near-term Potable Water Provision
    - B Improve Compliance and Enforcement Capacity to Achieve Water Quality Goals
    - C Develop a Sanitation Information and Education Campaign
    - D Analyze Metro Iloilo Options for Addressing Wastewater
5. Reduce Flood Risks
    - A Promote Enhanced Land Use Planning for Water Security
    - B Investigate Improvement of Flood Early Warning Systems in Metro Iloilo and the TAW
    - C Analyze Capacity of Iloilo's Flood Management System to Cope with Potentially Enhanced Floods under Climate Change
6. Reform Sector Governance
    - A Improve Water Sector Accountability and Coordination
    - B Build Civil Society Capacity to Advocate for Water Security
    - C Analyze Options for Public/Private Partnerships in Support of Water Security
7. Demonstrate Cross-cutting Solutions
    - A Conduct an Urban and Rural Water, Sanitation, and Hygiene (WASH) Study for Metro Iloilo and the TAW
    - B Develop a Case Study of Lessons Learned at SM Mall Applicable to Commercial Development of Old Airport

6.1 EVALUATE RESOURCES

Several studies have been conducted on the water resources of Metro Iloilo (e.g., SWECO, 1997; Castalia Strategic Advisors, 2009). Whether or not results and data from these studies have been used by local organizations, however, remains unclear. Despite the large amount of data generated by these studies, interviewed stakeholders complained about a lack of access to or presumed non-existence of data contained in these reports. Furthermore, in addition to one-time studies that extensively characterized some aspect of Iloilo's water resources, interviewed stakeholders noted that regular monitoring of water parameters such as flow or water quality was not reliable or comprehensive enough to support information-based decision-making. The following options address several of the most pressing issues identified by the research team to address these problems.

A. DEVELOP A LONG-TERM WATER SECURITY AND CLIMATE CHANGE MONITORING PROGRAM

Category: Capacity building; good management practices

Description. Given the paucity of monitoring data for Metro Iloilo's water resources, developing a long-term monitoring plan is of vital importance. The development of a long-term water monitoring program consists of seven steps:

1. Identify an implementing agency and cooperating partners
2. Determine data gaps
3. Perform a one-time survey of relevant river(s) and select wells to identify problem areas
4. Define appropriate monitoring stations and wells and required equipment
5. Develop a quality control and quality assurance program
6. Train personnel on monitoring procedures and equipment maintenance
7. Develop and implement a long-term program

Effectiveness. While some very high quality reports provide a snapshot of Metro Iloilo's water resources, the availability of a continuous time series of data on water supplies, water quality, and flooding does not exist for most parameters of interest. To address this absence of important information for making rational decisions about Metro Iloilo's water resources, a comprehensive plan is needed to create a practical and economic system for long-term monitoring of water resources. This option addresses the foundational needs to manage water supply, water quality, and flooding. It can begin with simple, near-term efforts, but will require long-term commitment to fully realize. This option will provide information useful at all geographic scales – from the quality of individual wells to an empirical understanding of system-wide water availability.

A long-term monitoring program provides benefits, in part, because so many other options for improving water security can be more effectively implemented using a sound basis of observational data. Among other benefits, a monitoring program can assist decision-makers and planners in defining water source supplies, evaluating flood risks, assessing the effectiveness of reforestation, defining priority areas for sewerage and wastewater treatment, determining the effectiveness of industrial and municipal wastewater treatment, identifying polluters, and making long-term plans for climate change adaptation by evaluating trends. Such a long-term plan can be used as a public relations tool to demonstrate how effective policies are in cleaning up waterways, how the health and welfare of citizens is being protected, how water resources are at risk, how specific government policies can improve water security, and more. Such a program is relevant to – either directly or indirectly – virtually every current and future stress on

water resources that has physical impacts on water, such as population growth, lack of sewerage systems, industrial pollution, inadequate water supplies, and climate change.

Climate change impacts are likely to affect all aspects of water management in Metro Iloilo. Projected increases in the variability of weather, changes in the timing and intensity of precipitation and storms, and sea level rise will impact water quality, water supply, and flood management. Current management decisions are often complicated by a paucity of data. Future climate impacts will make this data-poor management regime even less effective as past conditions will provide decreasing predictive power. Developing a long-term monitoring program, including enhanced data collection, will provide information both about current conditions and how those conditions change in response to climate change. This data can be used to improve water management decisions and ensure that those decisions are based on the best available information.

Feasibility. The technological and data requirements for a long-term monitoring program are well understood due to extensive experience with such programs in other countries. Financing appears to be the biggest barrier to action on this option. New sources of funding will be required for equipment purchases, laboratory development, personnel training, etc. Making a long-term monitoring program effective will also require buy-in from several government agencies with overlapping jurisdictions. Fully fleshing out steps 1 through 3 as outlined above should provide important insights into the political and social feasibility of this option with minimal financial costs.

Cost. Financial costs of a long-term monitoring program can vary significantly depending on the sophistication of the program, the willingness of stakeholders to be involved, and which of the program steps are being implemented. Based on our initial interviews with a variety of stakeholders, it appears that the scientific community and NGOs are willing to be a significant source of labor support for a monitoring effort. However, financial resources for equipment, laboratories, and transportation requirements appeared to be a significant impediment. Using the step-wise approach outlined above can assist stakeholders in the development of a cost effective program by starting small, and, as the steps become more cost-intensive, minimizing analytical costs by selecting analytes or biota that are most appropriate for long-term monitoring. No social or environmental costs are anticipated from this option.

Implementation time. Complete plan development and implementation would occur over the long-term time frame. Early steps in the process can be implemented in the short-term. Full effectiveness will require implementation of the long-term management plan. However, benefits derived from improved capacity building, collaboration, and public relations may be realized in the short or medium terms.

B. EVALUATE AND ENHANCE GROUNDWATER DATA FOR THE METRO ILOILO AREA

Category: Capacity building

Description. Well and resistivity surveys were reported in the SWECO report (1997), and follow-up work was conducted by the Mines and Geoscience Bureau (MGB). It was reported by multiple stakeholders that test wells dug in areas identified as promising in the SWECO report yielded low quality saline water (Engineer Noel Z. Hechanova, Department Head City Environment and Natural Resources Office, personal communication, July 12, 2012; Engineer Le Jayme Jalbuena, General Manager MIWD, personal communication, July 17, 2012). Evaluation and enhancement of existing groundwater data would involve making this existing groundwater information useful to regulators such as the National Water Resources Board, water suppliers such as the MIWD, or private water purveyors. This would involve inputting these data into a comprehensive geographic information system (GIS) to enable evaluation of the current state of the shallow and deeper groundwater systems. Some follow-up testing may also be necessary to complete the understanding of Iloilo groundwater resources. At this time, it is not recommended that a detailed geophysical study be completed, but rather an evaluation be made as to

what data and methods may be needed to establish a comprehensive baseline understanding of Iloilo's groundwater resources.

Evaluating and perhaps enhancing existing information can help identify drilling locations which are more likely to have high quality fresh water. For example, there is potential that the deep sandstone aquifer underlying the Metro Iloilo area could be used to augment water supplies. Such an assessment could also help with identifying the magnitude of the threat of salt water intrusion, which has been reported by most stakeholders as a major factor affecting the groundwater resources in the Iloilo region, although whether this holds equally for deep and shallow wells remains unclear. This option could be pursued in the near term by building off the existing SWECO and Castalia reports as well as MIWD and MGB data. Some longer-term effort may be required to collect additional data to fill in holes in the existing information base after it has been integrated together. This option can also be useful at multiple geographic scales across the watershed – from the entire MIWD service area to specific private investments.

Effectiveness. Given the dependence on groundwater in the Iloilo region, as well as the overall lack of potable water in the Metro Iloilo region, the development of tools which could be used for groundwater exploration and exploitation could be extremely effective in locating potentially highly productive wells. Because most wells in the region are shallow (< 10 m), the deeper aquifer is believed to be underutilized and to be a strong candidate for enhancing source water supplies. A case in point is the well that was drilled by the local Pepsi bottling facility, which was reported to be > 100 meters deep. This well not only supplies Pepsi but also surrounding communities. Several private water purveyors also indicated that they relied on deep wells to generate water that they sold either to MIWD or directly to hotels, the SM Mall, or the local hospital (Iloilo Business Club, personal communication, July 16, 2012). This option has the ability to address current stress from inadequate water supply, but it can also address potential future stresses, such as climate change, industrial growth, or population growth, even if additional surface water supplies are obtained by MIWD. This is because groundwater can often act as a supplementary water supply source to be used only when adequate surface water is unavailable.

Hydrogeology (SWECO, 1997)

There are two basic types of aquifers in TAW. In the upland areas, fractured sandstone is the principal aquifer, whereas in the plain, there is a multi-layered system consisting of a shallow, water table, alluvium aquifer, and deeper artesian aquifer which consists of fractured sandstones extending down from the highlands. A well completed in the artesian aquifer could produce up to 150 m^3/hr. Over 5,000 wells are drilled in the region with most being less than 10 meters deep.

Rising sea levels can increase the risk of salt water intrusion into aquifers. Climate change may also affect demand for water in the Metro Iloilo region. In addition, climate change is projected to alter the timing, volume, and intensity of precipitation as well as increase evaporation from surface water bodies. These impacts are likely to impact the availability and quality of surface water as well as ground water. The combination of changes in surface water supply and demand for water make establishing a sustainable groundwater regime even more important. Systematically collected data on groundwater quantity, quality, and use is essential to creating a plan for the sustainable exploitation and protection of this resource.

Feasibility. Much of the data necessary for this option is already available, and it appears that partners such as the DENR-MGB, NWRB, and MIWD are quite willing to share responsibility in the development of an enhanced groundwater data management system. It may be necessary to determine who should take on the lead role in this effort, however, since this function is typically performed by national agencies such as NWRB and DENR-MGB. The needed technologies and software are in widespread use in many countries and expertise is widely available for training. There are no significant social or policy impediments to implementing this option. In short, this option is highly feasible. If more geophysical studies are desired, the barriers are more significant. The needed technologies and expertise

will require more financing. However, USAID has teamed up with the United States Geological Survey (USGS) and the German BNG to conduct such studies in the past. The geophysical techniques that might be needed (e.g., potential field methods, gravity and magnetics methods, seismic methods, electrical and electromagnetic methods) have been applied to groundwater investigations in other locations, each with a history of relative success under the conditions that will be faced in Metro Iloilo.

Cost. At this time, the research team proposes that investment in this option be limited to assisting in developing a GIS database, data integration, and associated maps. This might be an expense on the order of US$50,000. Should further geophysical studies be needed to fill in the holes in the existing information baseline, then a greater level or resources would be needed. For instance, an Aero Electromagnetic survey, which has been found very effective in finding good sources of fresh groundwater in places like Aceh Indonesia could cost US$100,000 to US$400,000, depending on availability of equipment. Again, because this option focuses on the use of information, there are effectively no social or environmental costs associated with its implementation. However, future intensive exploitation of groundwater should only be undertaken in the context of a regulatory framework that prevents overexploitation of the resource. In addition, depletion of groundwater reservoirs can exacerbate saltwater intrusion.

Implementation timing. Evaluation and enhancement of existing groundwater data should be feasible in the short term. As noted above, identifying high quality freshwater sources can be implemented in the short term by starting with the existing SWECO and Castalia reports as well as MIWD and MGB data. Collecting additional data may take into the medium term.

6.2 IMPROVE KNOWLEDGE MANAGEMENT

Along with developing more or better data, we encountered many instances in which data was not being shared, there was a poor understanding of what data was available, or data had been developed that was not being used. Consequently, we felt that another major issue was knowledge management, or the processes, practices, and systems that enable data to be useful for water resources decision-making. Several options to improve knowledge management are addressed below.

A. ENHANCE MONITORING NETWORK FOR SUPPLY, QUALITY, AND FLOODING

Category: Infrastructure; capacity building; good management practices

Description. Existing weather stations, stream gauges, and water quality monitoring stations (e.g., the automated weather and rain gauges of PAGASA's flood monitoring program) would be integrated into a common monitoring network with standard operating procedures for data collection and storage, quality control, and broad data accessibility. Additional monitoring stations would be incorporated into this network by default as they are brought online (e.g., PAGASA is reportedly adding several additional remote weather and gauging stations to the upper TAW watershed). Note that data collection is just one aspect of this program. Personnel from partner organizations would have to be trained on how to calibrate/service weather or gauging stations, how to maintain the software systems that collect and store this information, how to quality control the data to ensure accuracy, and more. Note, this differs from Option 6.1.A "Develop Long-term Monitoring Program" because this is about making the information already available more useful to a broad range of stakeholders, researchers, and decision-makers.

PAGASA has promoted a Local Flood Early Warning Systems (LFEWS), where rainfall and river level data are observed and reported to a local operations center. Automated gauges play a key role in the system and are augmented by local, typically volunteer observers. In Iloilo, the LFEWS is being developed under a PAGASA initiative associated with planning for climate change adaptation. This will

include the establishment of automated weather, precipitation, and river stage monitoring gauges.[20] The Department of Science and Technology has installed weather monitoring at the Department of Agriculture Western Visayas Integrated Agricultural Research Center in Jaro, Iloilo City. In addition, there are five automatic rain gauges which are connected with the Smart Schools Program, a private sector offering by Smart Communications, Inc. To add water quality monitoring to this network, sensors that detect electrical conductivity, temperature, pH, salinity, and others could be installed in conjunction with the flood warning systems.

Effectiveness. The overall objective of the water monitoring network is to allow stakeholders, researchers, and decision-makers access to water quality, water quantity, and flood warning data. This basic step can lead to more advanced objectives, such as developing a flood or accidental spill warning system or evaluating changes in the overall water supply and water quality in the TAW and Iloilo watersheds due to climate change. Because so many stakeholders in Iloilo discussed the paucity or inaccessibility of data as a factor limiting their work in the water sector, the research team believes that a monitoring network will be a highly effective option across a variety of water security issues. A monitoring network is critical to ensure the free flow of water resources information to all interested parties to inform decision-making. Like Option 6.1.A above, this option addresses a foundational requirement for information-based management of water supply, water quality, and flooding. Nearly all other options for addressing water security can be more effectively designed and implemented using a sound basis of observational data, which is the core of this option. Once reduced (i.e., providing plots and statistical analysis) having monitoring data accessible from monitoring network empowers stakeholders, researchers, and decision-makers to more effectively address the socioeconomic and climatological impacts on water resources by better understanding the current state of water resources as well as the physical impacts of specific socioeconomic and climatological stressors on water resource systems.

Projected increases in the variability of weather, changes in the timing and intensity of precipitation and storms, and sea level rise will impact water quality, water supply, and flood management. Current management decisions are often complicated by a lack of data. Future climate impacts will most likely make this data-poor management regime even less effective as past conditions will provide decreasing predictive power. Increasing data collection efforts, providing additional access to data, and providing additional training on how to best utilize these data to inform management decisions should improve the capacity of decision-makers to plan for and respond to climate impacts.

Feasibility. Because of the participation of PAGASA and the Smart School program focused on disaster mitigation, enhancing the monitoring network is an ongoing process. Scaling up that process should be easier to accomplish than starting a project from scratch. While many of the technological barriers to data collection and reporting appear to have been overcome through remote technologies, there may still be significant barriers on the distributions of such data. Some policy issues may arise in getting local governments, national agencies, and private partners to work effectively together. While financing is always a constraint, there appear to be many opportunities to tap into national government funds and private partnerships to promote this option.

This option is at least a medium-term and possibly a longer-term option. Getting several different agencies to work together, change current standard operating procedures, and provide data free of

[20] Weather and river stage data in real time will be connected to a web under the Philippine Real-time Data Acquisition and Interpretation for Climate Related Tragedy Prevention and Mitigation (PREDICT). PREDICT is a nationwide system that is meant to complement the existing observation capability of PAGASA. It consists of a network of automated weather, rain gauges and water level measurement stations that gather and transmit observation data to a central server through the cellular network.

charge will be a time-consuming task. However, this option will provide baseline data that is fundamental to informed water resources decision-making at all geographical scales – from individual businesses to the MIWD.

Cost. The discussion of cost is divided into two parts. The first component includes the cost of the LFEWS, and is largely already committed by the Philippine national government through PAGASA, although some enhancements are proposed here. The second component includes the installation of multi-parameter water quality sensors, and would be a new cost.

PAGASA is in the process of installing an LFEWS in the Metro Iloilo region, and it was reported that PAGASA is in the process of moving a synoptic weather station back to Iloilo at a cost of PHP 100 million (approximately US$2.5 million). PAGASA is also anticipated to install automatic weather stations located elsewhere in the watershed and tipping bucket rainfall gauges. Because Smart Communications has donated communications equipment as well as mobile communications costs, a major component of the cost is eliminated. The research team believes that at least six additional automatic rain gauges need to be installed in the upper portions of the watersheds, at least three additional automatic weather stations (one in each watershed), at least three controlled cross sections with automatic water level recorders towards the middle of each watershed, and one additional water level sensor at the fresh water intake for MIWD. If this additional equipment is not funded by PAGASA, other partners or LGUs may need to pick up some of the costs, which are anticipated to cost approximately US$70,000. If sirens for an LFEWS are not covered by PAGASA, this is a substantial cost of around US$100,000. Training, installation, and calibration of this equipment by an external expert would cost on the order of US$70,000.

The second cost component is the installation of multi-parameter water quality sensors. These sensors would continuously measure pH, electroconductivity, salinity, and water temperature. At least four LFEWS stations should be equipped with these sensors. They should be installed on new stations, since existing automatic stations are located primarily near flood-prone areas and not intended for flood prediction or long-term water security and water quality monitoring. In addition to monitoring saltwater intrusion, at least three recording conductivity meters should be installed in select wells. Finally, at least three transducers need to be placed in select wells throughout the groundwater basin as well. Total cost for equipment, training, installation, and calibration by an external expert would be on the order of US$100,000. Working with PAGASA and Smart Communications, it is thought that the data platform already in use for the LFEWS program could be modified to also provide real-time water quality data. No significant social or environmental costs are anticipated in the installation of a monitoring network.

Implementation timing. Continued deployment of the monitoring network would occur in the medium- to long-term. Capacity building activities and data provision can begin in the short-term. Benefits from improved access to data would accrue in the short-term, with additional benefits from more extensive data accruing as the network is built out.

B. DEVELOP AN INFORMATION CLEARINGHOUSE FOR ALL WATER-RELATED DATA IN METRO ILOILO AND THE TAW

Category: Capacity building

Description. An information clearinghouse would be a central repository for the collection, storage, and distribution of information about the Iloilo and TAW watersheds. The clearinghouse could be a "wholesale" operation that stores and diffuses data and information collected by others or a "full service" operation that also collects and analyzes data.

A wholesale operation would be relatively modest in scope because other existing organizations generate the data, follow existing protocols for data analysis, and shoulder the responsibility for data quality. This

requires a lower level of funding and the data and information are more easily managed. The alternative full service operation is more elaborate, because it also must collect and analyze data. Ideally, such an operation would serve as a catalyst for stakeholder participation, generate support for sound watershed management, and provide valuable data and information to metro Iloilo and MIWD resource managers and decision-makers.

Many water resource managers noted the lack of available data or the expense of acquiring data as a core limitation to better watershed management. But through our background research, it was clear that much had been written about the watersheds in the direct vicinity of Iloilo (e.g., SWECO, 1997; IBC, 2004; Castalia Strategic Advisors, 2009). However, this data has not been readily available, and some exist only in hard copy or only in soft copy form. Furthermore, existing agencies (e.g., PAGASA, MIWD) were collecting data, but that data was not available to the public or large fees were required to access the data. Ultimately, it was not clear to many resource managers whether their desired data exists and who to ask to find out. This option is specific to the metro Iloilo area and would be useful to barangay, municipal, and provincial managers and elected officials. Action on this option could begin immediately by making existing information available through hard and soft formats, but a longer time frame would be necessary for training, community outreach, coordination among existing government agencies, and some other challenging tasks that would fall under the information clearinghouse.

Effectiveness. The development of an information clearinghouse would provide benefits to all aspects of water security – including water supply, water quality, and flooding. Each of these aspects of Iloilo's water security problem becomes more tractable with reliable and robust information sources that are available to government resource managers, academics, nongovernmental organizations (NGOs), and citizen stakeholders. This would address both future climate change as well as current stresses on water from pollution, typhoons, lack of wastewater treatment, population growth, and more.

A key choice in this option is whether the operation is wholesale or full service. The effectiveness of a wholesale operation would be lower than a full service operation because most organizations involved in monitoring water resources as well as environmental issues have their own agendas, authorities, and bureaucracies. While some existing information could be incorporated into a wholesale clearinghouse, the quality and extent of that information would not be subject to any kind of control by the clearinghouse itself. This would probably lead to a significant chance of business as usual within the region as those organizations who do not want to share data or information will not and those organization who do not collect good quality data will not revise their protocols or quality control procedures.

A full service operation would have the ability to influence both data availability and quality. Furthermore, such an operation could provide outreach to community organizations and act as a public relations arm for the City or Province of Iloilo, the MIWD, and other organizations. If the model followed were along the lines of the Chesapeake Bay Program and their Chesapeake Information Management System (CIMS) web site, the data and information available to the public at large would be easily understood, readily digestible, and available in a wide variety of formats, including maps to a variety of users ranging from government agencies to local stakeholders to schools.

Feasibility. Local talent in terms of computer skills and education appears to be adequate for developing a clearinghouse. However, to develop such an information clearinghouse, the project would have to work closely with not only PAGASA and other national level agencies, but also the City and Province of Iloilo, other neighboring municipalities, MIWD, irrigation associations, local universities, and NGOs. Getting all of these diverse organizations to abide by a set of data quality standards will most likely be a very challenging task. These diverse stakeholders in a clearinghouse may also have their own, sometimes competing agendas, which must be reconciled to some extent to ensure clearinghouse success.

Since a substantial percentage of Iloilo citizens do not have access to a computer, it may be important for the clearinghouse to establish a physical office with a library as well as computers for ease of information access. Experience by the research team indicates that not all organizations which collect data are willing to share that information. This attitude leads to a more difficult and potentially more costly full service clearinghouse, which may lead to some political problems.

Climate change impacts are likely to affect all aspects of water management in Metro Iloilo. Projected increases in the variability of weather, changes in the timing and intensity of precipitation and storms, and sea level rise will impact water quality, water supply, and flood management. Particularly when management decisions are dispersed, providing accurate and timely data is essential to encourage informed management decisions. Developing an information clearinghouse will allow for the broad and timely dissemination of information that can be used to improve water management decisions and ensure that those decisions are based on the best available climate information about current conditions and future projections.

Cost. The costs of such an information clearinghouse will depend in large part on how much non-local expertise is needed to get such a clearinghouse up and running and where the clearinghouse is located. We anticipate the costs for developing a clearinghouse will range from US$160,000 to US$350,000. Much of this cost can be reduced by working with existing agencies, local universities, and leveraging other public-private partnerships. Nevertheless, significant costs for training, web base development, staffing, and equipment are unavoidable. Cost recovery should not be an option since the provision of technical assistance, software, and the data itself should be free of charge to encourage use. No social or environmental costs are anticipated as a result of developing an information clearinghouse.

Implementation timing. The clearinghouse can be developed in stages, with a beta, or limited functionality, version created in the short-term. Additional data and functionality can be added in the medium- to long-term. The benefits of improved data access are likely to begin to accrue in the short- and medium-terms.

C. DEVELOP CAPACITY FOR INFORMATION-BASED MANAGEMENT DECISIONS AMONG MUNICIPAL AND PROVINCIAL RESOURCE MANAGERS

Category: Capacity building; good management practices

Description. Through extensive stakeholder interviews, it appears that beyond the failure to collect and distribute information about the watershed, there may be a significant lack of capacity when it comes to utilizing information to make management decisions. In other words – even if the information was available, it is not clear that such information would be used effectively. Informed decision-making requires not only that data and information be available and in a format suitable for use, but also that resource managers and political leaders possess the technical skills to use that information and promote the expectation that such information will drive management decisions. A wide range of information can support management decisions, including socio-economic data, historical climate conditions, and projections of future climate change. But according to our interviews, most management decisions are currently made on an ad hoc basis, and information that is perceived as politically inexpedient is sometimes ignored or censored.

A first step in developing information-based decision-making capacity in the metro Iloilo area could be through a facilitated discussion with key resource management stakeholders to determine the types of decisions being made and the data needed to support these decisions. The key to this option is to get informed professionals already working in the Iloilo and TAW watersheds to express their needs and desires for information more explicitly and to connect those needs and desires to specific decision outcomes.

Effectiveness. Without this project, decisions will continue to be made on an ad hoc or informal basis, often based on perceptions or assumptions that may or may not represent current or future watershed conditions. This project will lead to improved decisions by developing the capacity for using and applying appropriate data to decisions where information can improve the management of water resources. This option would be beneficial on a watershed level, but could play an important role at the municipal and provincial government levels. This project is an important part of ensuring that Options 6.2.A and 6.2.B lead to better management decision. Building this capacity would provide benefits to water security related to water supply, water quality, and flooding both related to current and projected future conditions.

Improving the capacity of decision-makers to access, understand, and apply the best available information to water management decisions is essential to ensuring that those decisions respond to current and future water management challenges effectively. This is particularly important as conditions change because of climate change (as well as change in other important factors such as population). There is sufficient reason without climate change to support this option; but climate change increases its benefits.

Feasibility. The recommended project would be a first step in developing the capacity for information-based management decisions. It is quite feasible to implement the initial stakeholder workshop discussed above, although greater integration of information into decision-making may face some political backlash if the data do not support politically popular decisions. The lack of existing information resources may hinder conversations and capacity building to some degree, although many of the local experts have university training, and thus have knowledge of the potential and promise of information in making better management decisions. Implementing this option in coordination with these two other options may reduce costs and increase the effectiveness of all of these options.

Cost. A small project of approximately US$50,000 to US$150,000 would be needed to support this effort. This cost may vary significantly based upon the use of local versus foreign experts. This money is intended to support a facilitator, travel costs, research on decision information needs, and multiple stakeholder workshops. No social or environmental costs are anticipated from this option.

Implementation timing. While a long-term effort may be required to build capacity, it was the research team's observation that significant technical capacity already exists in the Iloilo and TAW watersheds, and coordinating these skilled professionals would provide near-term benefits in a relatively short timeframe. The timing of this option is flexible, but it should be implemented prior to or in conjunction with the Enhance Monitoring Network option (6.2.A) and the Information Clearinghouse option (6.2.B).

6.3 AUGMENT WATER SUPPLIES

The augmentation of water supplies can be accomplished using a number of strategies. We have organized the options along two parallel lines, (A) augmenting water through community-based water supply systems, and (B) augmenting water through the official, centralized purveyor of Metro Iloilo water, MIWD.

A. COMMUNITY-BASED OPTIONS

1. Implement Rainwater Harvesting in the Metro Iloilo Area

Category: Infrastructure; capacity building

Description. Given the amount of rainfall in the Metro Iloilo area, rainwater harvesting is an appropriate option for augmenting water supplies. Rainwater harvesting uses large surfaces, such as the roofs of buildings, as collection systems for rainwater. The water is often stored in tanks or cisterns. By

appropriately designing roofs; installing gutters, tanks, and cisterns; and training people on the necessary maintenance of these systems, the large surface area dedicated to buildings can be harnessed at almost any scale to provide a source of water. This option primarily addresses the lack of available water supply, but can also address water quality since the rainwater collected locally can be either quality controlled or treated for potable use.

Effectiveness. Currently, rainwater harvesting would add to water supplies and reduce water scarcity. Over the long term, investments in rainwater harvesting could decrease the demand faced by MIWD by providing an additional, distributed source of water that is easily used for washing, cooking, sanitation, or other non-potable uses. This option is most useful at small geographic scales, such as individual buildings, and can be implemented by municipal or barangay officials, or even at the household level. Should climate change increase total precipitation or precipitation intensity, the benefits of this option could increase.

Rainwater harvesting effectively creates a new water source to supplement existing sources. Existing sources could be reduced by climate change. Rainwater harvesting could be effective at capturing runoff from more intense rain events. Creating a distributed rainwater harvesting program will help reduce stress on municipal supplies and allow citizens some control over their water supplies in the face of increasing variability.

Feasibility. Some small- and medium-scale pilot projects (200 liter drums to 1,000 liter cisterns) have already been implemented at the municipal level, typically using the roofs of barangay- or development-level buildings, such as schools or community centers, as the collection site. However, the storage tanks for these projects are relatively small and there was reportedly little funding to expand or replicate these systems. Rainwater harvesting technology was also integrated into individual homes in newer government housing developments that the research team visited. This practice did not appear to be widespread and was largely absent in older private developments. In most cases, the people involved with these projects were satisfied with their systems, the biggest complaint being that the systems did not store enough water to meet either household or community needs. Larger storage tanks or more widespread use of rainwater harvesting would address this primary complaint.

Some community members also expressed concerns about the quality of rainwater due to pests, particularly cats, using the collection surface. There were also some concerns about the storage tanks acting as stagnant pools that could serve as breeding grounds for mosquitoes, with consequent human health risks, such as Dengue fever. While these concerns can be addressed with appropriate maintenance of rainwater harvesting systems, these concerns still may affect the social and political acceptability of this option.

Costs. Rainwater harvesting systems are a relatively low-cost option since gutters and storage tanks can simply be added to existing structures. Nevertheless, the cost of gutters and storage tanks was considered too high at every level of potential implementation. In other words, a household system was beyond the means of many families and larger systems on community development or barangay buildings were beyond the means of many communities and barangays. Nevertheless, considering the expense of either MIWD water or bulk water, there may be a long-term payoff to rainwater harvesting. Municipal officials suggested that grants are needed to fund rainwater harvesting system infrastructure.

Implementation timing. This option is also ready for short- to medium-term implementation, as successful projects already exist in Metro Iloilo that can be scaled up and/or diffused to other communities. Benefits to individuals and communities would accrue in the short-term, with system wide benefits accruing with wider penetration.

2. Develop Community-based Potable Water Supplies

Category: Infrastructure; capacity building

Description. Because so much current water is derived from local sources such as community wells, community-level water systems are a promising option. For example, in areas where well water has become brackish or is of low quality, it might be possible to engage in small-scale, low-cost water treatment to make the water suitable for non-potable or even potable use.

While MIWD and other Water Districts are able to serve a portion of the population within the study area, most of the households – both within Metro Iloilo and in the peri-urban and rural areas of the TAW – rely on untreated surface or groundwater sources for their domestic and livelihoods needs. Even where formal service is provided, service performance requires improvements in terms of both the consistency and quality of water services. This option proposes to address gaps in service by focusing on a demand-driven approach at the community or Barangay level.

Local government units are charged with establishing water districts, but also with partnering with community-based organizations (CBOs) to provide water in areas not covered by a district, mainly in rural areas. This option proposes to strengthen these institutions where they do exist and to assist communities in organizing and incorporating as a formal service association where one does not exist to promote sustainable access at the Barangay or community level.

Effectiveness. Given the difficulties faced by MIWD and other water districts in attaining service provision goals, this option presents a realistic alternative to providing immediate services at the community level in a sustainable manner. Throughout the world, community-based service provision has become a model for implementing water supply, particularly in rural areas. While it can be time-consuming when done appropriately, the benefits of a community management approach are well-documented and include better performing water suppliers that benefit a broader cross-section of society. This option can address water supply and water quality by making currently unusable water fit for non-potable purposes as well as making non-potable water fit for potable use.

Climate impacts such as rising temperatures and changes in precipitation amount and timing are likely to affect the availability and quality of both ground and surface water as well as affecting water demand. The combination of changes in water supply and demand are likely to stress the already limited capacity of the municipal water services. Encouraging local communities to collect, distribute, and treat water can reduce demands on the municipal system. When community-based institutions have ownership over their water infrastructure, treatment, and use, there is also a higher likelihood that water management practices will be sustainable. Such measures may yield benefits as supplies diminish and demand is increased because of climate change.

Feasibility. Demand-driven, community-based management of water services is a well-established alternative to private or public utility supply. Both within the Philippines and around the world, there are ample examples, lessons, and guidance to draw on in tailoring an appropriate process for designing and implementing this option. This option is most useful at the community scale and not realistic at the household scale.

Applicable lessons, particularly those drawn from previously implemented rural or local supply projects in the Philippines, should inform the undertaking of this option. Specifically, previous community-managed systems failed to function effectively over time when:

- There is inadequate focus on institution building and capacity building to ensure the community has the necessary administrative, technical, and managerial skills to sustain water services.

- There is inadequate implementation of participatory approaches to ensuring representation of traditionally marginalized populations in planning, decision-making, and implementation.

- There is insufficient demand-responsiveness. It is important to tailor the capacity of the water system and treatment levels to the actual needs of the community to ensure willingness-to-pay and also ensure that people are getting access to sufficient quantities and quality of water to meet their needs. This can be avoided through effective participation of the community or its representatives in the design and siting of infrastructure and management institutions.

- There is insufficient capacity of local government or civil society to provide the necessary ongoing support to sustain service systems. One study assessing the effectiveness of several rural water supply systems found that involving barangay officials prior to project implementation to assist in targeting beneficiaries and developing water users' associations was critical for success.

- Inappropriate management and technical choices are made. The management structure and technologies chosen must be made with due consideration of the communities' willingness to pay and ability to operate, maintain, repair, and administer the system.

Cost. Community-based water service provision is a very cost-effective alternative compared to the cost of expanding district services or relying on continued informal service provision. Additionally, once the services are in place, there can be an expected reduction in health costs from waterborne and water-washed illness. No significant social or environmental costs are anticipated from treating water at the community level, although disposal of filters, membranes, or other potential technologies for treatment should be considered.

Implementation timing. Community based water supply projects can be implemented in the short- to medium-term as a means of addressing the Metro Iloilo supply shortfall.

3. Pursue Demand-side Management in the Metro Iloilo Area

Category: Policy/governance; good management practices

Description. This option involves a targeted suite of interventions aimed at reducing demand in Metro Iloilo and TAW to close the existing gap between supply and demand and ensure that any water supply augmentation options provide water where it is needed most.

There are a number of water demand management (WDM) tools available, ranging from economic incentives for conservation and more efficient use to regulatory requirements for retrofitting buildings with water-saving technologies. A WDM program should be tailored appropriately to the diverse sectoral needs in Metro Iloilo and TAW. Demand forecasting is a critical aspect of the planning for WDM. There are a number of forecasting tools that could be used to facilitate this process. The information garnered as part of this process could use as a baseline some of the information developed as part of the monitoring network proposed in Option 6.2.A. Once clearly delineated, demand projections [and the accompanying development scenario(s)], can help target where water savings are most effective and appropriate through WDM initiatives.

A multi-stakeholder planning process that builds on development priorities and demand projections would then enable selection of the most appropriate range of WDM tools and effective implementation. This should keep in mind the fact that WDM is not a goal in and of itself, but a tool for reaching broader social and economic development, as well as environmental protection goals. As such, WDM should be integrated into existing water resource planning processes. Within Metro Iloilo, demand management approaches will likely need to focus on industry, including hotels, hospitals, and other large users, as well as domestic users. Approaches will likely need to be sector-specific and accompanied by a broad-based

awareness raising and education component for the public. Examples of WDM approaches/tools for urban demand management include:

- Reduction of non-revenue water (see Option 6.3.B.1)
- Cost-reflective pricing, often including an increasing block tariff system to support equity in allocation of the cost burden
- Water auditing for high quantity users to identify opportunities for savings
- Regulatory requirements for water saving technologies to be installed in new developments/buildings or for retrofitting existing structures
- Regulatory water use restrictions, either on a short-term or permanent basis

In the broader TAW, many of these tools would remain applicable, but an additional set of tools might also be required to target the agricultural sector. Even as irrigated agriculture is expanded (as projected by NIA) to meet growing food security needs and capitalize on the additional water availability as a result of the Jalaur Multipurpose Dam Project, there are a number of tools to ensure that waste and inefficiencies are minimized. These include encouraging planting of higher-value and lower-water-consumption crops and targeted education and outreach for farmers on the need for and mechanisms for implementing WDM.

Currently, oversight of demand-side management could find a logical home in multiple local government institutions. There are numerous planning processes that could inform and benefit from integration of WDM considerations as well. This option provides a platform for bringing together the relevant decision-makers and stakeholders to increase understanding of actual water use in Iloilo, projected demands based on a number of different development scenarios or criteria, and the potential for more efficient and effective use of water resources across sectors. This process itself would be a valuable tool for raising awareness of water security issues and facilitate better integration of water resource and development planning processes.

Effectiveness. Implementation of WDM through a strategic and multi-stakeholder planning process has the potential to cost-effectively offer a number of water security benefits beyond the actual water savings realized through the demand management tools themselves. While an integrated approach to including both supply- and demand-side management will be necessary to ensure water security in Iloilo, the increased economic and water use efficiencies that can be realized through demand management will relieve pressure to augment supply through high-cost interventions.

Climate change is likely to impact both water supply and demand, with changes in the timing, volume, and intensity of precipitation and increased temperatures. Putting in place demand management measures will improve the efficiency of water use, reducing future stress on uncertain supplies.

Feasibility. Critical to the success of this process would be identifying the appropriate institutional "home" for the planning and implementation of WDM. As noted above, because of the broad applicability of WDM measures, this process could be integrated into ongoing planning processes and provide a focal point for coordination among those processes. However, an institutional "champion" would be necessary to ensure that the process was maintained and effective. EMB/DENR Region VI could provide oversight of the process and the necessary policy incentives. MIWD, NEDA, and IRDC/TAWMB should be involved in decision-making and implementation. NIA and the relevant Irrigation Users' Associations will be important agriculture stakeholders.

Tariff adjustment to ensure cost-reflective pricing and equitable distribution of the burdens of increased cost to ensure demand management will depend on the willingness and ability of MIWD and other service providers to negotiate the changes with LWUA. In our conversations with MIWD, it was noted that tariff adjustments were necessary but hadn't been achieved due to bureaucratic obstacles at the national level.

Cost. This option is relatively low cost, particularly compared to options for augmenting supply. Education campaigns can be effective at a low cost, particularly if integrated into existing institutional programs, such as schools, or taken on by voluntary associations, such as the Iloilo Business Council. Mandating water-saving technologies in new construction adds only small, incremental costs to a project. Retrofitting older buildings with water-saving technologies is a higher cost strategy, but can be encouraged through relatively low-cost incentives programs.

An integrated planning process, particularly one that requires the creation of new regulatory instruments and involves a high number of stakeholders, can be costly. However, it is also possible that WDM planning could be integrated into existing planning processes at a marginal, extra cost. There are no social or environmental costs anticipated with a WDM program.

Implementation timing. Some specific WDM measures appear quite feasible in the short-term. The research team observed a number of successful public education campaigns (e.g., an anti-smoking campaign and a Dengue fever awareness campaign), demonstrating that the educational component of WDM is immediately achievable. Many of the urban WDM tools noted above, including the regulatory and incentives programs, are also feasible, and there appears to be sufficient political will to push these types of interventions forward.

B. MIWD OPTIONS

1. Reduce MIWD Non-revenue Water

Category: Good management practices; infrastructure

Description. Non-revenue water refers to the water that is lost between treatment of source water and the end user. Non-revenue water is a fact of life for all water utilities, but it represents a very cost-effective way to increase supplies by repairing broken distribution pipes, reducing illegal taps, fixing water meters, etc.

The basic idea is that treated water is a highly valuable resource in the supply limited Metro Iloilo area. Reducing water wastage is a relatively easy way to increase effective water supply and will increase the yield of any future supplies that are dispersed through the MIWD distribution system. This option is limited to the Metro Iloilo area and does not address the rural areas of TAW.

Effectiveness. MIWD reports that some 38% of water is reported as non-revenue (Engineer Le Jayme Jalbuena, General Manager MIWD, personal communication, July 17, 2012; Castalia Strategic Advisors, 2009). MIWD's daily production of water is 40,222 m^3/day and 14,923 m^3/day is lost in distribution (Hechanova, 2009). This represents a large supply of water that can be reclaimed. Notably, however, this option does nothing to provide water to the 60–80% of Metro Iloilo residents that are not served by MIWD. Consequently, it is only a partial solution and may be best tackled in conjunction with other options for augmenting water supply, especially if proposed additional water supplies will be distributed through the MIWD distribution system. Additional benefits may accrue to water quality as defects in the distribution system may be relevant to lost supplies as well as water quality problems at the tap.

Climate-driven changes in water supply and demand may be a strong incentive for MIWD to improve and expand its existing infrastructure. Reducing non-revenue water will help to finance that expansion by

delivering more water to more customers. Fixing distribution system leaks and bringing current users of non-revenue water into the management structure can also enable more effective demand management strategies. Finally, as stress on limited water resources increases due to changes in climate, measures to reduce water loss will become increasingly important. Reducing non-revenue losses essentially provides additional supply that will be relatively insensitive to climate change.

Feasibility. This option will require new data gathering to determine where non-revenue water is going, whether through distribution system leaks, faulty meters, illegal taps, or other. This will require significant financing not just for the data gathering, but for subsequent investments in repairing the distribution system or meters. Enhanced enforcement to prevent illegal tapping may require additional financial resources, but could also lead to some social difficulties. In addition, a feasibility study may need to be conducted to examine the entire system and how new trunk lines and connections with the water from the Jalaur Dam could be coupled with a reduction of non-revenue water.

Cost. This option has significant financial costs. New investments may need to be made in the distribution infrastructure, meters, or enforcement to prevent illegal taps.

Implementation timing. Significantly reducing non-revenue water will require a medium time frame to implement and to realize benefits because many of the techniques to reduce non-revenue water require significant infrastructure upgrades. However, short-term benefits can be produced by beginning to reduce losses.

2. Conduct a Feasibility Study of MIWD Treatment of Jalaur Water

Category: Infrastructure

Description. Approximately 1 m^3/sec of water is intended to be transferred from the Jalaur Dam reservoir to the MIWD freshwater intake at Barangay Daja, Maasin. This will effectively more than double the current freshwater supply and provide water for approximately 96,000 households, essentially providing enough water to potentially meet all currently unmet domestic water needs in the MIWD service area. However, to make this transfer effective in augmenting the current water supply, the current water treatment plant at Barangay Talanghauan, Santa Barbara will have to be expanded to meet water treatment requirements. This option proposes conducting a feasibility study of expanding the raw water treatment capacity of MIWD to make effective use of this new raw water supply. Failure to make use of the raw water that has been promised to MIWD could lead to that water being diverted to other uses and effectively eliminating the MIWD claim to partial rights to the Jalaur Dam water.

Effectiveness. There is little doubt that augmenting raw water supplies will improve the amount of water delivered to MIWD customers. Note, however, that many MIWD customers complained that the delivered water is not fit to drink, and there was a high level of non-revenue water reported. This implies there are problems with the water distribution system after treated water leaves the raw water treatment facility (which the research team visited and noted was in good working order). Addressing problems in the distribution system both for water quality and to enhance water supply, is treated as a separate option from making use of Jalaur Dam water in this report (e.g., see 6.3.B.1 "Reduce MIWD Non-revenue Water"). In order for Jalaur Dam water to assist MIWD in meeting its current and future water needs, the MIWD will need assistance in preparing a detailed feasibility study which takes into consideration other potential options for treatment and use of the Jalaur water which may be more cost or resource effective. To ensure maximum effectiveness, a terms of reference (TOR) should be developed that is appropriate in scope and level of detail to facilitate cost-effective decision-making.

Benefits from the project will depend on what fraction of the available Jalaur water is used for consumptive versus other uses. It is possible that some Jalaur water will be used to maintain natural flows and the environmental values that depend upon them. However, the primary purpose of the dam

was to provide irrigation water to a largely undeveloped and rain-fed agricultural area to promote economic development of the agricultural sector. So the more significant trade-off is the social cost of providing Jalaur River water to consumptive human use versus agricultural irrigation. Typically there are much larger benefits to using water for municipal purposes than agriculture.

Climate change is likely to affect surface water resources in a number of ways. Reduced precipitation and increased evaporation may reduce the supply of surface water. Changes in the timing and intensity of precipitation may make water storage even more important for ensuring adequate year-round supply. Climate impacts, e.g., through higher temperatures or change in nutrient loadings resulting from more intense rain events, may also impact surface water quality, making effective treatment even more important. These potential impacts make it more worthwhile to expand store, treat, and enhance transmission capacity as part of a comprehensive water management regime.

Feasibility. The Jalaur Dam project has cleared a number of hurdles that indicate that the project is very likely to come to fruition. Most recently, Philippine President Aquino witnessed the signing of a US$207.88 million loan agreement with the Republic of Korea to support implementation of the Jalaur River Multipurpose Irrigation Project Phase II.[21] Funding a separate feasibility study of water treatment options for MIWD may be a burden for MIWD, but a number of opportunities for shared financing may be available in conjunction with the Jalaur Dam project as a whole. No other real barriers to a feasibility study seem likely. However, it is worth noting that there may be significant barriers to specific options for raw water treatment, including siting water transmission pipes from the Jalaur reservoir to the MIWD intake at the dam in Massin, expanding the existing raw water treatment facility in Santa Barbara, developing a new raw water treatment facility elsewhere in Metro Iloilo, etc.

Cost. It is estimated that such a feasibility study would cost approximately US$400,000. But expansion of the existing water treatment facility or building a new one would carry substantially higher costs. The costs of water treatment for municipal uses, however, should result in higher benefits because municipal use carries a high value. Because the Jalaur Dam project has already been approved and funded, we do not consider the environmental and social costs of a "no dam" alternative.

Implementation timing. Work has already begun on the Jalaur Dam, and it is scheduled to be completed within the next five years. If this option is implemented, it is, therefore, important that this feasibility study be completed in the very short-term (i.e., within the next two to three years) so that expansion of the current treatment plant or development of a new treatment facility can be completed within the next five years.

6.4 IMPROVE WATER QUALITY AND SANITATION

Water quality and sanitation were perhaps the most conspicuous problems in Metro Iloilo and the TAW, even if stakeholders did not rank these as their top concerns for achieving community development objectives. Nevertheless, water quality and supply are interconnected as a key question is how much potable water or water of sufficient quality for other uses is available. Consequently, we address several options for addressing water quality and sanitation issues below.

[21] See http://iloilonewstoday.com/index.php/opinion/editorial/10563-20788-m-loan-agreement-for-jalaur-river-project-signed.

A. EVALUATE POINT-OF-USE SOURCE WATER TREATMENT FOR NEAR-TERM POTABLE WATER PROVISION

Category: Infrastructure; capacity building

Description. Currently, the Metro Iloilo population relies almost exclusively on bottled water for potable drinking water. The stakeholders said that most water sources in the region are not considered of sufficient quality for potable use. While in the long-term, improvement in these water sources is necessary to improve the quality of life in the region, this options focuses on the immediate need of providing safe, high quality water through point-of-use treatment. Point-of-use treatment can be employed quickly and does not require large investments in infrastructure.

Point-of-use treatment typically refers to treatment at the tap or point where water is used for drinking and cooking, such as on a kitchen faucet. Water can also be treated at the point-of-entry where the water enters a residence or building, thereby treating all water used in that location. For example, small-scale package plants can purify water to supply the needs of a neighborhood, development, or small facility. Point-of-use treatment can be off-the-shelf or designed to meet specific needs. In areas lacking infrastructure and without resources for a larger system, small-scale package plants or other point-of-use treatment may be the only viable options. Because point-of-use systems have been widely available for some time, there is a need for a consistent approach to the use of point-of-use systems in the Iloilo and TAW watersheds.

Effectiveness. A point-of-use strategy and adoption of such technologies in the Iloilo and TAW watersheds would provide benefits primarily at the building and individual household level, but a strategy for implementing such technologies could provide benefits at the provincial, municipal, barangay, and neighborhood levels. Point-of-use can provide effective solutions to ensure potable water at the level of installation (e.g., residence, commercial building). But this option does not address the larger, watershed-wide issue of insufficient potable water or the issue of treated MIWD water degradation through the transmission system. There may also be significant difficulties with the adoption of such technologies without significant subsidies or creative rent-to-own schemes that offset the cost of such technologies through, for example, savings on bottled water expenditures. This option would provide some buffering against current and future stresses on an already limited supply of potable water.

Climate impacts are likely to affect the quality of both ground and surface water. In areas where municipal water services are not available or reliable, point-of-use treatment can enable households, commercial building, or housing developments to use currently impaired water today. This will provide even more benefits in the future as warming temperatures lead to further water quality declines and as precipitation changes may increase reliance on shallow wells with low water quality. Changes in climate are likely to stress the already limited treatment capacity of the municipal water services. In light of limited municipal capacity and projected climate driven changes in water quality, individuals and institutions can be encouraged to improve the quality of the water they consume by adopting point-of-use treatment options.

Feasibility. Point-of-use treatment can be effective if applied in strategic locations, providing water to specific populations. This option is unlikely to be feasible in many locations in the Metro Iloilo region – especially areas dependent on shallow and contaminated ground water wells. The technologies for treatment and desalination would likely be too high. The largest challenge with point-of-use systems is long-term maintenance. These units need to be maintained and replaced on a regular basis. Failure to do so can result in the units being ineffective or bypassed altogether. This would require an education campaign and policy continuity for the program that is difficult to find precedent for in the Metro Iloilo region.

Cost. The costs of point-of-use treatment vary based on the type of unit and volume to be treated. Point-of-use treatment units (for a single faucet) can range from US$100 to US$500. Large point-of-entry and package plants can reduce costs when serving multiple customers. Beyond the cost of the unit, budgeting is needed for operations and maintenance and replacement. Replacement rates vary on the source water quality. It is important to note that the savings from not purchasing bottled water could significantly offset this financial expenditure. The research team estimates that an assessment of point-of-use options and strategies for deployment can range from US$75,000 to US$150,000. These estimates presume the involvement of an advanced technical team from a developed country. This estimate does not include costs associated with piloting or deployment. This option has no significant social or environmental costs.

Implementation timing. Point-of-use treatment may offer an immediate short-term solution in providing safe, potable water. Benefits would begin to accrue immediately if point-of-use systems were implemented in the Metro Iloilo area. To be sure, this should be considered as a short-term option to improve access to potable water. However, while effective on short timescales, this option is not likely to be as effective on longer timescales or at larger scales where municipal treatment is preferred.

B. IMPROVE COMPLIANCE AND ENFORCEMENT CAPACITY TO ACHIEVE WATER QUALITY GOALS

Category: Policy/governance; capacity building

Description. This option would entail a three-part training initiative and provision of technical support to the WQMAs and DENR. The first training component would bring together the two WQMAs with representatives from each of their constituent LGUs to review the relevant components of the Philippines Clean Water Act and its implementing rules and regulations and the WQMA Action Plans and to set a clear path forward for creating compliance and enforcement plans within each LGU. This would include the untreated water initiatives required pursuant to the act and begun under the USAID-assisted Local Initiative for Affordable Wastewater Treatment Program (LINAW).

This training or trainings would: clarify the regulatory role of the WQMAs and LGUs in managing water quality at the local level; and identify the relevant gaps for achieving water quality goals; and identify opportunities for filling those gaps through targeted, technical assistance projects and more integrated institutional responses. For example, representatives of the WQMAs highlighted the need for creation of local implementing rules and regulations (IRRs) in order to expand the list of regulated effluents and also to provide direct enforcement authority to the local governments. Without such regulatory action, LGUs and WQMAs can only rely on enforcement from the national level, which is unrealistic given the lack of resources and personnel available to undertake these actions.

The second level of training in this option would be to bring together the Technical Secretariats of the WQMAs and identify enforcement officials from DENR and LGUs to provide comprehensive capacity building on compliance assistance and enforcement tools. This would include a three-part focus on compliance promotion tools (e.g., information dissemination, technical assistance, "good citizen" agreements, creating IRRs that can be complied with, regulatory and financial incentives), compliance monitoring tools (e.g., inspections, audits, ambient water quality monitoring, citizen monitoring) and enforcement tools (e.g., sanctions, permitting options). This would also include training on the management aspects of compliance assurance, including budgeting, strategic planning, performance assessment tools, etc.

The final training would be a training-of-trainers of selected WQMA, DENR, LGU, and potentially additional civil society representatives to create a cadre of officials and organizations capable of working with regulated industry on compliance issues. A component of this would be the development of training materials targeting high-level emitters and non-point source issues, and could also entail the

development of a web-based training tool that could be broadly disseminated among the regulated community.

Effectiveness. This option is likely to be very effective, as it builds directly on ongoing initiatives to improve water quality and targets identified gaps in capacity for compliance assistance and enforcement. Improving enforcement and compliance are essential to improving water security, especially water quality objectives, because without adequate enforcement capabilities, water quality for consumption and environmental flows will remain impaired. As long as water quality remains poor, tourism and economic development objectives will be undermined as conditions on the ground deteriorate beyond the status quo that stakeholders throughout Iloilo identified as key obstacles to achieving water security in the region.

Climate change impacts are likely to further impair water quality. One way to compensate for this reduction in water quality is to reduce the stress on water resources from non-climate stressors. Enforcement of water quality regulations will help reduce the impacts of non-climate stressors.

Feasibility. The activities in this option and the resulting increase in compliance and enforcement capacity are highly feasible. As noted above, this option builds directly on ongoing activities of local institutions and responds directly to their articulated need for additional capacity and technical assistance. The tools for the proposed training are available, including those that could be implemented at low-cost on an immediate basis. Additionally, this option includes the identification of non-capacity related obstacles to more effective compliance and enforcement that would be addressed through targeted technical assistance activities. These activities should be carefully designed to include the appropriate stakeholders and to facilitate increasing awareness of the impacts of water quality issues and the need for integrated institutional action to mitigate them.

Cost. The costs of these trainings and technical assistance would vary according to the number of personnel trained, the specific technical assistance projects selected for follow-up, and the capacity of the trainers. It is quite feasible to undertake the preparation for this training at a low-cost, utilizing existing materials on compliance assistance and enforcement that are available through institutions such as the Organization for Economic Cooperation and Development (OECD) and the International Network for Environmental Compliance and Enforcement (INECE). Trainings would be conducted locally and thus be limited to the daily cost of equipment, training materials, and food. Additional costs would be incurred for bringing in experts from the national or international level, but this would still be reasonable given the expected output. We estimate that if local personnel are used to conduct training, costs could be in the range of US$10,000 to US$20,000. If international experts are needed, costs could be significantly higher.

Implementation timing. With buy-in from the relevant agencies, training could commence in the short-term and begin accruing benefits immediately. Ideally, a well-organized training regime for continuing education and new hires would be continued over the medium- and long-terms.

C. DEVELOP A SANITATION INFORMATION AND EDUCATION CAMPAIGN

Category: Capacity building; good management practices

Description. One of the greatest challenges to water quality, public health, and sustainable development in Iloilo is the almost complete lack of sanitation infrastructure. In 2008, the city conducted information and social marketing campaigns on sanitation, which included presentations for hundreds of teachers and students on proper wastewater treatment, proper construction and management of septic tanks, the effects of poor sanitation on health and the environment (Philippines Sanitation Alliance, 2011).

This option proposes that Iloilo City update the materials created for the initial social marketing campaign and draw on additional materials available from resources such as the Philippine Sanitation Alliance (PSA) to reinvigorate a widespread information and education campaign on sanitation. This would include an assessment of the populations (both urban and rural) that are most threatened by poor sanitation to inform how existing materials can be tailored to target those communities. Civil society organizations should also be targeted to raise their awareness of the provisions of the Clean Water Act that require the development of sewage treatment infrastructure by LGUs so that they can more effectively advocate for implementation.

Effectiveness. Poor water quality is one of the biggest challenges to achieving water security in Iloilo. Building the necessary wastewater and sewage treatment facilities has proven to be financially challenging. While low-cost interventions are being undertaken in targeted industries and public service institutions, the most immediate impact will be made through household level interventions and behavior change. Iloilo has had great success with similar information and education campaigns, such as the Dengue awareness campaign. The PSA has also been actively involved in Iloilo sanitation issues for many years and could provide a valuable partner in both developing additional materials and implementation an awareness raising campaign.

Climate change impacts are likely to further impair water quality. One way to compensate for this reduction in water quality is to reduce the stress on water resources from non-climate stressors. One of the biggest stressors on water quality is poor sanitation practices by the citizens of Metro Iloilo. Therefore, an education campaign can be an effective tool to reduce the impact of this non-climate stressor and increase the resilience of Iloilo's water resources to climate stress on water quality.

Feasibility. The capacity for producing the materials is already high and it would appear that there is good technical understanding of how to conduct social marketing campaigns within the LGU, as well as within the potential partner organization, PSA.

Cost. This option should be fairly low-cost, given the fact that it is building on and expanding previous activities.

Implementation timing. Improved outreach and education can be implemented in the short-term and begin accruing benefits immediately. Full socialization of new sanitation practices will continue to produce benefits over the medium- and long-terms.

D. ANALYZE METRO ILOILO OPTIONS FOR ADDRESSING WASTEWATER

Category: Capacity building; policy/governance

Description. The objective of this option is to conduct a comprehensive assessment of wastewater treatment (WWT) options for Metro Iloilo and surrounding areas. This would include options such as septic systems, package plants, and more centralized systems for wastewater collection that would include conveyance, treatment, and solids disposal – and could possibly include reuse. These options will vary considerably in the cost and time for implementation, operating and maintenance expenses, effectiveness, and degree of acceptance to users. But a single analysis should be able to compare the various options across a range of pertinent criteria.

The current approach to wastewater treatment has been piecemeal, and largely ineffective. This is evidenced by the contamination of many near surface wells, and a number of stakeholders indicated that the existing septic systems were poorly maintained and people were unaware of maintenance needs. There have been recent regulatory requirements for WWT systems for newly constructed large commercial developments and facilities that include hospitals, hotels, and government buildings. Regulations for residential and community systems appear to be absent.

Ultimately, a densely populated area such as Metro Iloilo will need a more centralized WWT approach to ensure that wastewater does not contaminate source waters or imperil natural resources such as the fisheries in the Iloilo and Jaro River estuaries. Decentralized approaches, as currently being employed, start to address the problem in the near term. However, these approaches often suffer from a lack of maintenance and upkeep. Also, systems such as septic tanks only provide minimal treatment and therefore are not suitable for long-term sustainability in a metropolitan area.

A feasibility study should, in theory, provide information about use at multiple levels – from local governments to individual households. However, the most important scale for such an assessment would be for a watershed-wide WWT plan.

Effectiveness. The analysis would identify the current treatment options that are being employed and the pros and cons of different WWT options. It seems reasonable to presume the analysis will be effective in that it can provide information to inform planning on how to address Iloilo's WWT needs. It is important that the analysis be carried out by sanitary engineering companies or organizations that have experience assessing WWT needs in developing countries. Ensuring effective treatment of wastewater can help ameliorate existing stresses on water resources and address anticipated future stresses, such as population growth, and the continued decay of existing septic systems.

One of the biggest stressors on water quality is the lack of management of waste water. While the regulatory efforts (6.4.B) and educational campaigns (6.4.C) proposed above can help reduce this non-climate stressor, these are only short-term solutions. As Iloilo continues to develop, this non-climate stressor will eventually overwhelm most efforts at managing water quality. A long-term solution to mitigating this non-climate stressor is to assess the development of WWT options. A comprehensive plan presents a good opportunity to assess the potential impacts of climate change and examine options to ameliorate the risks.

Feasibility. The major barrier to implementing this option will be securing financing. It is not clear to the research team that there is a clear source of authority for wastewater issues in Metro Iloilo, so there may be some difficulties in finding a lead agency or NGO to spearhead this option. Furthermore, it may be difficult to garner cooperation among the many government units that have a stake in water quality, although precedents exist in the TAWMB and the TAWQMA.

Cost. The research team estimates that a thorough assessment of WWT options could be done for US$50,000 to US$200,000. These estimates presume the involvement of an advanced technical team from a developed country, and a base level analysis of options suitable for selecting the options to explore in greater depth. The costs will vary depending in part on whether field work will be required in Iloilo and whether local contractors could be used for some of the analysis. This option has no significant social or environmental costs.

Implementation timing. While such a feasibility study could be conducted in the near term, the issue of WWT is anticipated to be a long-term problem that requires actions that provide benefits only over the long-term.

6.5 REDUCE FLOOD RISKS

Flood risk is a major issue for Metro Iloilo and the TAW more generally and one that is likely to be exacerbated by climate change. Significant progress has already occurred on this front in the aftermath of Typhoon Frank, but in our assessment, there are opportunities for further work to achieve greater water security. Several options are described below.

A. PROMOTE ENHANCED LAND USE PLANNING FOR WATER SECURITY

Category: Policy/governance; good management practices

Description. Land use planning refers to a comprehensive process by which decisions are made about the best use of specific parcels of land. While LGUs are required to prepare and submit Comprehensive Land Use Plans (CLUPs) on a regular basis, enhanced land use planning requires access to reliable and updated information about the land, flood hazards, climate data, available water resources, and potential value of the land for different uses, as well as regulations and enforcement capability.

Land use planning can help with all aspects of water security, including improving water supply and quality as well as reducing flood risk. Enhanced land use planning yields long-term benefits and will require improvement of institutional capacities for planning to effectively incorporate into standard development and government processes and practices.

Effectiveness. Land use planning can provide a variety of benefits. Reforestation of upland areas has already received some support as a means of increasing soil moisture and reducing flood hazard. Improving agricultural land use by incorporating terracing or altering tillage practices can have beneficial effects on water use, flood risk, and non-point source agricultural runoff of pesticides or fertilizers.

Climate change is projected to increase flood risks by raising sea level and increasing the frequency and intensity of extreme weather events. Improving land use planning can reduce the property at risk of flood and reduce the intensity of flooding by improving water management during extreme weather events. Benefits to the climate change impacts on water quality and water supply are also possible though enhanced land use planning.

Feasibility. Land use in Metro Iloilo and the TAW has occurred in an ad hoc fashion for many years. Only recently has the idea of land use planning become part of the lingua franca of municipal officials. According to one interviewee, land use planning as a concept only really became popularized in the Philippines around 2005 (Sherwin Bering, Alimodian Municipal Disaster Risk Reduction and Management Officer, personal communication, July 14, 2012). Some attention to land use planning is evident in Iloilo City as they have started relocating informal settlements from areas near the Iloilo River to more suitable locations that have lower flood hazard and less potential to contaminate the river water. While there are a variety of potential barriers to such a program, the apparent success of relocation efforts is a promising sign that enhanced land use is a socially, politically, and financially feasible option. Enforcement capability, however, is a significant ongoing concern. Designating an area a hazardous flood zone and relocating informal settlers does not guarantee that new informal settlers will not repopulate the area. Likewise, it is important to be able to enforce building codes or other regulations designed to protect water resources or minimize flood hazard.

Cost. Land use planning will require administrative costs for regulatory and enforcement institutions and capacity. These will be largely personnel costs. Perhaps the largest cost of land use planning is its impact on property values, the cost of construction, government spending, and a number of ancillary costs.

Implementation timing. Institutionalizing land use planning will require legal, administrative, and cultural changes that are likely to take place over the medium- to long-term. Benefits from improved land use planning are also likely to accrue of these longer time scales.

B. INVESTIGATE IMPROVEMENT OF FLOOD EARLY WARNING SYSTEMS IN METRO ILOILO AND THE TAW

Category: Infrastructure; capacity building

Description. A flood early warning system consists of a series of precipitation and/or flow monitoring stations combined with a communications system to provide proactive warnings to low-lying and flood

prone areas. PAGASA is in the process of the establishing a Local Flood Early Warning System for the TAW. LFEWS are community-based, utilize local personnel, and base their operations center in or near the flood-prone area. Automated rainfall and river-level data are collected by the operations center, but this data is augmented by local volunteer observers.

In Iloilo, it is our understanding that an LFEWS is being developed. PAGASA is reportedly working to establish a local flood forecasting system, including the establishment of automated weather and river stage monitoring gauges that will provide real time data through the Philippine Real-time Data Acquisition and Interpretation for Climate Related Tragedy Prevention and Mitigation (PREDICT) program.[22] Despite these ongoing investments, several stakeholders indicated that they did not think that the flood forecasting capabilities in Iloilo were adequate to mitigate future floods. The research team believes that the USAID project could assist is several aspects of the LFEWS system (illustrated in Figure 7). This could include the establishment of communication centers, warning alarms, river stage monitoring, and precipitations gauges. The involvement of the local community in the LFEWS program provides important opportunities for supporting capacity building, training, and information management support. Since aspects of this system are already being implemented, this would be a near-term project with near-term and long-term benefits.

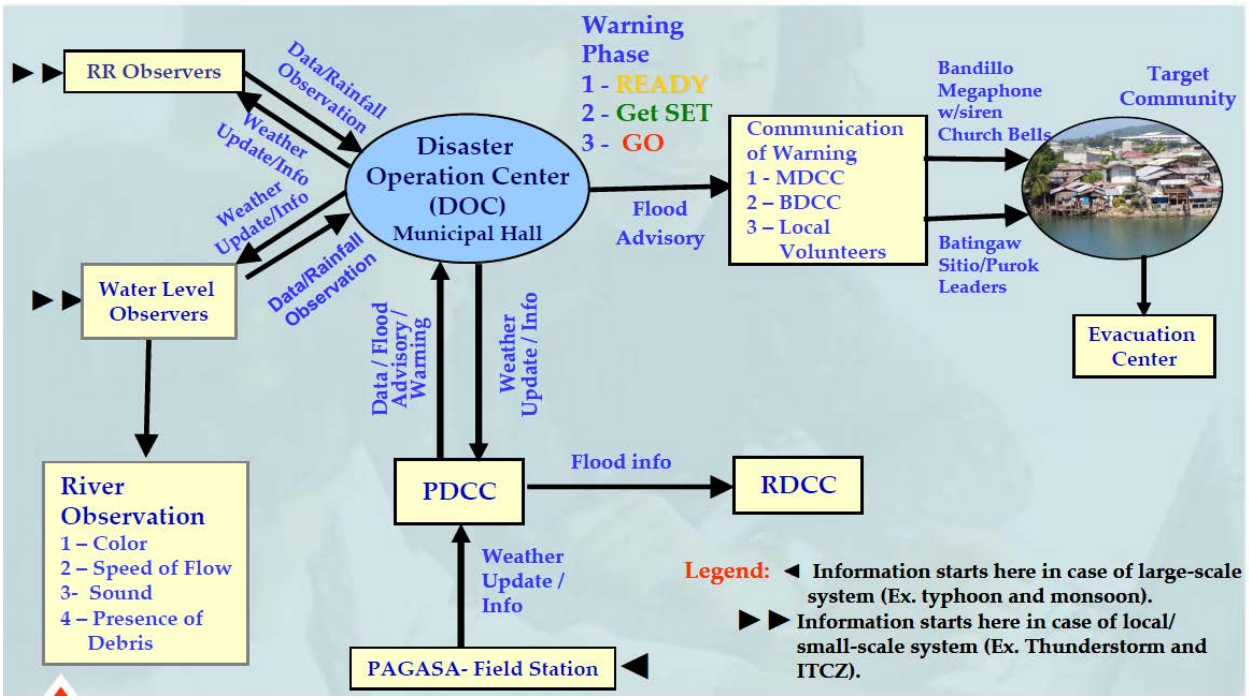

Figure 7. Flow diagram of current early warning system operations.[23]

[22] PREDICT is a nationwide system that is meant to complement the existing observation capability of PAGASA. It consists of a network of automated weather, rain gauges, and water level measurement stations that gather and transmit observation data to a central server through the cellular network.

[23] See PowerPoint: http://www.internationalriversummit.com/downloads/Climate%20Change%20and%20DRR%20Forum/The%20PAGASA%20and%20its%20Flood%20%20Early%20Warning%20Services%20.pdf.

Effectiveness. A flood early warning system can help to prevent or mitigate many of the consequences of a flood. As evidenced by the flooding during Typhoon Frank, and other recent events, the Metro Iloilo community is highly vulnerable to flooding, and the impacts of flooding can be significant. Flooding affects all aspects of society, including water security. Recent flooding events have damaged property and crops, led to landslides, uprooted trees, impaired water supplies and quality, and more. For example, water supply from MIWD to Iloilo City was disrupted when a bridge was knocked loose during the flood and damaged the main supply pipe carrying water from MIWD's water treatment facility in Santa Barbara. This led to dramatically reduced coverage for MIWD water as well as water quality problems (Hechanova, 2009). Typhoon Frank caused significant damage to infrastructure, agricultural production, and businesses estimated at PHP 1.3 billion (US$28 million; Mabilog, 2010).

Climate-driven increases in the frequency and intensity of extreme weather events create an additional incentive to improve the early warning system for floods. Providing early and accurate information about extreme weather events can reduce the impact of these events on public health, safety, and property. Thus, early warning systems may become more important as more intense extreme events happen. A key consideration is to ensure that the coverage of such systems considers changing risks under climate change.

Feasibility. This option is highly feasible as indicated by existing national level initiatives to implement an LFEWS. The technology is available, although data management systems may be more difficult to implement and maintain, because PAGASA is already funding this project along with some private funding by Smart Communications, Inc. The policy environment is ripe for this kind of project. Social acceptance could pose a barrier in terms of response to sirens or flood warnings, but those challenges do not affect the viability of this option, they only suggest that a public outreach campaign and education initiatives will be needed on an ongoing basis. If the system is not accepted, then its effectiveness could be limited.

Cost. The financial costs of a flood early warning system can be modest, but challenging for a local government to fund alone. However, the reduced costs of avoided flood damage typically make for a compelling cost/benefit analysis. The costs however, can vary widely depending on how much of the infrastructure is already funded through PAGASA and how much of a communications system is already in place, as well as training and capacity development. There are no social or environmental costs associated with implementing a flood early warning system.

Implementation timing. Full implementation of a flood early warning system and the associated behavioral changes required for warnings to be effective are likely to require a medium- to long-term commitment.

C. ANALYZE CAPACITY OF ILOILO'S FLOOD MANAGEMENT SYSTEM TO COPE WITH POTENTIALLY ENHANCED FLOODS UNDER CLIMATE CHANGE

Category: Capacity building; good management practices

Description. As noted above, recent investments have been made to improve flood management in the Aganan and Jaro Rivers and the construction of the Jaro River floodway. This project was funded by JICA and consists of the construction of a new outlet channel (Jaro Floodway) and improvement of the Jaro River System as well as improvements for the Iloilo City Urban Drainage System. Lower and upper portions of the Jaro River as well as the Aganan, Iloilo, and Ingore Rivers have been lined with concrete, but built in a manner to allow flood waters to seep through the flood works. The new floodway will channel flood water to the sea. The improvements were made after Typhoon Frank so it is not clear if the new system would avoid or significantly reduce flooding.

With climate change, the concern is that flooding could become more severe. The amount of precipitation from storms and typhoons is projected to increase, perhaps as much as 10 to 20% by the middle of the century. A key question is therefore whether the improved flood management can handle increased flooding. Major floodway improvements by JICA have been designed for a 50-year return period flood with urban drainage improvements for a five-year event. A key question is what climate change will do to reduce the reliability of the flood control system. In other words, by 2050, will the 50-year storm become the 30-year storm because of the increased intensity of precipitation projected to happen because of climate change.

The current flood control system would be modeled to assess the degree of protection provided against different magnitude floods. The degree of protection would include whether there is any flooding and what areas would be at risk. The magnitude of flood would consider the size e.g., flood height, stage as well as return period. This analysis would first be done under historic (observed) climate conditions. It would then be done under various scenarios of change in precipitation from climate change. Among the issues to resolve is how far into the future the analysis should go. The analysis could determine whether the current flood infrastructure provides protection at least up to the intended 50-year standard and the extent to which the standard may be at risk in the future because of climate change.

The analysis could be done using the widely accepted USCOE HEC-RAS (U.S. Army Corps of Engineers Hydrologic Engineering Center River Analysis System) model. Key inputs to the model include topography, cross-section analysis, stream flow characteristics, long-term precipitation data, and other factors governing the flood characteristics of the watershed. This model can be coupled with GIS and the results can be distributed through an Information Clearinghouse. This in turn can assist land-use planners, insurance companies, and other government agencies in watershed management.

Effectiveness. The benefit of the analysis is to assess the extent to which current flood control infrastructure and measures, in particular, recent investments in flood protection, protect against the potential for more intense floods under climate change. Done well, the analysis should provide information on the capacity of the flood control system to withstand more intense floods in the future.

Climate change may increase the likelihood of flooding by raising sea level and increasing the frequency and intensity of extreme weather events. Developing sophisticated analysis of these risks and their consequences will aid planning that can reduce the negative effects of floods on public health, safety, and property. Incorporating climate projections into this analysis is essential as past conditions are unlikely to provide a full picture for future vulnerabilities. For example, it is not clear whether the JICA-funded Iloilo Flood Control Project took climate change into account in its design standards. Future phases of this project might benefit from considering projections of future climate conditions in the design process.

Feasibility. It is feasible to use hydraulics analysis to analyze the effectiveness of the flood management system. If a new hydraulics model is to be built, data availability is a key factor. Climatological data, topography, land surface, and data on other factors is needed. If the data are available, they may have to processed. If they are not available, then they will have to be collected. The latter could substantially increase costs.

Cost. It is our estimate that the assessment would cost in the range of US$50,000 to US$200,000. A very detailed hydraulics analysis would skew toward the higher end of this range. On the other hand, if a hydraulics model was built to assess the effectiveness of the Iloilo Flood Control Project, perhaps that model could be run with climate change scenarios to estimate the potential increased risks. In that case, the cost may be toward the lower end of this range.

Implementation timing. Depending on data needs, an assessment of flood control capacity could be completed in the short- to medium-term. Benefits of such an assessment would stem from long-term improvements to the area's flood control infrastructure.

6.6 REFORM SECTOR GOVERNANCE

Fragmentation and lack of coordination among regulatory requirements and decision-making processes was identified by many participants as the single greatest barrier to improving water resources management and promoting water security. In our assessment, the interviewees that identified this issue as critical were quite correct. Very basic questions about authority, control, enforcement, institutional capacity, and coordination garnered different answers from different people representing a variety of institutions. Consequently, we identified several targeted options to reform sector governance which are described below.

A. IMPROVE WATER SECTOR ACCOUNTABILITY AND COORDINATION

Category: Policy/governance; good management practices

Description. As noted earlier in this report, water governance in the Philippines broadly, and in Iloilo specifically, suffers from a high level of fragmentation and lacks a coherent unifying framework for planning and implementation. These structural and institutional issues have left the water sector in Iloilo vulnerable to corruption and patronage. Some interviewees alluded to patterns of patronage in providing water connections and repairs of service-related infrastructure, deliberate lack of enforcement or collection of fees as a result of patronage or political influence, deliberately overpriced tariffs, and general misuse of water service fees and public funds allocated to the sector. Moreover, the mismatch between political election cycles and the timeline for the necessary sector improvements was cited several times as a key obstacle to achieving water security objectives.

Underlying many of these issues is the fact that there are few incentives and mechanisms to hold the various institutions and stakeholders within the sector accountable and ensure that decisions are being taken in the public interest and in line with the stated public objectives or policies. To achieve these goals, this option proposes a sector accountability assessment to identify specific mechanisms for improving transparency, accountability, and coordination in Iloilo.

One tool that has been developed to undertake such an assessment is the Annotated Water Integrity Scan (AWIS), developed by the International Water and Sanitation Centre (IRC) and the Water Integrity Network (WIN).[24] The AWIS methodology provides a relatively quick snapshot of integrity and accountability issues within the water sector through convening one or more multi-stakeholder workshops that map sector integrity risks, increase stakeholder awareness about integrity issues, identify priority areas for action, and can document change over time if convened throughout the process. A key resource for undertaking this analysis is the OECD's analytical framework for understanding key gaps in multilevel governance in the water sector of its member States.[25]

The AWIS, or a similar rapid participatory assessment process, can be used for prioritizing immediate actions or, if necessary, can provide the baseline information for more detailed analysis of specific issues related to sector accountability. Additional diagnostic tools that could be used in this context have been

[24] More detailed information on the AWIS process, including a manual for undertaking the process, is available at http://www.waterintegritynetwork.net/awis/awis.

[25] Available at http://www.oecd.org/gov/regionaldevelopment/watergovernanceinoecdcountriesamulti-levelapproach.htm.

developed and piloted by Transparency International[26] and the World Bank Institute and Transparency International.[27]

Once the diagnostic study has been undertaken, specific mechanisms and activities for improving sector accountability can be pursued. A critical part of these activities will be capacity building and training for local government, civil society, and the private sector on ways in which new mechanisms can be used and how to monitor implementation (see Option 6.6.B).

Effectiveness. The analysis proposed in this option would fill a critical information gap and highlight areas for targeted intervention to improve that enabling environment that could then form the basis of a work program.

Climate impacts are likely to increase stress on the Iloilo water management system, which has evidenced an inability to meet present needs. Weak governance systems are more likely to show strains under the pressures of climate change than in a stable climate. Many good ideas to address climate stressors as well as non-climate stressors are not being implemented because of fragmented authority and control over water resources. Improving integration in the water sector and ensuring the accountability of those with authority over the resource is critical to empowering the kinds of bottom-up solutions that were generated by stakeholders in the TAW.

Feasibility. The tools highlighted have been successfully implemented in other contexts, and there is sufficient expertise and understanding of the issues to develop a tailored analysis for Iloilo. The requisite expertise is a critical aspect in order to uncover and elicit the necessary information from stakeholders and to avoid the potential political and social risks inherent in uncovering issues related to accountability and corruption. There is also potential political risk involved in undertaking this type of analysis. Many actors in the sector have a vested interest in maintaining the status quo and stand to lose either political power or opportunities for financial gain as the spotlight is shown on issues related to accountability and corruption. While these risks are not avoidable, they can be managed appropriately and effectively if an appropriate process is undertaken that avoids marginalizing key stakeholders and manages expectations. This requires specific expertise and should be carefully planned in order to avoid political marginalization of the project/staff.

Cost. The monetary cost of this option could vary depending on the depth of the analysis undertaken. A rapid assessment focusing on water services could be undertaken in one to two participatory workshops. The additional analysis recommended would require an expert national or international consultancy, optimally with travel to Iloilo on at least two occasions to initiate the process with a diagnostic workshop and conduct follow-on interviews, and then to undertake one or more additional workshops to review the results and track progress. The overall budget for this would be on the order of US$200,000.

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[26] Transparency International (TI) has developed in-depth analyses of water service sector integrity in Kenya, Ghana, and Senegal through a Transparency, Accountability and Participation ("TAP") Risk Mapping tool. TAP identifies relevant stakeholders and assesses the integrity of their relationships in terms of transparency, accountability, and participation using specific definitions of each pillar of "water integrity" and through detailed questionnaires tailored for each group of stakeholders involved. The Kenya report is available at www.tikenya.org.

[27] Transparency International and the World Bank Institute have developed a manual on *Improving Transparency, Integrity and Accountability in Water Supply and Sanitation* that includes a conceptual framework for understanding corruption in the sector, several diagnostic tools, case studies that have used a number of tools to improve sectoral and institutional accountability, and a planning process for sector actors to address these issues and tailor the tools to their situation. Available at http://www.oecd.org/environment/environmentinemergingandtransitioneconomies/44475062.pdf.

Implementation timing. The tools needed to conduct this assessment are readily available. With appropriate expertise, an assessment could be completed in the short-term. Improvements to water services based on the findings of an assessment would require a longer-term commitment.

B. BUILD CIVIL SOCIETY CAPACITY TO ADVOCATE FOR WATER SECURITY

Category: Capacity building

Description. Many of the water governance challenges in Iloilo stem from the lack of transparency in decision-making and the need for improved accountability on the part of the various government agencies that have authority over various aspects of water management. One of the major weaknesses in the institutional landscape of Iloilo and TAW that is contributing to these issues is the apparent lack of organized civil society engagement in the water sector. While many stakeholders are active in various aspects of the sector, there appears to be only one nongovernmental organization – the *Kahublagan sang Panimalay* Foundation – playing the role of government watchdog on water issues.

This option proposes to identify and build the capacity of additional civil society organizations throughout Iloilo City and the TAW to more effectively advocate for improved water security in the region. Civil society is deeply rooted in Filipino culture, and CSOs have a critical role to play in building public awareness of water security issues and facilitating necessary behavior change; holding government officials accountable; increasing transparency and representativeness in water-related decision-making; and mobilizing action on critical issues.

There are a number of issues that could form the basis for CSO capacity building, and a project developed to address this issue could work with a broad cross-section of CSOs including, for example, the Tourism Board and the Business Council, as well as NGOs with a mandate related to sustainable development, public health, or environmental protection. Once these groups are identified, targeted training materials could be developed to build their awareness on a variety of water security issues and a suite of advocacy tools that can be used to more effectively engage civil society in water management, decision-making, government oversight, and enforcement. This could also involve training journalists on reporting on water issues and training legal NGOs or CSOs on public interest litigation in the sector.

Because of their longstanding experience as an active CSO in the sector, the *Kahublagan sang Panimalay* Foundation could be engaged to work as a local partner, helping to identify the relevant CSOs, create training materials and conduct workshops. Materials can also be drawn from the vast amount of existing resources developed by other organizations and freely available to adapt to the needs of CSOs in Iloilo.

Effectiveness. Civil society organizations have a critical role to play in building public awareness of water security issues and facilitating necessary behavior change; holding government officials accountable; increasing transparency and representativeness in water-related decision-making; and mobilizing action on critical issues. The lack of advocacy on the part of civil society for critical water issues is a serious weakness in the overall governance of the water sector in Iloilo. These interventions would thus be extremely effective in building the enabling environment for sustainable water security in the region.

Projected increases in the variability of weather, changes in the timing and intensity of precipitation and storms, and sea level rise will impact water quality, water supply, and flood management. It was clear, in speaking with stakeholders in Metro Iloilo, that they had many promising solutions in hand. However, they often lacked the organization to engage in the political process in an effective way to realize their interests in the TAW. Enhancing capacity will allow for the implementation of many solutions to climate impacts that would otherwise fail to be taken seriously by authoritative institutions.

Feasibility. It will initially be necessary to ensure that CSOs from various sectors understand why water security is relevant to their mission and this may involve some outreach prior to beginning any capacity

building work. Consulting or partnering with the *Kahublagan sang Panimalay* Foundation would likely help identify any political issues and facilitate implementation.

Cost. The cost of this option will depend on how extensive the training materials and capacity building trainings are. Overall, this is quite a low-cost option.

Implementation timing. Measures to build decision-making capacity could begin immediately and yield benefits in the medium-term. Continued commitment to maintaining the necessary expertise is necessary as technology evolves over the long-term.

C. ANALYZE OPTIONS FOR PUBLIC/PRIVATE PARTNERSHIPS IN SUPPORT OF WATER SECURITY

Category: Capacity building; policy/governance

Description. As noted in Section 2, the majority of residents and commercial establishments in Metro Iloilo are not provided treated fresh water. There are also numerous institutional issues related to in the governance of MIWD that inhibit effective service provision. High levels of political infighting have prevented progress in attracting the necessary capital and technical support to expand services. Moreover, interest rates on the Local Water Utilities Association loans are reportedly too high to provide reasonable levels of financing and the LWUA itself was struggling to raise sufficient capital from donors. In addition, requests for tariff increases to LWUA have so far been ignored. Overall, there appears to be a clear need for a more effective business model for the utilities in Metro Iloilo and TAW to reduce non-revenue water (NRW), increase cost recovery, and support the necessary investments in infrastructure repair and expansion to meet growing demand.

Increasingly, countries around the world (including Manila Water Company in the Philippines) have turned to various forms of public-private partnerships to achieve water service and management goals that have not been possible with public sector reforms alone. Engaging with a private service provider can provide increased access to financial resources, as banks and other financiers are likely to invest more in a utility with a credible, commercial management approach (World Bank, 2010). The process of creating a successful PPP also presents a unique opportunity to address issues related to policy clarity (for example, related to tariff-setting) and sustainability of the enterprise in a way that isn't necessarily politically feasible under a public sector reform process. Ultimately, PPPs provide an opportunity to create accountable mechanisms for improved service provision, expansion, and cost recovery if they are regulated appropriately.

This option would require a careful planning process to determine the scope of the PPP, the precise set of issues that the private firm would address (including level of risk-bearing for billing, operational costs, expansion, capacity building or technical assistance to MIWD, etc.), and the appropriate type of PPP to achieve the articulated goals. This would entail a participatory process, led preferably by an expert in private sector engagement in partnership with LGUs and other stakeholders to facilitate an honest assessment of the issues and their underlying causes. The analysis could examine the incentives and disincentives for effective management, LWUA's role in providing effective financial and technical support in the region, and how patronage and corruption affect expansion of services. These are issues not only for MIWD, LWUA, and LGUs to answer, but also for customers, the unserved public, existing bulk suppliers, and others.

Effectiveness. If the planning process recommended above is undertaken, this option should provide an effective mechanism for further identifying specific regulatory, financial, and administrative challenges to maintaining and expanding service delivery in Iloilo. Whether the ultimate decision is to proceed with public sector reform or to enter into a form of PPP, this information is a key step in achieving better utility accountability and more effective service provision. However, if structured inappropriately, private

sector involvement can lead to lower levels of access and higher cost burdens to those who can least afford it. There is also the potential for corruption or patronage in the selection of the firm involved. Capacity building for both structuring the PPP agreement and regulatory oversight of its implementation and enforcement are therefore critical.

Climate change is perceived as a threat to the economic interests of private parties in Metro Iloilo. Our interviews with the Iloilo Business Club and other business sector organizations indicated an informed and well intentioned set of private stakeholders frustrated with the inability of the public sector to establish the foundation for economic prosperity in the region, including preparing for climate disasters and climate change. PPPs present an opportunity to encourage investment in planning, building, and maintaining both distributed and centralized infrastructure. It also offers an opportunity to remove some of the governance impediments to good climate adaptations by empowering a partnership of private interests and public institutions. This capacity is already needed, but pursuing this option can effectively reduce non-climate as well as climate stressors.

Feasibility. MIWD is entrenched both politically and legally, and so an arrangement that alters the power structure and control over service provision may be difficult to achieve from a political standpoint. From a technical standpoint, there is a wealth of expertise and experience on which to draw to structure an appropriate arrangement (including the World Bank's Public-Private Infrastructure Advisory Facility (PPIAF) and the Asian Development Bank's PPP guidance). However, as noted above, the success of PPPs is highly dependent on a legitimate and accountable planning process and the capacity of the local government to actually regulate the implementation of the arrangement. The feasibility of a workable PPP in Iloilo will thus depend on how well this process is structured and the effectiveness of the capacity building component.

Cost. The costs of this option include the hiring of national or international experts on utilities reform and private sector participation, which could range anywhere from US$25,000 to US$100,000. Additionally, there are the costs associated with consultations with various stakeholder groups and meetings with relevant agencies. If a process for contracting with a private firm is entered into, there may be additional costs for ensuring the regulatory framework is structured appropriately to ensure effective implementation and enforcement of the concession or contract, including potentially the training of existing or hiring of new staff.

Implementation timing. An assessment of the potential for the creation of PPPs could be completed in the short-term. Accomplishing any necessary regulatory reforms to encourage the participation of the private sector will likely require a medium- to long-term commitment.

6.7 DEMONSTRATE CROSS-CUTTING SOLUTIONS

In addition to the options above that address specific water security issues, we identified two options which cut across many of the water security issues facing Iloilo. These options are better characterized as case studies or demonstration projects that could provide important information on many aspects of water security in metro Iloilo.

A. CONDUCT AN URBAN AND RURAL WATER, SANITATION, AND HYGIENE (WASH) STUDY FOR METRO ILOILO AND THE TAW

Category: Policy/governance; infrastructure; capacity building; good management practices

Description. As noted throughout this report, MIWD and other Water Districts are able to provide water services to only a small portion of the population within the study area. Most households – both within Metro Iloilo and in the peri-urban and rural areas of the TAW – continue to rely on untreated surface or groundwater sources for their domestic and livelihoods needs. Option 6.3.A.2 above suggests

an approach that involves identifying pilot communities to create sustainable community-based water supply systems to overcome this deficiency in access to water. Option 6.4.A proposes point-of-use treatment at the household level to reduce the expense of relying on bottled or purchased bulk water for domestic purposes. Option 6.4.D recommends undertaking a comprehensive assessment to identify appropriate wastewater treatment options for Iloilo City and the TAW. The proposed demonstration initiative builds on these options and recommends a broader, integrated approach to identifying and implementing WASH solutions at the community level in selected urban, peri-urban, and rural communities within Iloilo City and the TAW.

USAID could work with local government and civil society to identify three to five pilot communities within Iloilo City, a peri-urban area, and the rural regions of the TAW to undertake an integrated, community-based WASH demonstration project that would incorporate options for: (1) improved service delivery supported by community-based institutions; (2) point-of-use treatment options for communities that rely on untreated sources either in lieu of or in combination with improved service delivery; (3) wastewater treatment options to improve water quality and augment supply for irrigation or other appropriate purposes; and (4) additional community-based sanitation options to improve household and community-level health and hygiene and reduce impacts on water sources from open defecation or other poor sanitation practices.

As noted, this option builds on other options proposed in this report and could thus provide a mechanism for integrating the findings of the recommended assessments, building community awareness of and institutions for addressing water security issues, and identifying targeted solutions that significantly improve the overall water security in those communities.

Once communities have been identified, USAID could partner with local government, community leaders and civil society to conduct multi-stakeholder workshops that present the findings of the broader assessments and lay out options for use at the local level. The workshops could be used to identify community priorities, preferences, and resources that could contribute to effective implementation in each of the areas. The workshops would also provide a meaningful mechanism for raising awareness of water security issues, building relationships among the relevant stakeholders, and identifying local champions and institutional mechanisms for implementing the work. The workshop may need to be complemented by more targeted stakeholder interventions, such as focus group meetings, household interviews, and further studies on the specific characteristics of the local water resource(s).

The options that are derived from the community coming out of these workshops and other stakeholder consultations could provide the basis for a proposal that could then be vetted with community leaders and other relevant stakeholders before implementation.

Targeted training workshops would then be necessary to build the capacity of local stakeholders to help undertake the technical aspects of the work or to demonstrate the use of specific technologies and their maintenance, as well as in the administrative and financial aspects of service provision options. With respect to the sanitation component, community-led total sanitation (CLTS) methodologies could be employed to elicit appropriate options and encourage the necessary behavior changes.

Effectiveness. This option could be very effective in determining a variety of targeted and integrated packages of water security solutions that can be implemented and sustained at the community level. Each of the components have been broadly tested in the Philippines and around the world, but require additional assessment in order to tailor the institutional and technological responses to the needs, priorities, and constraints of the specific communities in Iloilo and TAW. By integrating several of the options in this report to identify such targeted solutions, this option could significantly improve overall water security in the identified communities, build the capacity of the local government and civil society, and provide options for scaling up throughout Iloilo and the TAW. Since these measures would likely

improve the performance of the water management system, they will likely help enhance water supplies and decrease community vulnerability to climate change.

Feasibility. Integrated, community-based WASH projects have proven to be extremely effective when they are structured appropriately. As stated, this demonstration builds on other, feasible options proposed and could provide a mechanism for capitalizing on the findings of various water security interventions while significantly improving community-level water security and creating a suite of options and lessons for scaling up throughout Iloilo and the TAW.

Cost. This option builds on information that would be generated by other proposed options. Additional costs would stem from the workshops and targeted interventions that are necessary to identify relevant community stakeholders and build the necessary capacity to implement and sustain the interventions. Additional institutional oversight and development of local capacity may be needed. Workshops, if locally run, can cost about US$10,000 to US$20,000 each. Capacity building would also require training. If U.S. or other foreign facilitators or trainers are needed, costs could be higher. Implementation of options such as treatment would require investments in capital.

Implementation timing. Developing an integrated strategy will require a short-term planning effort. Implementation of these strategies will likely occur over the medium- to long-term. Benefits that accrue from these reforms will be realized over the medium- to long-term as implementation proceeds and behavior evolves.

B. DEVELOP A CASE STUDY OF LESSONS LEARNED AT SM MALL APPLICABLE TO COMMERCIAL DEVELOPMENT OF OLD AIRPORT

Category: Policy/governance; infrastructure; capacity building; good management practices

Description. Some economic development is occurring in Metro Iloilo despite explicit concerns by developers and business interests about unreliable and high-cost water supply. A prime case in point is the recently developed SM Mall. Another major infrastructure project is underway to redevelop the old airport site into a commercial hub known as the Iloilo Business Park.[28]

Stakeholders said the SM Mall ensures adequate water for its commercial operations by utilizing independent water deliveries by private water purveyors to fill onsite cisterns. They also reported that the building engages in some level of water re-use and onsite water treatment before releasing wastewater into the environment. Effectively, the SM Mall has ensured water security on site to allow this commercial development to thrive in the near-term while the water supply situation is resolved on a longer time frame. This case could be explored more thoroughly to better understand the reasons certain decisions were made, the tradeoffs between various options for water security, and lessons learned to enable future commercial developments like the Iloilo Business Park.

One of the conditions of the developer for the Iloilo Business Park is that they have an adequate supply of water supplied by MIWD. It is unclear at this time whether MIWD plans to drill wells on site, connect the Iloilo Business Park to its existing distribution system, or supply water through truck deliveries. A considerable amount of analysis is needed to determine the most viable among these options.

The option could consist of the following elements:

Water Supply: Working with MIWD and other appropriate stakeholders, an economic evaluation could be made to determine the most cost-effective approach to supply water to the Iloilo Business Park, including trucking water in, the use of shallow wells with desalination, drilling of deep wells, and

[28] See http://www.exploreiloilo.com/megaworlds-iloilo-business-park-project-overview.

connecting the development to MIWD's distribution system. In addition, rainwater harvesting could be used to augment water supplies by utilizing rooftops as well as storm water collection systems in parking lots.

Wastewater Treatment: Working with the various industries and commercial clients as well as the MIWD, various wastewater treatment systems could be evaluated. These could include turn-key systems or innovated systems such as bioreactors and wetlands. The system would be planned in a way that grey water could be separated and used for toilet flushing and plant watering. This water would be used to augment water supplies or offset water demand.

Water Recycling and Minimization: Most modern industries as well as commercial properties use internal methods to reduce water use to cut down costs. These include the use of waterless urinals such as those used at the SM Mall or recycling water in plants. External experts could work with various industrial and commercial owners and designers to develop appropriate and economically viable methods of water recycling and minimization.

USAID could work with MIWD as well as the Iloilo Business Park developers on a pilot program to develop an integrated commercial/industrial water management plan for the property. The overall objective of the plan would be to develop a sustainable water supply for the site and through a combination of conservation measures, water recycling, treated wastewater reuse, and storm water management (including rainfall harvesting) provide an efficient water management system. The SM Mall could be used as a local example of such a commercial/industrial park integrated water management program. This pilot project could be diffused and adapted to other development projects in the Metro Iloilo area.

Effectiveness. Such a site-specific, integrated water resource management plan could be effective in attracting commercial and industrial developers by providing greater assurance that the water needs of current and past commercial developments have been met and within specific cost ranges. Integrated water resource planning provides security against stresses such as supply and seasonal shortage, flooding, drought, water quality issues, and affordability. Furthermore, such a plan can assure that commercial/industrial developments can accommodate changes in precipitation and temperature patterns as well as storm and flooding regimes. We envision this plan would tackle the following three aspects of water security explicitly by:

- Providing a demonstration as to how water can be managed commercially in such a way that industries, hotels, and other enterprises are only marginally affected by prolonged drought
- Securing a long-term reliable supply of water for commercial areas
- Reducing the burden on MIWD by reducing the amount of water required to maintain these enterprises
- Being a potential water resource for the surrounding community during times of drought

Feasibility. The feasibility of such a study is largely dependent on the willingness of the MIWD and the potential clients of the park to work with USAID, local government units, or others on the study. There is no guarantee that the developers will accept the recommendations of the study, but since this pilot project is intended as a proof of concept to attract other commercial and industrial development, it may not be critical that the developer follow through on the recommendations.

Cost. This program is expected to be a feasibility study determining the economic viability of water management for large commercial and industrial developments in Metro Iloilo. Consequently, the costs should be quite modest, but may vary depending upon the extent to which local versus out-of-country

expertise is used. There will be different financial, social, and environmental costs and benefits to the various options examined in this feasibility study, but the feasibility study itself is expected to generate no social or environmental costs. We estimate that, depending on the level of expertise and technical detail of the study, a feasibility study could cost US$25,000 to US$75,000.

Implementation timing. Because initial construction of the Iloilo Business Park is already underway, this case study would need to be implemented immediately. Since development is already underway, this project may be a bit late to change the design of the Iloilo Business Park. Nevertheless, the lessons learned both from the SM Mall and from the Iloilo Business Park could inform future development in the Metro Iloilo area.

7. SUMMARY OF ADAPTATION OPTIONS

To assist in prioritizing the various options for adaptation measures, we have developed a simple reference guide in the form of the two tables below. The tables present summary information on six criteria: category, effectiveness, feasibility, cost, implementation timing, and vulnerability addressed. Two of these criteria – category and vulnerability addressed – are categorical in nature and are illustrated with check boxes (note that many adaptation options fall into more than one of these categories). The other four criteria involve making qualitative expert judgments about the ability to satisfy the four evaluative criteria – effectiveness, feasibility, cost, and implementation timing. Table 1 presents the guidelines used for these evaluative criteria. The full adaptation option summary is in Table 2. Note that three of the evaluative criteria – effectiveness, feasibility, and cost – are color coded to facilitate quick reference. In this color coding scheme, green represents a superior scoring (i.e., high effectiveness, high feasibility, low cost), yellow an intermediate score, and red an inferior score (e.g., low effectiveness, low feasibility, low cost).

The ranking provided in Table 2 is intended to be illustrative only. The ranking of each adaptation option is extremely subjective and should typically be done in consultation with stakeholders. For example, the effectiveness criterion is defined here as the directness of contribution to water security, but this may be a deceptive ranking. Note how this definition of effectiveness ranks all governance options as "low" effectiveness by definition, even though governance issues feature prominently in this report as critical for water security in Iloilo. Also note that this table does not synthesize information. For example, cost and effectiveness, when considered in isolation, can lead to a biased assessment. Synthesizing the two rankings to evaluate "cost effectiveness" may be a more desirable criterion for choosing among adaptation options.

Table 1. Guidelines used to assign values to the four evaluative criteria across all 22 adaptation options.

Criteria	**High**	**Medium**	**Low**
Effectiveness	Directly improves water security	Contributes to improving water security	Multiple steps away from improving water security
Feasibility	Technology/expertise is readily available; reform is widely supported	Technology/expertise may be accessed; some support exists	Technology/expertise must be developed; opposition may to reform may exist
Cost	Millions US$	Hundreds of thousands US$	Tens of thousands US$
	Short	**Medium**	**Long**
Implementation timing	~ 1–3 years	~ 3–7 years	~ 7+ years

Table 2. Summary table for all 22 adaptation options in Section 6.

Option	Category				Vulnerability addressed			Effectiveness	Feasibility	Cost	Implementation timing		
	Infrastructure	Capacity building	Policy/ governance	Good mgmt practices	Water quality	Water supply	Flooding				Short	Medium	Long
1.A Develop a long-term water security and climate change monitoring program		✔		✔	✔	✔	✔	Medium	Medium	Medium	✔	✔	✔
1.B Evaluate and enhance groundwater for the Metro Iloilo area		✔				✔		Medium	High	Low	✔	✔	
2.A Enhance monitoring network for supply, quality, and flooding	✔	✔		✔	✔	✔	✔	Medium	Medium	High		✔	✔
2.B Develop an information clearinghouse for all water-related data in Metro Iloilo and the TAW		✔			✔	✔	✔	Medium	Low	Medium	✔	✔	
2.C Develop capacity for information-based management decisions among municipal and provincial resource managers		✔		✔		✔		Low	High	Low	✔		
3.A.1 Implement rainwater harvesting in the Metro Iloilo area	✔	✔				✔		High	High	Low	✔	✔	
3.A.2 Develop community-based potable water supplies	✔	✔				✔		High	High	Low	✔	✔	
3.A.3 Pursue demand-side management in the Metro Iloilo area			✔	✔		✔		High	Medium	Low	✔		
3.B.1 Reduce MIWD non-revenue water	✔			✔		✔		High	Medium	High	✔	✔	
3.B.2 Conduct a feasibility study of MIWD treatment of Jalaur water	✔				✔	✔		High	High	Medium	✔		
4.A Evaluate point-of-use source water treatment for near-term potable water provision	✔	✔			✔			Medium	Medium	Medium	✔		

Option	Category				Vulnerability addressed			Effectiveness	Feasibility	Cost	Implementation timing		
	Infrastructure	Capacity building	Policy/ governance	Good mgmt practices	Water quality	Water supply	Flooding				Short	Medium	Long
4.B Improve compliance and enforcement capacity to achieve water quality goals		✔	✔		✔			Medium	High	Low	✔		
4.C Develop a sanitation information and education campaign		✔		✔	✔			High	High	Low	✔		
4.D Analyze Metro Iloilo options for addressing wastewater		✔	✔		✔			Low	Medium	Medium	✔		
5.A Promote enhanced land use planning for water security			✔	✔			✔	Medium	Low	Medium		✔	✔
5.B Investigate improvement of flood early warning systems in Metro Iloilo and the TAW	✔	✔					✔	Medium	High	Medium		✔	✔
5.C Analyze capacity of Iloilo's flood management system to cope with potentially enhanced floods under climate change		✔		✔			✔	Low	High	Medium	✔	✔	
6.A Improve water sector accountability and coordination			✔	✔	✔	✔	✔	Low	Medium	Medium	✔		
6.B Build civil society capacity to advocate for water security		✔			✔	✔	✔	Low	High	Low	✔		
6.C Analyze options for public/private partnerships in support of water security		✔	✔		✔	✔	✔	Low	Medium	Low	✔		
7.A Conduct an urban and rural WASH study for Metro Iloilo and the TAW	✔	✔	✔	✔	✔	✔	✔	High	High	Low	✔	✔	✔
7.B Develop a case study of lessons learned at SM mall applicable to commercial development of old airport	✔	✔	✔	✔	✔	✔	✔	High	Medium	Low	✔		

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