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Economic Cooperation

Good Practices for Securing Drinking Water and Conserving of Water Environment

APEC Public-Private Dialogue on Water

Initiative for Inclusive Resilience and Sustainability

Senior Officials' Meeting

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Chapter 1 Executive Summary

Background

Water has been commonly recognized as one of the most important issues in urbanizing economies. Many economies and cities have encountered water shortage and water pollution issues and there is a strong need for sharing good practices to overcome these challenges among APEC economies.

In May 2015, Ministers Responsible for Trade (MRT) “acknowledge(d) the importance of addressing water issues such as serious water pollutions and shortage in urban areas.”, and MRT also “welcome(d) the endorsement of APEC Water Initiative." This initiative contributes to “building sustainable and resilient communities", and urbanization agenda in APEC. It was also mentioned that MRT “look forward to outcomes” of this Dialogue.

In this context, Public-Private Dialogue (PPD) on Water was held on 1 September 2015 at Marriott Hotel Sapaguita Ballroom in Cebu City. The PPD included following topics;

1) Challenging Water Shortage and Water Pollution
2) Securing Drinking Water
3) Conservation of Water Environment by mitigating water pollutions
4) Towards a healthy water environment for sustainable development

This PPD welcomed 122 Participants including government and private sectors and experts from 8 economies. In the dialogue, Good Practices on water were shared, and its result was reported to Friends of the Chair on Urbanization 3 September 2015 and Third Senior Officials’ Meeting (SOM3) on 5-6 September 2015.

Key findings

In this PPD, following findings were shared;

1) Water shortage:
   - ✓ As the demand for water supply increases with urbanization and population growth, water shortage will be more serious.
   - ✓ The world’s population tripled and the use of water grew six times in the 20th century.
   - ✓ Only less than 0.01% of the water in the planet is available to use.

- ✓ Climate change will exacerbate this issue.

2) Water pollution:
   - ✓ Human-generated water pollution is a serious threat to human and ecosystem health.
   - ✓ 4,900 children are dying every day because of the lack of sanitary water.
   - ✓ Inadequate wastewater management causes crucial environmental problems.

Good Practices

Good Practices were shared as follows;

1) Challenging water shortage and water pollution
   - ✓ Septic tank with solar-heated water for efficient wastewater treatment proposed by Thammasat University
   - ✓ Vision and actions for water and wastewater management in Metro Cebu

2) Securing drinking water
   - ✓ Advanced analytical method for ground water contamination with field cases in Chinese Taipei
   - ✓ Water desalination systems for alternative water resource management in Australia

3) Conservation of water environment by mitigating water pollution
   - ✓ Legal and financial framework, and wastewater management technologies (Johkasou and public sewerage system) in Japan
   - ✓ Legal and technological solutions for domestic wastewater in Ha Noi, Viet Nam
   - ✓ Global platform of water education for mitigating water pollution from the United States

4) Towards healthy water environment for sustainable development
   - ✓ Novel financial evaluation called “Life Cycle Cost” for building efficient wastewater management system proposed by Japan
   - ✓ Technologies for leakage control and capacity building of the operators in

the Philippines, as cooperated by Yokohama City

Way forward

Through these good practices, it was commonly acknowledged that water issues are major challenges in urbanization and immediate actions are required to avoid further water shortage and pollution that may cause serious problems to the next generations.

For overcoming these challenges, legal and technical as well as “human” solutions (i.e. public education) are undoubtedly essential. When discussing on water shortage and pollution, it is important to engage not only central governments but also municipalities and the private sectors. Furthermore, it is effective to deepen cross-border cooperation between developed and emerging economies, which involves such a wide range of stakeholders.

APEC is an excellent platform to provide an opportunity where local people in different economies can meet together and cooperate with each other. APEC can also play an important role in awareness-raising of the general public on water issues. It is therefore expected that APEC’s urbanization agenda would continue to focus on this matter.

Chapter 2 Good Practices

2-1 Session1: Challenging Water Shortage and Water Pollution

2-1-1 Water Shortage and Pollution Issues in the Urbanizing Economies

Chongrak Polprasert in Department of Civil Engineering, Faculty of Engineering, Thammasat University, Thailand, **Thammarat Koottatep** and **Tatchai Pussayanavin** in Environmental Engineering and Management, School of Environment Resources and Development, Asian Institute of Technology, Pathumthani, Thailand

The world population is currently about 7 billion people with more than 50 % of them living in urban areas. Urbanization in many economies is generally due to the economic growth in the past 40 years. A recent report of the United Nations (2009) estimated more than 66 % of the world's population will add to the urban population by 2050. In fact, population growth especially in developing economies, has caused negative impacts not only on poverty alleviation, but also the global environmental problems. Hinrichsen et al. (1998) estimated the demand for global freshwater to be about 64 billion m^3 per year, and due to inadequate water resources, the percentage of the world population affected by water-scarcity could increase up to 47% in a mere three decades. Lack of access to basic sanitation facilities is one of the most important concerns of global water pollution. Due to limited of wastewater treatment facilities in the urbanizing economies, water pollution problems are also increasing with more than 1,000km^3 of untreated wastewater from human activities (blackwater and greywater) being discharged to nearby canals and rivers. Fecal contamination is often detected in the water environment in many economies such as Thailand, China, India, and Iran (Carr and Neary, 2008). Furthermore, water pollution by the emerging pollutants such as pharmaceutical and personal care products (PPCPs), widely used nowadays, is normally caused by wastewater discharges from households, hospitals, livestock farms and related industries. PPCPs can accumulate and magnify in the food chains, causing impacts to the environment and public health including occurrence of drug-resistant pathogens. The conventional wastewater treatment technologies have been found to be ineffective in removing PPCPs from the waste streams. Another major environmental concern is global warming due mainly to burning fossil fuels to produce energy, which has caused negative impacts on the hydrological cycle and, consequently, unfavorable changes in water quantity and quality. The above issues of water shortage and problems, especially in the urban economies, give rise to concern about appropriate water/wastewater management practices.

However, in the stages of economic development in most of developing economies, water/wastewater management is not considered to be a priority from the government sector or the people. Large investment of centralized wastewater treatment systems is one of the barriers for decreasing affordability of construction. To come up with cost-effective and implementable solutions, innovative

decentralized treatment technologies with low investment cost and easy to operate are more applicable.

Some innovative sanitation technologies recently developed such as solar septic tanks, hydrothermal carbonization for fecal sludge and constructed wetlands have been found to be effective treatment technologies because they are able to inactivate the pathogens, remove the pollutants and producing valuable by-products. Operating a solar septic tank at temperatures higher than ambient condition could enhance pathogen die-offs, and increasing biodegradation of organic matters and reducing sludge accumulation. Koottatep et al. (2013) reported that the removal efficiencies of septic tanks operating at temperatures of 40-70 ^{o}C, to be more than 80 % for TCOD and BOD_5, while *E.coli* reductions were 4-6 logs. The treated wastewater from the solar septic tank is free of pathogen and rich of nutrients, and it could be reused for agricultural proposes. Rates of sludge accumulation and amount of CH_4 production in the solar septic tank operating at a temperature of 40-45 ^{o}C were found to be about 50 % when compared with the conventional septic tank (Pussayanavin *et al*, 2014). Hydrothermal carbonization is an alternative technology that can be used to treat and convert fecal sludge into valuable solid product called hydrochar. The energy content and hydrochar yield were 20.3 MJ/kg and 70%, respectively (Fakkaew *et al*. 2015). To remove PPCPs contamination in wastewater, constructed wetlands planted with vetiver grass seem to be the potential treatment technologies in developing economies for degrading some PPCPs residuals. These technologies which are cost-effective should be able to protect the public health, improve quality of the water resources in the urban areas, all contributing to water sustainability.

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Armando H. Paredes, a consultant of the board of directors, Metro Cebu Water District

In addressing the challenge of securing water for Metro Cebu, the Water District has to consider the following:

1) The current and projected water demand and supply
2) The water distribution system
3) The water quality issue

The Metro Cebu Water District (MCWD) was created in 1975 with the mandate to provide water and septage/sewerage services within its service area composed of the cities of Cebu, Mandaue, Lapu-Lapu, and Talisay, and the municipalities of Compostela, Liloan, Consolacion and Cordova.

As of 2015, the MCWD is serving only 43% of the total water demand in its service area. The remaining 57% of demand is being served by private wells which are also drawing water from the same aquifer as MCWD. Since 18% of the total water supply of MCWD comes from surface water sources, MCWD accounts for only 34% of total groundwater extraction within Metro Cebu, while 66% of total groundwater extraction is due to private wells.

The unregulated groundwater extraction by private wells is largely contributing to the saltwater intrusion which can adversely affect both MCWD and private wells. Some of the measures which may help to regulate or reduce excessive groundwater extraction are:

1) Enforcement of the provision in P.D. 198 requiring all establishments within 100 meters distance of a Water District's distribution line to connect to the Water District
2) Entering into a Tri-Partite Agreement to regulate groundwater extraction among the National Water Resources Board (NWRB), MCWD, and the Local Government Unit (LGU)
3) Implementing a moratorium on additional groundwater development, and
4) Developing primarily surface water sources for the future additional water supply of Metro Cebu

In order for the additional water supply to reach the consuming public, MCWD will also have to increase or enhance its distribution system. From 2015 to 2020 alone, the MCWD plans to increase the total length of its distribution lines by about 86 kilometers. Additional 14 reservoirs with a total storage capacity of 43,000 cubic meters will likewise be constructed to augment its present capacity.

Another challenge of the Water District is the deterioration of the quality of water sources caused by the lack of or improper sewage treatment and disposal. The effect of this situation is the increase in nitrate levels in some of the MCWD wells. Since it is part of the mandate and vision of MCWD to provide septage/sewerage service in Metro Cebu, the MCWD has initiated and recently awarded to a private contractor the provision of Septage Management services within Cordova and Lapu-Lapu City. Expansion of coverage to the other parts of Metro Cebu can be expedited with the cooperation of the LGU, such as passing an ordinance for mandatory septage desludging.

For a Metropolis like Metro Cebu, the provision of Septage Management services will ultimately have to evolve into the provision of sewerage services.

2-2 Session2: Securing Drinking Water

2-2-2 Some Practical Issues of Groundwater Contamination

Chia-Shyun Chen, Professor of Hydrogeology, National Central University, Chinese Taipei.

Purpose: Using field cases to elucidate the importance and difficulty in reserving groundwater resource, and to elicit ideas and understanding of how to deal with groundwater contamination.

"NAPLs", coined for "Non-Aqueous Phase Liquids", are of high carcinogenic risk, have very complicated fate underground (volatilized into vapor, remain as liquid, or very slowly dissolved in groundwater), and come from some major backbone industries, such as oil refineries, petrochemical plants, auto industry, gas stations, electronics manufactories, etc. NAPLs lighter than water are called LNAPLs (e.g., gasoline, diesel, petroleum derivatives…), heavier than water DNAPLs (e.g., chlorinated solvents, like TCE, PCE, TCA…).

Groundwater exists underground in sandy aquifers or fractured rock formations. Groundwater is one link of the earth's hydrologic cycle, and thus its sustainable development requires a multi-disciplinary management policy that can ensure a water budget balance (the total amount pumped out = the total amount replenished), at least, of the basin scale, and can prevent water quality deterioration by artificial and natural contamination. Both are easy to say but extremely difficult to do!

Groundwater problems cannot be directly seen with naked eye or other human sense, largely increasing the difficulty in dealing with the problems. For a geologic material, "K" stands for its hydraulic conductivity, which is well analogous to the heat/electric conductance of a metal. Water moves faster in high-K layers of coarser materials (e.g., sands and gravels), and moves slower and even become stagnant in finer, low-K layers (e.g., silt and clay). All aquifers are composed of various geologic materials of different K values. The variation of K in space of an aquifer is called "heterogeneity", which significantly influences groundwater movement and contaminant migration.

During the contaminating stage the low-K layers "absorb" contaminants diffused from adjacent high-K layers, functioning as a "storage tank". In the remedial process; however, they release the stored contaminants back to the adjacent high-K layers. It is the low-K layers that form the bottle neck of in-situ remediation and can significantly prolong the remediation process.

A three-dimensional (3D) characterization of heterogeneity and contamination is important since it can reveal the locations of the low-K layers and the worst contamination. These information is instrumental in the remediation design and the selection of the better remedial methods. A double-packer system can be easily moved up and down to specific depths in a well without altering the well structure. Using it groundwater samples at different depths can be retrieved by the multilevel groundwater sampling technique (MLGS), and water pressure measured at different

depths by the multilevel slug test technique (MLST). The MLST response oscillates with time for a high-K material, and steadily varies for a low-K material. A correct analysis of the MLST responses gives the vertical profile of K of the aquifer materials neighboring to the test well. Both MLST and MLGS are able to produce 3D data with a number of wells. A more detailed illustration is given in the presentation with figures and schematics.

The MLST and MLGS were applied at a contamination site in an oil refinery, which had 22 wells. Without the multilevel techniques, each well can only yield one K value and one water sample, which contain little information on the natural vertical changes. Using the MLST and MLGS, each well is able to give 30-40 pressure responses and water samples at different depths. As a result, more than 700 K values and BTEX concentration data were acquired at 700 different locations in the site, making 3D investigation possible.

When surface water and groundwater are in shortage in plain areas, the exploitation of groundwater in mountain areas attracts attention. As not all the fractures are interconnected and permeable, knowledge of the fracture connectivity and fracture K is essential for finding groundwater in mountain areas. In a mountain area, we successfully employed the MLST along with the conventional geophysical method to identify the most productive fracture zones for a new water supply.

Brief, by no means exhaustive, suggestions are as follows.

1) A good and implementable policy clearly specifies the goals of groundwater management and expectation at different stages/times.
2) A practical and enforceable law sets forth reasonable and achievable standards (e.g.; how clean is clean? how dirty is dirty?), and includes technically sound rules or regulations to solve the practical problems.
3) Public awareness makes the abstract tangible and easily understandable, and wide spreads understanding and acknowledgement of the issues on a societal level and a personal level.
4) Educational programs train more professionals and allow students more access to the subject of interest, as by lowering the entry level of teaching.
5) Effective 3D technologies for site investigation, groundwater sampling and chemical analysis, and in-situ or off-situ remedial methods and equipment.
6) Funding sets aside for research and development, and for disputed sites or problems.

2-2-2 Securing Drinking Water through Desalination

Francois Gouws, Managing Director, Trility, Australia

TRILITY

TRILITY is a Private Water Utility operating throughout Australia and New Zealand. Services provided include the financing, construction and operations of water, waste water, desalination and bio-solid schemes for the municipal, resources and industrial markets. TRILITY is 100% Japanese owned with shareholding by Mitsubishi Corporation, Innovation Network Corporation of Japan (INCJ) and JGC Corporation.

Australia

Australia is a continent covering 7.76 million square kilometres of landmass which roughly equates to the size of the USA. The current population of 23.8 million people is expected to increase to over 40 million by 2050. The current Australian GDP amounts to 1.5 trillion USD and is growing at around 3% per annum. Australia has a federal government system with six states and two territories. Water management is mainly a state responsibility.

Millennium Drought

Australia is still the world's driest inhabited continent and has experienced several droughts over the last century with the most recent being the millennium drought (1997 – 2009). This drought resulted in major cities such as Perth, Sydney, Melbourne, Adelaide and the Gold Coast experiencing rapidly declining water reserves. State and Federal governments responded with several measures that included usage restrictions, awareness campaigns, formation of trans-state border authorities, drought relief, water trading and subsidies. As a result, total water consumption per household reduced however Governments were left with little choice but to invest in major desalination plants in order to become less dependent on climate affected water resources.

Major Desalination Plants

Australia has six major sea water desalination plants as follows:

Plant	Capacity (per day)	Upgradable Capacity (per day)	Location	Completion
Gold Coast Desalination Plant	125 megalitres	(167 upgradable)	South East Queensland	2009
Perth Seawater Desalination Plant	130 megalitres		Kwinana, Western Australia	2006
Kurnell Desalination Plant	250 megalitres	(500 upgradable)	New South Wales	2010
Wonthaggi Desalination Plant	410 megalitres	(550 upgradable)	Victoria	2012
Southern Seawater Desalination Plant	100 megalitres		Binningup, Western Australia	2013
Port Stanvac Desalination Plant	300 megalitres		South Australia	2012

Present Rainfall

The Millennium drought is officially over with above average rainfalls returning to Australia's east coast regions. As a result most major desalination plants are presently operating at minimum capacity or not at all and this has attracted some unfair criticism of investment in desalination plants. In Western Australia for example, drought conditions are still present and the city of Perth relies heavily on its two desalination plants. The Bureau of Meteorology is predicting declining rainfalls for the east coast of Australia during the coming years.

TRILITY and Desalination

TRILITY – as part of the AdelaideAqua joint venture - operates and maintains the Adelaide (Port Stanvac) Desalination Plant. This 100GL/annum (300ML/d) plant has the capacity to provide up to 50% of Adelaide's water needs and the plant has received several prestigious international awards. TRILITY also operates and maintains a desalination plant for the Gladstone Regional council in far north Queensland. TRILITY was responsible for the design and construction of this plant as well as the neighbouring sewage treatment plant under a Design, Construct and Operate (DBO) contract model.

The future

Australia is now better positioned to face the next major drought due to the investment made in desalination plants and other drought proofing initiatives. Desalination plants represent the ultimate 'insurance policy' as they safeguard access to a sustainable, reliable and non-climate dependent water source.

2-2-3 Addressing Water Woes: The Manila Water Experience

Mr Virgilio C. Rivera, Jr., Chief Operating Officer -New Business, Manila Water Company, Inc., the Philippines

Prior to 1997, the Philippines' capital, Metro Manila, suffered from various problems such as insufficient infrastructure and environmental deterioration, accelerated by rapid population increase. 24-hour water supply was only available to 26 percent of the area's population mainly due to leakages often caused by meter tampering and illegal connections which caused a domino effect of problems including water contamination and water-borne diseases. Water system losses or non-revenue water (NRW) was at a record high of 63 percent at the time. This prompted the Philippine economy to enact the National Water Crisis Act, which paved the way for the government-owned Metropolitan Waterworks and Sewerage System (MWSS) to enter into Public Private Partnerships (PPP).

Ayala Corporation-led Manila Water Company took over the East Zone of Metro Manila under a Concession Agreement that granted the company exclusive rights to provide water and used water services.

Manila Water employed multi-pronged approach in addressing key challenges and issues including (a) employees' lack of customer focus, (b) organizational constraints, (c) high network losses and inefficiencies, and (d) lack of customer and community support.

To address employees' lack of customer focus, the company introduced corporate cultural transformation, part of which is the introduction of several in-house schooling and programs with the end goal of instilling accountability while empowering employees.

This was supplemented by development of the company's workforce through Territory Management, wherein the whole of East Zone was subdivided into Business Areas which were then further identified as Business Zones, Demand Monitoring Zones, and District Metering Areas respectively. Through this, Territory Managers empowered to address technical, business, and other customer-related issues while enhancing their entrepreneurial relationship management.

Manila Water replaced old and dilapidated kilometers of pipes through proactive technical solutions encompassing technology and innovations in a holistic approach. The company also institutionalized walk-the-line concept where Territory Managers efficiently serve as the frontliners in addressing water-related issues, directly at the site, to heighten resolution of customers' concerns.

Finally, Manila Water has strengthened its relationship and involvement with its stakeholders to establish synergy and partnership with the communities it serves. Manila Water's flagship program, Tubig Para sa Barangay or Water for the Poor

Program, has also enabled low-income communities to have continuous and reliable access to water.

With all these organizational strategies, Manila Water has expanded service connections, increased service availability, and reduced NRW from 63% in 1997 to a world-class 11% in 2012. From 3.1 million customers in 1997, the company is now serving 99% of the East Zone equivalent to 6.2 million residents.

Manila Water has expanded its business operations in strategic economic expansion of Metro Manila namely, Clark Freeport Zone in the North, and Laguna Province in the South of Luzon. Moreover, the company utilized the same PPP model in supporting sustainability of tourism in Boracay Island and addressing water crisis in the Province of Cebu. Manila Water has also established management contracts and investments in the Asia-Pacific Region, particularly in Viet Nam, Myanmar and Indonesia.

2-3 Session3: Conservation of Water Environment by mitigating water pollutions

2-3-1 Policies and Technologies for Wastewater Management in Japan

Takehiko Kawai, Director of Japan Sanitation Consortium, Japan

There were recycling systems for night soil treatment in Edo (Tokyo) city about 300 years ago. Night soil was used as agricultural fertilizer in the suburban area outside Edo city. After chemical fertilizers were introduced, night soil changed to become only solid waste.

After World War II, there was a rapid increase in economic growth in Japan. As a result, severe air and water pollution happened everywhere in Japan from the 1960s to the 1970s. There were, for example, severe diseases due to the heavy metals contained in the industrial wastewater discharged from chemical plants. As countermeasures, the National Diet enacted several environmental control laws in 1970, including the revised Sewerage Law, which was originally enacted in 1900. The central government increased the grants for sewage works to local municipalities, provided several 5-year plans for sewage works development. The central government promoted not only off-site sanitation systems but also on-site sanitation systems. Consequently, sewerage coverage rate reached 72.3% at the end of fiscal year 2013, while Jokasou coverage rate was 20.9%.

According to the Japanese experience in the challenge of improving sanitation, I would like to recommend several key factors for promoting wastewater management.

1) Technology options:

We need wastewater treatment systems (both on-site and off-site), reliable facilities and equipment, and proper operation and maintenance techniques/system.

2) Institutional and management arrangements:

We need to identify the role of central government and local municipalities, to arrange project implementation organization, public private partnership, to ensure human resource development and technical support to medium-small scale municipalities.

3) Financial system for sanitation:

We need to establish construction and O&M costs sharing principles among nationwide stakeholders.

4) Planning:

We need to establish planning procedures and methods for sanitation management.

5) Public relation and /or citizen's participation:

We need to promote the awareness and understanding of citizens as tax payers and users in the sanitation field.

6) Establishment of a legal system/frameworks:

We need to establish a legal system/frameworks and an enforcement system of the laws.

2-3-2 Advanced On-site Domestic Wastewater Treatment Technology (Jokaso) in Japan

Kaichi Watanabe, President of Fuji Clean Co. Ltd., Japan

In the early 1960s Japanese researchers developed a modern sewerage system capable of treating the full range of domestic waste water from the household. Today, Fuji Clean Japan Co. Ltd manufactures and sells over 50,000 units annually. Japan experienced deterioration in the quality of its natural water environment such as the pollution of many rivers and coastlines concurrent with its economic growth in the late 1950s.

The *Jokaso* (meaning “purification tank” in Japanese language) has been utilized in regions with relatively low population density in Japan for 50 years as a compact, light-weight and economical tool to clean domestic wastewater before discharging to the environment. The total accumulated number of *Jokaso* installations in Japan is about 9 million units (150,000/year). With the extensive use of *Jokaso*, much improved clean water environment has been achieved.

The *Jokaso* system is composed of several functional aerobic/anaerobic chambers. Efficient biological processes are supported by the use of different types of contact media in the anaerobic and aerobic chambers. Appropriate media is important for achieving a high quality of treatment performance, providing the ideal habitat for bacteria to thrive and actively digest the organic substances. Size of the surface area of the media is important to enable enough bacteria to grow and form protected colonies. Another important role of the media is to work as a physical filter. The shape of each media has been optimized by collating and considering field performance data.

Mechanical processes such as flow equalization and sludge return are also essential to maximize treatment performance. Flow equalization is achieved by making use of extra space in the upper part of each chamber effectively functioning as a buffer, allowing for variable fluctuations of inflow. Relatively constant flow is transferred to the next chamber by an air-lift pump. Sludge return from storage (clarification) chamber to sedimentation (primary) chamber is also done with use of an air-lift pump. These processes, as well as the supply of air to the aerobic chamber are conducted by the use of a reliable diaphragm air pump which has been developed and manufactured by Fuji Clean. Further treatment to remove nutrients such as nitrogen (using a combination of aerobic and anaerobic biodegradations) and phosphorus (using an electrochemical process) have also been established. The Fuji Clean *Jokaso* system is housed in a fibre-reinforced plastic tank.

Jokaso’s positive impact on society can be summarized in three categories.

Firstly- short installation period, typically constructed within one week (efficient). Secondly – these systems make valuable contributions to the economy by creating local job opportunities. For example, there are now approximately 200,000 people working in Japan for the installation as well as fulfilling the service (maintenance) work. Finally, there is a very important contribution of providing clean waterways and preserving a green water environment (Biodiversity).

There are two important aspects for building a economy or community wide *Jokaso* infrastructure. One is to secure functionality and performance by enforcing strict performance standards in order to rule out low quality (inferior) products. The other is to utilize robust construction and O&M (Operation and Maintenance) systems and educating and regulating suitably qualified installation and O&M operators. Implementing these measures results in mutual benefits both for individuals (quality of life improvement, job creation, tourism) and for the economy (better public sanitation and biodiversity).

Achieving positive environmental outcomes using the experiences of successful on-site wastewater treatment by *Jokaso* in Japan is also applicable to other economies as a relevant measure for the treatment of wastewater. Fuji Clean intends to expand business internationally, starting from the USA (NSF40/245 standard accredited) and Australia (AS/NZS1546.3 standard accredited) and introducing this advanced technology to Asian economies and other parts of the world.

2-3-3 Domestic Wastewater in Ha Noi

Nguyen Quang Hung, Deputy Manager of Environmental Treatment Department, PetroVietnam Drilling Mud Corporation, Viet Nam

1) What is the domestic wastewater

Domestic wastewater was accounted for about 80% of the wastewater in the city, that is a major cause of pollution water and tend to the increasingly worse problem.

According to Circular No.125/2003/TTLT-BTC-BTNMT, dated 18/12/2003, domestic wastewater is defined as follows:

- Domestic wastewater is water discharged from: Households, State agencies, Unit of People's Armed Forces, Office of organizations and individuals, Cars and motocycle cleaning stations, Hospitals, clinics, restaurants, hotels, motel, factory and business services.

Upon Ha Noi People's Committee, the city has 152 new urban areas. There are 15 areas of which were formed basically an putted into use, 45 areas are being deployed the infrastructures and buildings; 92 areas were approved plan, has been cleared, is being prepared of investment or building new infrastructure.

2) Status of domestic wastewater treatment in Ha Noi

While there is the Rules basis and Environmental Standards for domestic wastewater, but the current state of domestic wastewater and sewage treatment are urgent issues that need to be improved step by step.

Upon The Ha Noi Department of Natural Resources and Environment, domestic waste water of Ha Noi is about 700,000 m3 per day. However, less than 7% of domestic waste water is treated according to the standards. Addition that a large amount of wastewater from hospitals and industrial parks. Estimated that 260,000 m3 of industrial wastewater per day and only about 10% of wastewater is treated before being been out of the river. The hospital also discharged about 7,000 m3 per day, and only 30% is being treated. More remarkable is that only 6 of the 42 major hospitals in Ha Noi have invested wastewater treatment system which wastewater is extremely toxic.

- Urban areas and buildings: Upon the Department of Ha Noi Natural Resources and Environment, 100% wastewater of new urban areas in Ha Noi is discharged directly into the environment.
- Most of the building that only has septic tank, some of the building have the sewage treatment system but these systems doesn't work proper.

- The restaurants, amusement parks and other small household: According to statistics, Ha Noi has more than 1.5 million households in which most of the individual households (private house), this means that nearly 100% of homes have no standard sewage treatment system. That house only applies traditional septic tank. Wastewater treatment systems are used in the household was too outdated and inadequate. Only some residential areas have sewer wastewater pipework system activated but that is often used in conjunction with rainwater drainage system that discharge directly into the natural environment or ponds or rivers or discharged into the sea. Almost no collection system and wastewater treatment plants is separated.

3) Consequence of discharging untreated domestic wastewater into the receiving resources

Serious water pollution is happening in Ha Noi, where there is more densely populated. Most lakes and rivers in the cities were heavily contaminated and in the red lever alarm by domestic wastewater. The majority of wastewater is not being treated in a centralized treatment, but that flows directly into the lakes, then flowing out of the big rivers in the Red River Delta area.

4) Settlement of the domestic wastewater contamination

- Ha Noi, Viet Nam should consider to the decentralized wastewater treatment system like Jokaso that has been used widely in society in over the 50 years in Japan. As a study shows that now situation of Viet Nam are similar to those in Japan, so if we apply Jokaso system in Viet Nam at the moment, it is very suitable and convenient.
- Jokaso equipment including shell is made of Polymer Composite. This system is compaction, lightweight design and optimization to bring us the simplicity of installation and use.
- Upon the Jokaso installed project in Viet Nam showed that this wastewater treatment technology is perfect suitable with Viet Nam.
- According to our experiences, connecting the Jokaso technology in the system of sewerage infrastructure will bring real values: preventing the new pollution source generated from residents areas and new urban areas, centralized rural residents areas (more and more developed strongly). The system will help us need not built sewer network separately. Treated wastewater after use Jokaso systems will discharge directly to the drainage water systems network.

2-3-4 Water Education as a Solution to Mitigating Water Pollution

John Etgen, Senior Vice President of Project WET Foundation, the United States

The question: “How can youth and educators in schools and communities help address global water issues in local settings?” is addressed in depth from a regional and global perspective. These audiences play a key role in every community and are often overlooked in their ability to affect change and implement solutions to water issues.

Educational systems are as diverse as watersheds – basic principles apply to all, while each has its own unique identity and characteristics. Survey results demonstrate that water education is not applied consistently across the globe and within economies, and that there are numerous barriers to water education.

The water and education sectors have a unique opportunity to design, develop and deliver water education materials and training to countless people through new and innovative systems. The formal and non-formal educators are an underused resource and high-quality; hands-on educational materials and the networks to deliver them are the key to water education being a stronger tool in the water manager’s portfolio.

Water Education as a Key Water Management Tool

Over the past quarter-century, global water problems have continued to escalate. Every day, the health and well-being of the 7.26 billion people on our planet is affected by the availability of clean water resources. To face these challenges, governments, international and non-governmental organizations, private institutions and many communities are making efforts to build capacities in multiple water-emerging issues. Nevertheless, water education remains a forgotten priority. There have been many disperse, isolated efforts to strengthen environmental and even water education, but few have had success or continuity.

Through water education, learners identify their watershed address, discover their role in the hydrological cycle, and recognize that water flows through and connects us all. Through water education, students, teachers, parents, business and community leaders are empowered to take action in their local communities. These ActionEducation™ projects contribute to a healthier local environment and economy. On a worldwide scale, water education helps learners recognize the relationship between the availability of clean water and global stability. An understanding of water resources is critical for educators, students, business professionals, political

leaders and others to meet the water challenges of the 21st century, because tomorrow is already here.

What is ActionEducation™?

ActionEducation™ is defined as education that empowers learners to take positive and appropriate actions to solve a local water resource issue. AE was initiated by Project WET Foundation after being asked by a major philanthropic foundation what a water education program like Project WET can do to reduce the number of deaths caused by waterborne diseases. Through the ActionEducation™ initiative, Project WET has evolved from learner awareness to empowering students to take action leading to sustainable solutions for community water resource issues.

Why Do We Need Water Education?

Escalating global water problems: Global water problems continue to intensify and affect the quality of life for billions of people.

An elastic global economy: The global economy of the 21st century will grow or stall based on banking, industry and commercial professionals and others understanding sustainable water management.

Disproportionate water distribution: Because of inequitable distribution of water and increased demand, the expansion of existing technologies, as well as innovations still to be imagined, will be necessary to ensure clean water for the predicted population of 8 billion in 2025.

Transboundary water conflicts: International stability depends upon economies protecting and sharing transboundary water resources, both above and below the ground's surface.

Conclusions and Future Actions

The research conducted by the Project WET Foundation over the past twenty-five years has clearly documented the value and importance of educating children and young adults about water and its use, management and protection. The most successful water education programs combine the scientific and technical expertise of water professionals with formal and non-formal educators. When water and education sectors work together, children win.

The water and education sectors have a unique opportunity to design, develop and deliver water education materials and training to countless people through new and innovative systems. The first step in the design process is to ask: "What does every

person need to know about water and its use, management, and protection?" Project WET has documented that its water science methods can be translated, adapted (localized), and successfully used by educators worldwide.

The question now becomes one of delivery. Other than through Project WET, there has never been a unified effort to scale-up water education with a goal of annually reaching large percentages of children and young people.

Finally, water and education sector leaders should establish a certification program to give credibility and value to the educational programs and to the people who take their courses. The key question is: "Does learning occur and can the learner use the information in their daily life to better manage and improve water conditions?" If the answer is yes, we have done our job.

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2-4 Session4: Towards healthy water environment for sustainable development

2-4-1 Building Efficient Wastewater Treatment System

Yoshiro Abe, Director, Overseas Business Division, JFE Engineering, Japan

Main objective is to discuss on the “Design and Build with Life Cycle Cost” tender methodology and highlight its benefits in the procurement of high-quality Wastewater Treatment Systems through JFE Engineering’s experiences in the Philippines.

JFE Engineering Corporation is a leading Japanese engineering company possessing a wide range of cutting-edge technologies in fields such as environment, energy, steel and structure, industrial machinery, among others.

In the Philippines, JFE Engineering started our engineering business with the development of the Laguna Technopark in 1989. Soon after this project we concentrated on Industrial Wastewater Treatment projects until around the year 2000. Ever since, our main focus in the Philippines has been on Design and Build projects for the development of Municipal Wastewater Treatment plants in Metro Manila. Currently, JFE has successfully design and built close to 30 sewage treatment plants with outstanding operational records.

Most of these sewage treatment plant projects utilize the Design and Build with Life Cycle Cost (LCC) evaluation as a preferred bidding method. In this method, the scope of work includes the whole construction works of the STP facility as well as process proving for one year. The bidder is also required to prove that the proposed process can meet the guaranteed effluent quality and operational cost through the process proving results.

With regards to the financial evaluation, the sum of the Capital Cost and the Operational Cost for 15 to 20 years in Net Present Value is the evaluated amount. This is called Life Cycle Cost.

Talayan Sewage Treatment Plant, which was completed by JFE Engineering, last December 2014, was also tendered under the Design and Build method with LCC for 15 years. It is one of the successful cases of this tender method as JFE was successfully able to propose optimum technical solutions and offer a reasonable Life Cycle Cost. JFE applied optimum design based on data and know-how developed during its experiences in Manila.

Through the actual project case as well as the comparison between the Design and Build with LCC and the Bill of Quantity tender methods, we will see that the client can expect an innovative technology with a reasonable life cycle cost which is guaranteed by the bidder's experience and know-how by the Design and Build with LCC.

The Design and Build with LCC method can be one of the most efficient alternatives for the successful procurement of newly constructed facilities since it allows for the development of projects not only reasonable in cost but also of superior quality.

2-4-2 Water Source Development and Appropriate Technology

Hiroyuki Morita, Manager, Yokohama Water, Japan

1) Introduction of YWC

Yokohama Water Company (YWC), a private company legally, was established by Yokohama Water Works Bureau (YWWB), one of the organizations of the municipal government of Yokohama in 2010; it has since been expanding businesses mainly in consulting work of water supply and sewerage. Leakage prevention and human resource development are main pillars in YWCs consulting work in the field of water supply. In the following, what YWC lays special emphasis on is introduced; leakage prevention and technical cooperation suited for local environment.

2) Water resource from the aspect of leakage

(1) Worth equal to another water resource

Water leakage brings serious problems wasting precious water to which was poured huge amount money. It is frequently reported that water leakage rate exceeds 50% in water utilities especially in developing economies.

Assuming the supply amount of a water utility is 100,000m^3, 50% leakage makes 50,000m^3 of water loss. In case this utility reduces the leakage rate to 10%, the supply volume will increase by 40,000m^3. If the leakage rate still remains at 50%, the additional 40,000m^3 would require the additional capacity of 80,000m^3, close to the current capacity. The utility would have to invest in expanding the capacity of the whole process of water supply to almost double to meet this increase. It is undoubtedly crucial to water utilities to reduce the leakage rate. Implementing countermeasures against water leakage will definitely lead to a stronger financial status sufficiently enough to tackle the leakage, and worth equal to produce new water resource.

(2) YWCs achievement

YWC has been participating in several projects in regard to operation and maintenance of water supply, especially non-revenue water reduction which is the key to improve water supply business by securing the revenue from water tariff to establish the sustainable management. YWCs technical assistance covers fields relating non-revenue water reduction; detection and repair of water leakage, pipe replacement, water distribution block system, SCADA, meter management and reading, tariff collection, customer service and water quality control.

3) Appropriate technology

(1) Concept

Introducing a highly sophisticated technology is not necessarily appropriate in technical assistance to developing economies, which may lead to inappropriate

management, insufficient utilization of ability and shorter life of machines or devices. From this viewpoint, YWC transferred the very basic points and then helped accumulate knowledge and know-how to introduce advanced technology.

(2) Case in Cebu

The survey team found insufficient management of purification plant at first sight; sedimentation and filtration. Checking facilities with local staff members, the reasons became clear to be misunderstanding of facility's function and misidentifying of operational problems due to the malfunction.

a) Sedimentation

The problem in sedimentation was caused by insufficient mixing at the coagulation process, due to which floc didn't grow enough to sediment. The first proposal was to install temporary wall so that water flow enables floc to grow. The local staff members were supposed to design, manufacture and install it and through these processes they learned the function of facility and ideal shapes and sizes. After deepening the understanding, they installed the permanent concrete wall by themselves.

b) Filtration

The problem in filtration was attributed to the state of filter sand which needs to be routinely renewed but was actually never done, which caused bad water quality as well as insufficient water production due to the frequent filter clog. The first proposal was for staff members to wash, sieve and refill the filter sand. They leaned the function of filtration and filter sand and the importance of sand renewal. At the next stage, introduction of sand washing machine was proposed utilizing JICAs scheme.

(3) Case in Solomon

a) Capacity building

To enhance staff ability, it is not enough only packing knowledge and technique. Grasping level of their skill is essential to perform training and OJT. Without this step, it turns waste of time, misunderstanding and may connect with an accident, and increase objection from customer.

YWC provided some staff training programs in Solomon, aiming to learn improvement of customer management. Training program has two steps, first learning from the lecture and then performing drills by themselves assuming the scenes which talk with customer. Other training program is customer survey. Staff learned not only survey method also from voice of customer, and could know customer's dissatisfaction and expectation. This approach related to collect water charge more effectively smoothly utilizing the apparatus which introduced newly, and such action was able to reduce the number of the dissatisfaction dramatically.

(4) Conclusion

The most important thing in technology transfer is that local staffers deepen the understanding of facility function and aim of action. So that assessment of level of

technology and local staff ability are essential, after this situation is achieved, the effect of introducing highly sophisticated technology is meaningful and service advanced effectively smoothly. Otherwise it would become a waste of asset.

Annex - Programme

PPD programme is shown below;

PROGRAMME	
A Public-Private Dialogue on Water	
13:30 - 13:40	**OPENING SESSION** **Opening Remarks** **Mr Toshiyuki Sakamoto,** *APEC Senior Official of METI, Japan* **Welcome Remarks** **Hon. Laura Q. Del Rosario,** *APEC 2015 SOM Chair*
13:40 – 14:30	**Session 1: Challenging Water Shortage and Water Pollution** Water shortage and water pollution is commonly recognized challenges in rapidly emerging economies. This session will address the water shortage and pollution issues that urbanized economies encounter. **Moderator:** Mr Laurence Rogero, *President, Metropac water Investments Corp.* **Speakers and Topics:** - **Dr Chongrak Polprasert**, *Faculty of Engineering, Thammasat University :* Water Shortage and Pollution Issues in the Urbanizing Economies - **Mr Armando H. Paredes,** *Consultant of the Board of Directors, Metro Cebu Water District:* Securing Water for Metro Cebu Open Forum /Q&A
14:30 - 15:35	**Session 2: Securing Drinking Water** This session will introduce the experiences to meet the water shortage in APEC economies. Securing water has been done by means such as groundwater conservation, river water conservation, alternative water resources development, and efficient drinking water systems. This session will share the technical and institutional efforts that have been implemented to overcome the water shortage problems. **Moderator:** Mr Laurence Rogero, *President, Metropac water Investments Corp.* **Speakers and Topics:** - **Dr Chia-Shyun Chen,** *Professor of Hydrogeology, Founder and Honorary Founding President, Association of Soil and Groundwater Environmental Protection, Chinese Taipei :*

	Some Practical Issues of Groundwater Contamination - **Mr Francois Gouws,** *Managing Director, Trility :* Securing Drinking Water through Desalination - **Mr Virgilio C. Rivera, Jr**., *Chief Operating Officer – New Business, Manila Water Company, Inc. :* Address Water Woes: The Manila Water Experience Open Forum /Q&A
15:35 - 15:50	Coffee Break
15:50 – 17:10	**<u>Session 3: Conservation of Water Environment by mitigating water pollutions</u>** This session will introduce the experiences to mitigate water pollutions caused by human activities in urbanized economies including municipal and industrial wastewater. Technological and institutional measures include centralized and decentralized wastewater treatment system and water remediation. **Moderator:** Ms Veronica. A. Santos, *Principal, SGV &Co* **Speakers and Topics:** - **Mr Takehiko Kawai**, *Director, Japan Sanitation Consortium :* Policies and Technologies for Wastewater Management in Japan - **Mr Kaichi Watanabe**, *President, Fuji Clean Co., Ltd. :* Advanced On-site Domestic Wastewater Treatment Technology (Jokaso) in Japan - **Mr Nguyen Quang Hung,** *DMC* Domestic wastewater in Ha Noi - **Mr John Etgen**, *Senior Vice President, Project WET Foundation :* Water Education as a Solution to Mitigating Water Pollution Open Forum /Q&A
17:10 – 18:00	**<u>Session 4: Towards healthy water environment for sustainable development</u>** This session will discuss on future strategies or plans to overcome the water issues in emerging economies including the Philippines. Discussions will include how to implement appropriate technologies as well as the institutions/legal frameworks for sustainable development.

	Moderator: Ms Veronica. A. Santos, *Principal, SGV &Co* **Speakers and Topics:** - **Mr Yoshiro Abe,** *Director, Overseas Business Division, JFE Engineering :* Building Efficient wastewater treatment system - **Mr Hiroyuki Morita**, *Manager, Yokohama Water:* Water Source Development and Appropriate Technology Open Forum /Q&A
18:05 – 18:15	**Closing Remarks** **Mr Renato Mercado**, *Chairman, Metro Cebu Water District*

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