行政院所屬各機關因公出國人員出國報告書
(出國類別：出席國際會議)

出席「亞洲水協會第一屆全體會員大會」

The 1st General Assembly of Aisa Water Council

服務機關：經濟部水利署
姓名職稱：李友平 組長
派赴國家：印尼-峇里島 (Bali, Indonesia)
出國期間：105 年 3 月 23 ~ 26 日

報告日期：中華民國 105 年 5 月 14 日

摘 要

亞洲水協會第一屆全體會員大會(The 1st General Assembly of Aisa Water Council)於本(2016)年 3 月 23 ~ 26 日假印尼峇里島(Bali, Indonesia)舉行，經濟部水利署(下稱本署)為亞洲水協會的會員，受主辦單位(印尼公眾事務與住宅部及韓國 K-Water)邀請派員參加會議。

本次會議本署由水利行政組李友平組長代表出席，參與制定亞洲水協會組織章程、選舉亞洲水協會理監事會成員、決定近未來優先推動專案、水商業展等活動。並帶回亞洲水協會組織章程、亞洲水協會第一屆全體會員會議大會手冊、洞悉亞洲水資源報告(Insight into Asian Water)、聯合國世界水發展 2016 年報(The United Nations World Water Development Report 2016)、導入智慧水管理開創水資源管理新紀元倡議報告(New Era of Water Resources Management with Smart Water Management Initiative)及水商業展中有關 17 家廠商展示的監測設備、智慧水錶、抽水馬達、汙水處理等資料。

本次出席 AWC 水商業展，看到世界各國紛紛發展智慧水管理技術的趨勢，而我國在智慧水管理(例如河川、排水、海堤區域管理、疏濬管理及行動水情...等)也多有成效及經驗，應多在國際上推廣。

另亞洲水協會第二屆全體會員大會將在 2016 年 7 月於新加坡 SIWW 會場舉辦，及第 1 屆亞洲國際水週(AIWW)將在 2017 年 10 月於韓國舉辦，我國可提前因應。

目　錄

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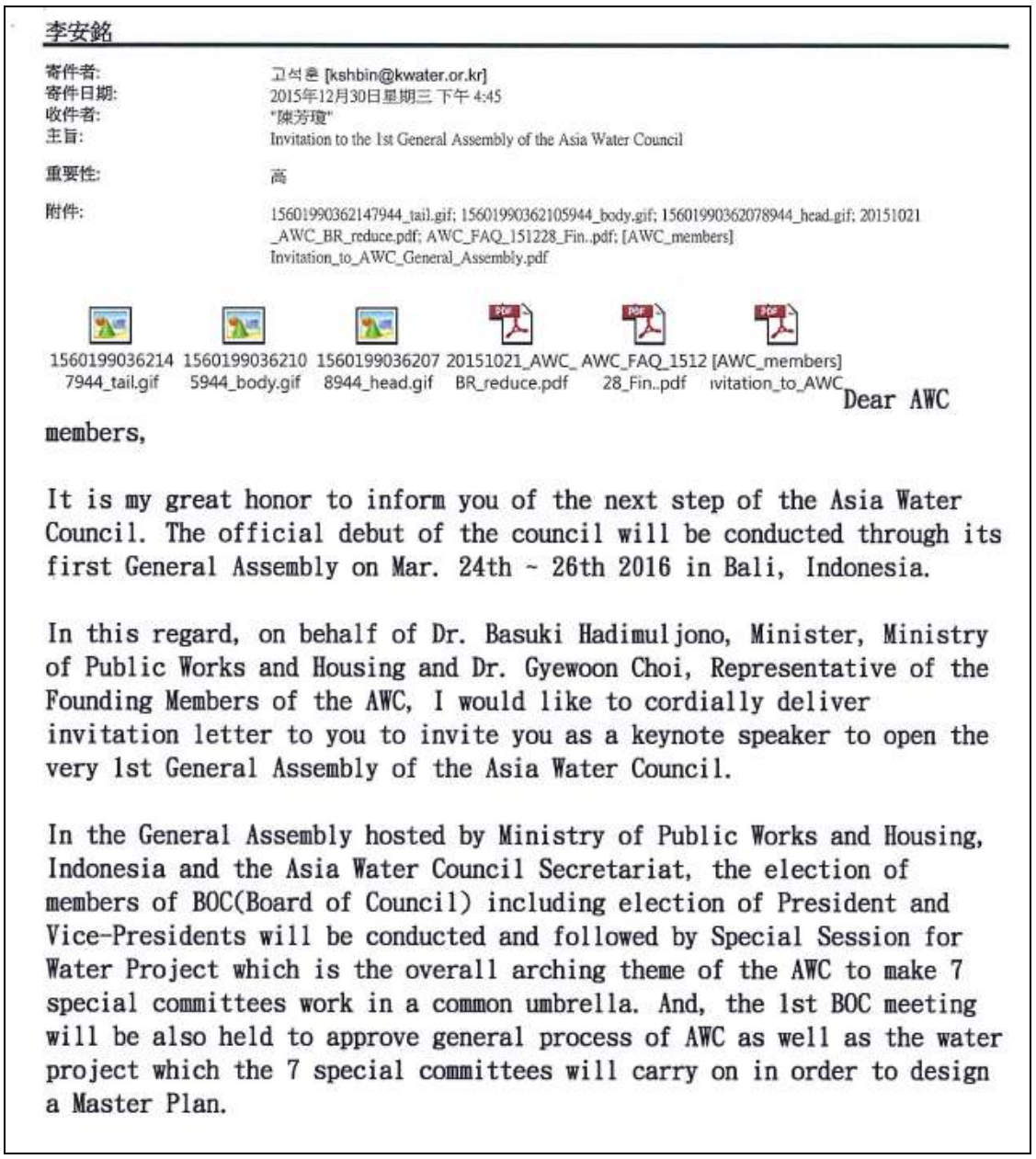
壹、前言

一、本案緣起：

亞洲水協會(Aisa Water Council, AWC)於本(2016)年3月24~26日召開第一屆全體會員大會，本次會議由印尼公眾事務與住宅部與亞洲水協會創始會員代表韓國K-Water共同主辦，邀請本署參加會議，邀請文件(如圖1)。



李安銘

寄件者: 고석빈 [kshbin@kwater.or.kr]
寄件日期: 2015年12月30日星期三 下午 4:45
收件者: "陳芳瓊"
主旨: Invitation to the 1st General Assembly of the Asia Water Council
重要性: 高
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Dear AWC members,

It is my great honor to inform you of the next step of the Asia Water Council. The official debut of the council will be conducted through its first General Assembly on Mar. 24th ~ 26th 2016 in Bali, Indonesia.

In this regard, on behalf of Dr. Basuki Hadimuljono, Minister, Ministry of Public Works and Housing and Dr. Gyewoon Choi, Representative of the Founding Members of the AWC, I would like to cordially deliver invitation letter to you to invite you as a keynote speaker to open the very 1st General Assembly of the Asia Water Council.

In the General Assembly hosted by Ministry of Public Works and Housing, Indonesia and the Asia Water Council Secretariat, the election of members of BOC(Board of Council) including election of President and Vice-Presidents will be conducted and followed by Special Session for Water Project which is the overall arching theme of the AWC to make 7 special committees work in a common umbrella. And, the 1st BOC meeting will be also held to approve general process of AWC as well as the water project which the 7 special committees will carry on in order to design a Master Plan.

圖1、水利署受邀請參加會議文件

二、亞洲水協會(AWC)簡介：

AWC 為 2015 年 4 月於韓國舉辦的第 7 屆世界水論壇(WWF7)後成立之協會，其成立宗旨係以解決亞洲水資源面臨之問題，並研擬區域水資源改善方案為目標，會員代表包含亞洲各國、世界重要水領袖代表、學者專家及 NGO 代表，目前有 107 個會員組織，包括我國經濟部水利署及台大水工所等 2 個組織。

AWC 的願景、任務及策略說明如下：

(一)願景：致力於智慧用水、保護自然環境、天然災害減輕等三大領域的課題。

(二)任務：致力於鼓勵成熟技術的推廣及國際合作，促進永續發展。

(三)策略：分下列三階段：

1.將 AWC 目標與亞洲永續發展目標鏈結。

2.AWC 提供平台促進所有利害關係人建立合作網絡共同面對水的挑戰。

3.AWC 倡議智慧水管理(SWMI, Smart Water Management Initiative)在亞洲地區提供解決方案。

三、亞洲水協會第一屆全體會員大會活動說明：

(一)主辦單位：印尼公眾事務與住宅部及韓國 K-Water

(二)會議地點：印尼峇里島 Nusa Dua 旅館會議中心

(三)活動項目：

1. 開幕式
2. 選舉 AWC 理監事會及第一屆理監事會主席
3. 確定 AWC 組織章程

4. 確定 AWC 組織架構
5. 確定近未來 AWC 將推動的專案計畫及活動
6. 水商業論壇
7. 晚宴
8. 文化之旅

(三)會議活動議程：

Mar. 24 (Thu)		
09:00~10:30 (90)	Registration	High Level Panel Discussion (Exclusively for invited guests)
10:30~11:00 (30)	Mingle up (tea time) and VIP Water Business Forum Tour	
11:00~12:30 (90)	Opening	
12:30~14:00 (90)	Luncheon	
14:00~15:30 (90)	Election of Board members	
15:30~16:00 (30)	Break	
16:00~18:00 (120)	Special Session for Water Project & PFIs(Priority for Implementation)	
18:30~20:30 (120)	Welcome Reception hosted by Ministry of Public Works and Housing, Indonesia	
Mar. 25 (Fri)		
09:00~09:30 (30)	Opening for Water Business Forum	
09:30~12:00 (150)	the 1st Board of Council	Water Business Forum(Seminar)
12:00~13:30 (90)	Luncheon	
13:30~16:00 (150)	Special Committee Meeting	
16:00~17:00 (60)	Break	
17:00~18:00 (60)	Closing	
18:30~20:30 (120)	Farewell Dinner hosted by the President of the Asia Water Council	
Mar. 26 (Sat)		
08:00~14:30 (390)	Culture Tour and Lunch	
14:30~	Departure	

貳、出席會議報告

本次出席 AWC 第一屆全體會員大會自 3 月 23 日啟程至 3 月 26 日返國，共計 4 日，本次參加大會之總人數約 1 百餘人，大會團體照(如圖 1) ，我國僅有本署指派李友平組長 1 人出席(如圖 2)。

圖 1、大會團體照(李組長站在第 2 排左起第 6 位)

圖 2、李友平組長出席會議照片

一、報到：

本次出席 AWC 第一次會員大會，本署在 AWC 官網上是以 Water Resources Agency, Chinese Taipei 的會員身分報名(如圖 3，AWC 官網只有這個選項)，但當天在現場報到時，AWC 秘書處卻找不到我的名牌，我立即拿出我的名片嚴正要求立刻補印，拿到名牌的國名是 Taiwan, ROC (如圖 4)。

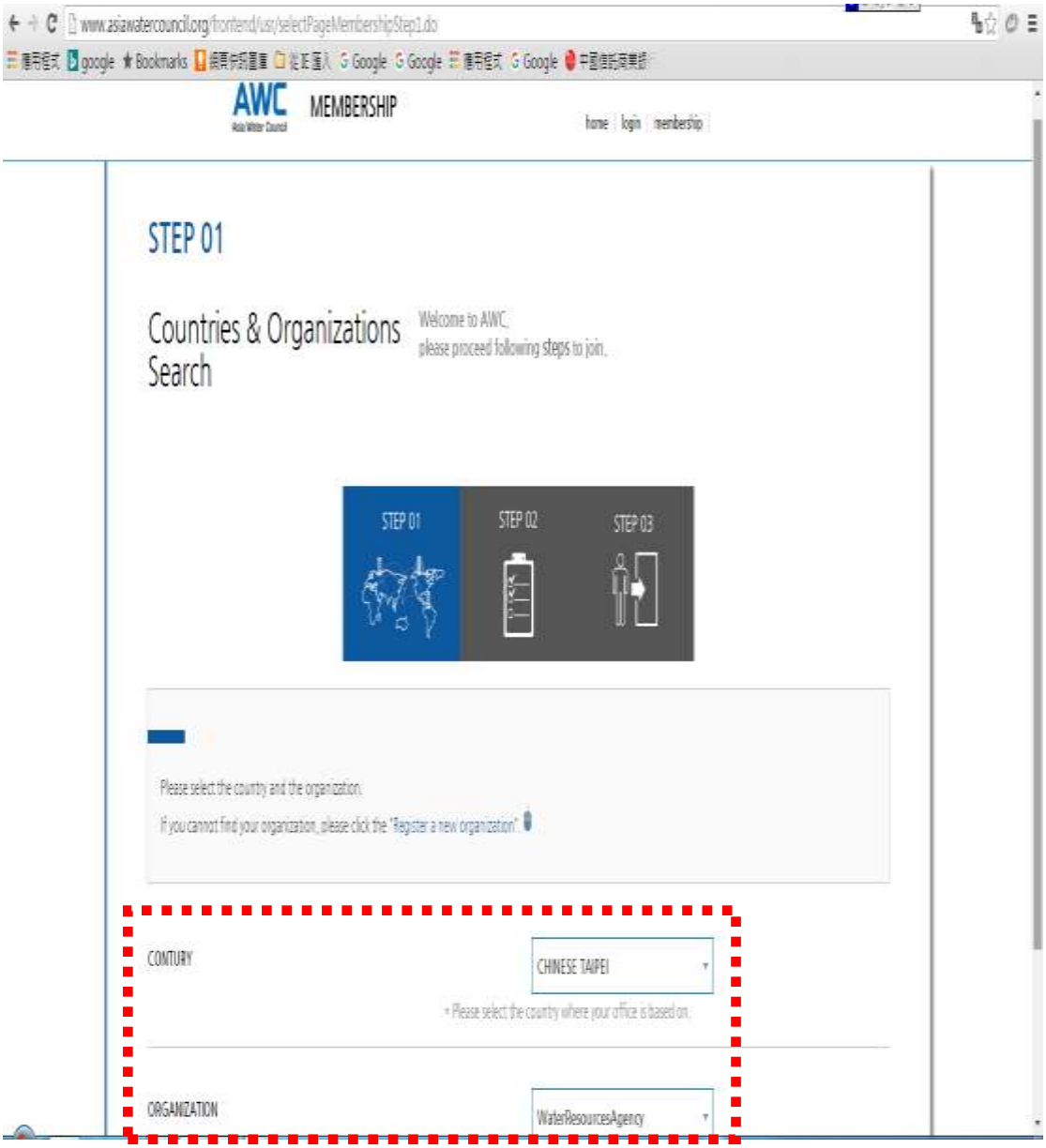


圖 3、本署在 AWC 官網以會員身分報名

圖 4、出席會議報到拿到的名牌

二、開幕式：

本次大會由印尼公眾事務與住宅部部長 Ir.M.Basuki Hadimuljono 部長及韓國 K-Water 主席 Gyewoon Choi 主持開幕式，開幕式中介紹 AWC 的由來。其中 AWC 的由來是由 2014 年 6 月由 K-Water 發起邀請亞洲與水相關的利害關係人，召開亞洲水務高峰圓桌會議(Asian Water High Level Round Table，簡稱 AWHoT)，研商確保亞洲的永續發展及解決該地區的水資源挑戰的議題，所有成員都同意建立一個更有影響力的實體，討論水問題及提出解決方案，而經濟部楊次長偉甫於 2014 年 6 月也受邀出席 AWHoT 會議，當時出席會議的領袖照片(如圖 5)。

圖 5、AWHoT 會議領袖合照(楊次長站在右邊第 4 位)

三、選舉 AWC 理監事會及第一屆理監事會主席：

經由出席第一屆會員大會的 1 百多位會員投票，選出 9 個 AWC 理監事會代表組織，依得票高低順序排列(如表 1)，我國只有 1 人出席，因此我國只獲得 1 票而未入選。而韓國 K-Water 主席 Gyewoon Choi 當選 AWC 第一屆理監事會主席(如圖 6)。

表 1、AWC 理監事會代表組織

項次	組織	國家
1	國土資源、基礎設施及交通運輸部 Ministry of Land, Infrastructure and Transportation	韓國 Korea
2	水利部 Ministry of Water Resources	中國 China
3	公眾事務與住宅部 Ministry of Public Works and Housing	印尼 Indonesia
4	能源和礦業部 Ministry of Energy and Mines	寮國 Laos
5	環境、綠色發展及旅遊部 Ministry of Environment, Green Development and tourism	蒙古 Mongolia
6	水資源和氣象部 Ministry of Water Resources and Meteorology	柬埔寨 Cambodia
7	城市供水與污水部 Ministry of Metropolitan Waterworks and Sewerage	菲律賓 Philippines
8	農業與合作社部 Ministry of Agriculture and Cooperatives	泰國 Thailand
9	K-water	韓國 Korea

圖 6、AWC 第一屆理監事會主席 Gyewoon Choi

四、確定 AWC 組織章程：

AWC 組織章程分為 12 章 53 條及 3 個附屬文件，規範 AWC 的願景、目標、組織、會員權利義務、會員大會、理監事會、秘書處、特別委員會、財務、亞洲水週舉辦、雜項規定等(如附錄 1)。

五、確定 AWC 組織架構：

1.組織架構：

AWC 的組織架構由主席下轄理監事會、秘書處辦理公務處理、國際事務、秘書業務、財務、教育等 5 大項業務，並成立 7 個特別委員會(如圖 7)。

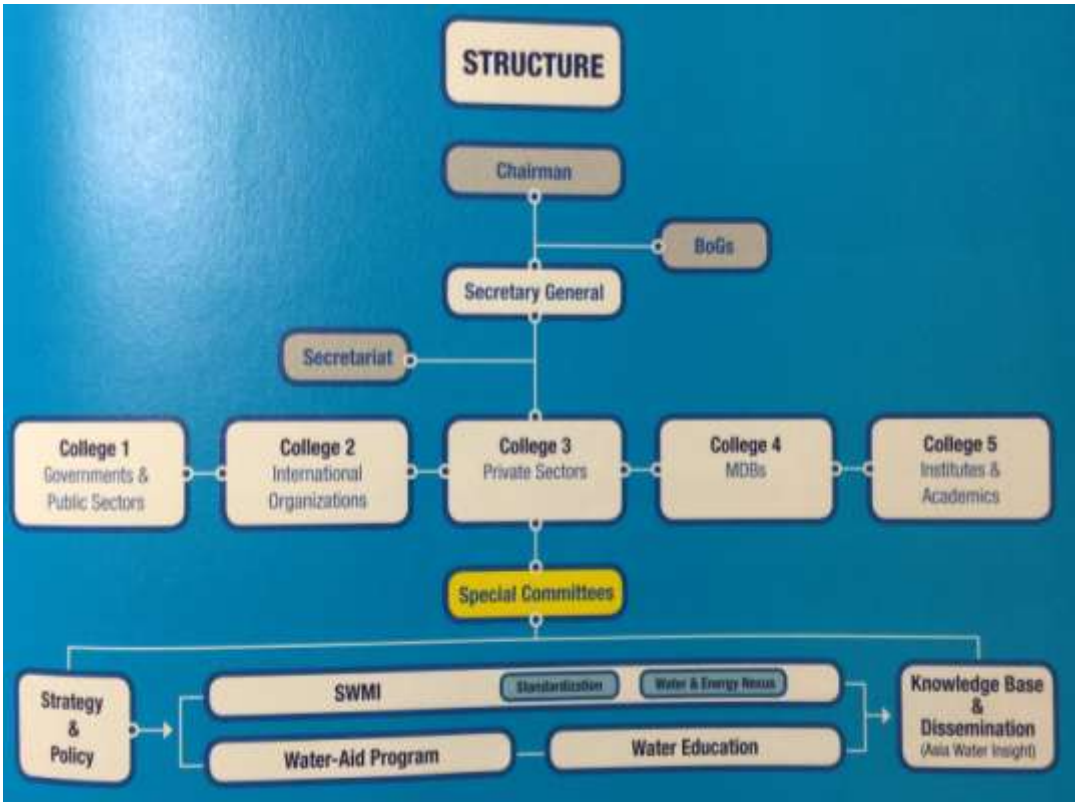


圖 7、AWC 組織架構

2.秘書處：

第一屆秘書處配合 AWC 主席由韓國負責擔任，設秘書長 1 人，協會官網：http://www.asiawatercouncil.org/。

3.會員：

AWC 會員分創始成員、活動會員及榮譽會員 3 大類，其權利義務規定於組織章程中，目前已有 107 個組織加入會員：

(1)創始成員(Founding Members)：

授予參與創立 AWC 的 14 位成員(如圖 8)。

圖 8、AWC14 位創始成員

(2)活動會員(Active Members)：

致力於履行組織章程規定的責任與義務的組織或個人，分為政府組織、多邊開發銀行和出口信貸機構、公共組織、企業、學術研究機構、國際 NGO 組織等 6 大項類別，本署及台大水工所均屬於活動會員。

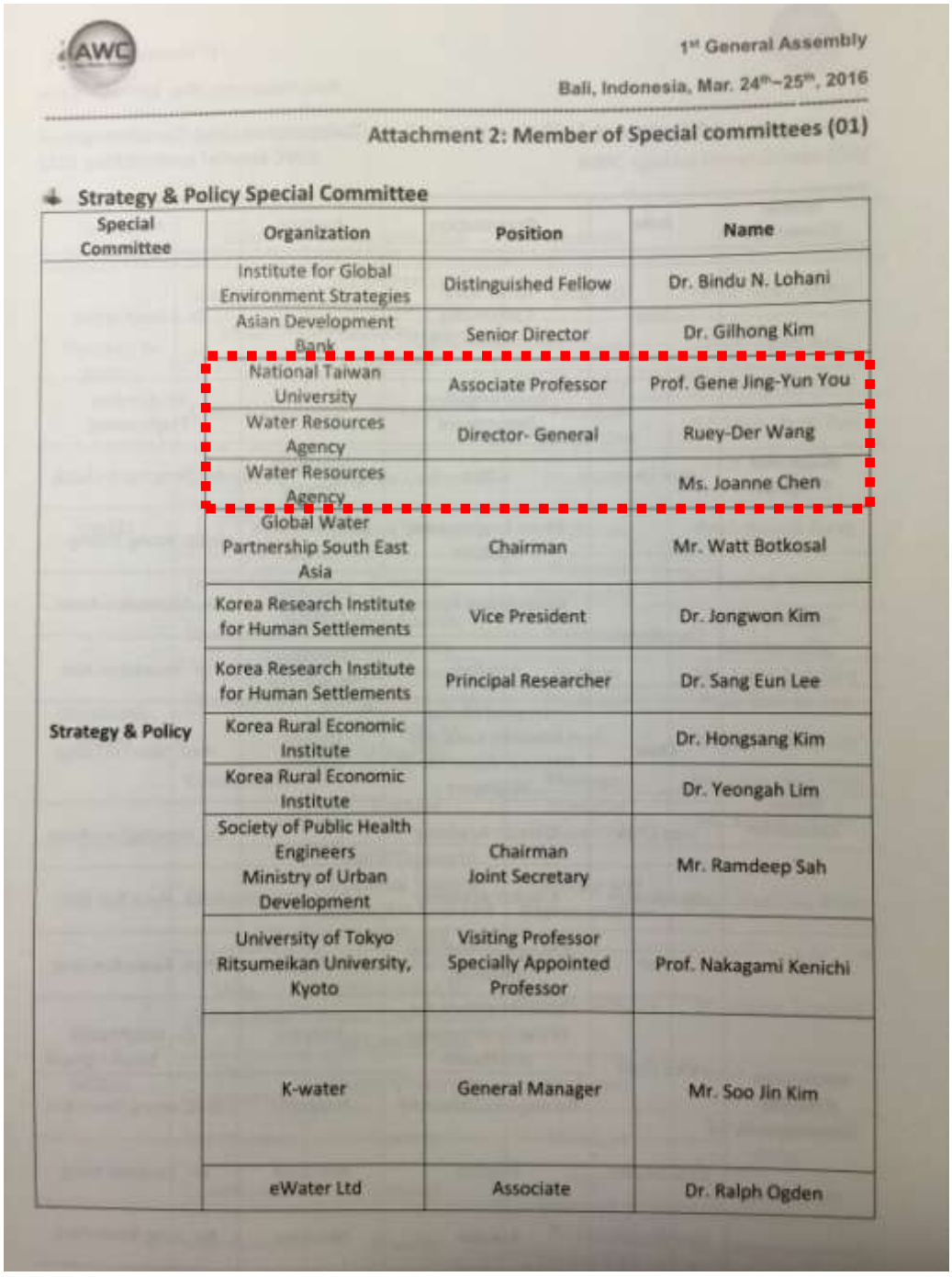
(3)榮譽會員(Honorary Members)：

有可促進 AWC 目標及顯著社會成就的個人、企業或組織，需要獲得 AWC 理監事會的批准。目前尚無榮譽會員。

4.特別委員會：

(1)策略及政策委員會(Strategy & Policy Committee)：

目的在建立高效能可靠的決策系統，達成永續水資源管理的目標。本署王署長瑞德、陳正工程司芳瓊及台大游景雲教授成功爭取加入策略及政策委員會(如圖 9)。



AWC

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Attachment 2: Member of Special committees (01)

Strategy & Policy Special Committee

Special Committee	Organization	Position	Name
Strategy & Policy	Institute for Global Environment Strategies	Distinguished Fellow	Dr. Bindu N. Lohani
	Asian Development Bank	Senior Director	Dr. Gilhong Kim
	National Taiwan University	Associate Professor	Prof. Gene Jing-Yun You
	Water Resources Agency	Director- General	Ruey-Der Wang
	Water Resources Agency		Ms. Joanne Chen
	Global Water Partnership South East Asia	Chairman	Mr. Watt Botkosal
	Korea Research Institute for Human Settlements	Vice President	Dr. Jongwon Kim
	Korea Research Institute for Human Settlements	Principal Researcher	Dr. Sang Eun Lee
	Korea Rural Economic Institute		Dr. Hongsang Kim
	Korea Rural Economic Institute		Dr. Yeongah Lim
	Society of Public Health Engineers Ministry of Urban Development	Chairman Joint Secretary	Mr. Ramdeep Sah
	University of Tokyo Ritsumeikan University, Kyoto	Visiting Professor Specially Appointed Professor	Prof. Nakagami Kenichi
	K-water	General Manager	Mr. Soo Jin Kim
	eWater Ltd	Associate	Dr. Ralph Ogden

圖 9、本署及台灣大學爭取成功加入策略及政策委員會

(2)智慧水管理委員會(SWMI Committee)：

目的在利用先進的資訊通信技術和大數據技術，提供亞洲水挑戰可能的解決方案。台灣地球觀測學會主席劉閱安教授成功加入智慧水管理委員會。

(3)標準委員會(Standardization Committee)：

目的在由 SWMI 技術解決亞洲水挑戰的解決方案中形成技術標準，提高國際標準化水處理技術的學習及推廣。

(4) 水 - 能 源 - 糧 食 委 員 會 (Water-Energy-Food Nexus Committee)：

目的在提高水-能源-糧食週期的效率，並運用回收再利用的自然資源，以防治水與自然災害，並保護水資源和生態系統。

(5)水援助計畫委員會(Water-Aid Program Committee)：

目的在改善獲得淡水、提高用水效率、增加水的生產、減少自然災害風險及損害。

(6)水教育委員會(Water Education Committee)：

目的在提供亞洲各國水的相關資訊及知識，使亞洲各國的水技術共同成長。

(7)知識庫及傳播委員會(Knowledge Base Dissemination Committee)：

目的在建立亞洲水資訊共用平臺，並透過產生和傳播亞洲準確的水資訊，建議以亞洲國家合適的技術及正確的決策方向。

六、確定近未來 AWC 將推動的專案計畫及活動：

(一)舉辦「亞洲水協會第二屆全體會員大會」：

1.時間：2016 年 7 月

2.地點：新加坡(將在 SIWW 會場舉辦)

3.會議內容：

- 公布 7 個 AWC 特別委員會近未來將推動的專案計畫。
- 規劃 2017 年將舉辦的第 1 屆亞洲國際水週(The 1st Aisa International Water Week, AIWW)細節。

(二)舉辦「第 1 屆亞洲國際水週」：

1.時間：2017 年 10 月

2.地點：韓國

3.會議內容：

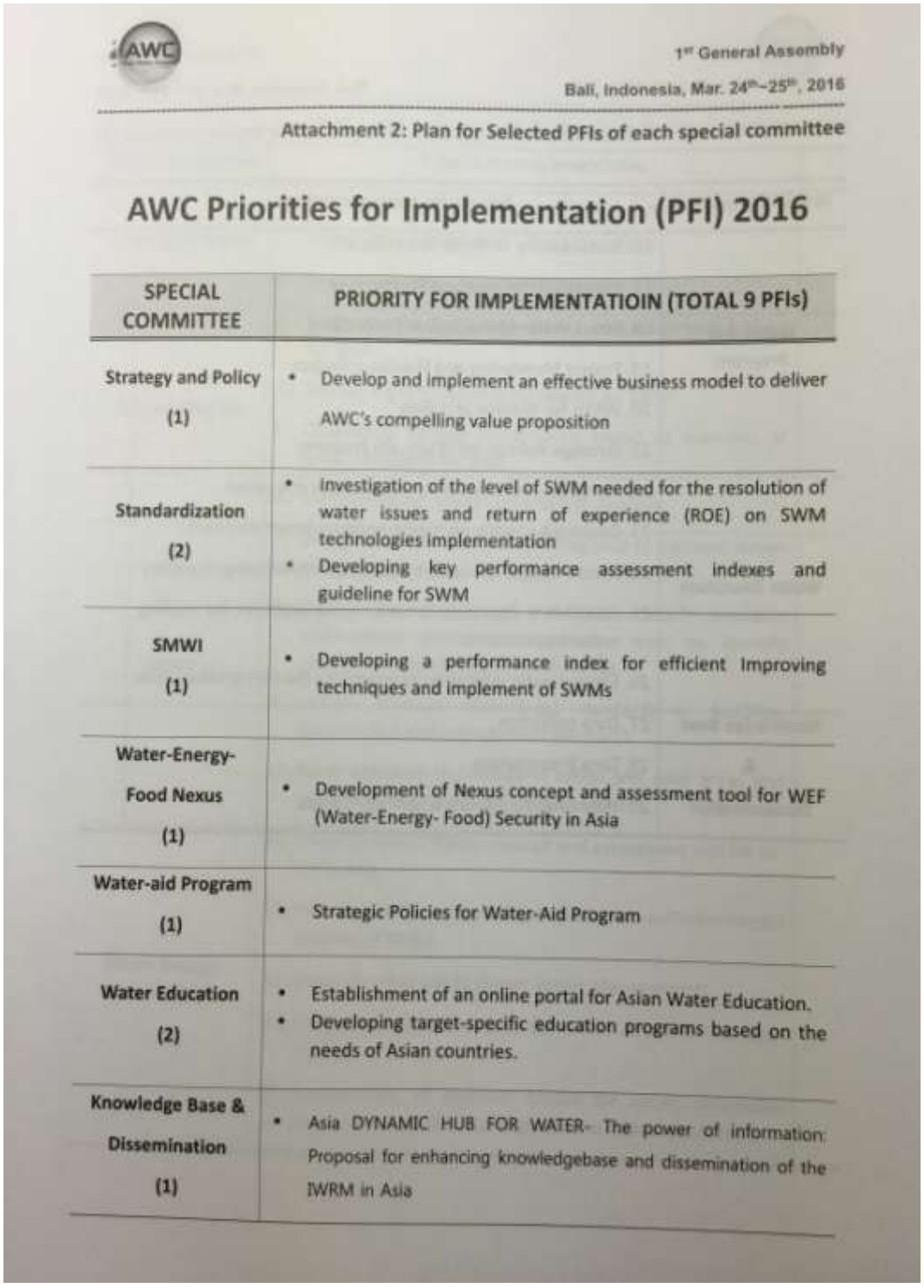
- 專門議題。
- 區域問題。
- 智慧水管理最佳實務分享。
- 水展。
- 商業及公民論壇。
- …等

(三)推動亞洲國際水週(AIWW)與新加坡國際水週(SIWW)及世界水論壇(WWF)合作。

(四)AWC 的 7 個特別委員會於 2016 年優先推動之專案計畫：

AWC 的 7 個特別委員會於 2016 年優先推動之專案計畫(如圖 10)，其中我國水利署及台灣大學加入的策略及政策委員會，於 2016 年將優先推動「制定並實施有效的商業模式促進 AWC 的價值主張受世界各國重視及注意專案

計畫 (Develop and implement an effective business model to deliver AWC's compelling value proposition.) 」



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Attachment 2: Plan for Selected PFIs of each special committee

AWC Priorities for Implementation (PFI) 2016

SPECIAL COMMITTEE	PRIORITY FOR IMPLEMENTATIOIN (TOTAL 9 PFIs)
Strategy and Policy (1)	• Develop and implement an effective business model to deliver AWC's compelling value proposition
Standardization (2)	• Investigation of the level of SWM needed for the resolution of water issues and return of experience (ROE) on SWM technologies implementation • Developing key performance assessment indexes and guideline for SWM
SMWI (1)	• Developing a performance index for efficient Improving techniques and implement of SWMs
Water-Energy-Food Nexus (1)	• Development of Nexus concept and assessment tool for WEF (Water-Energy- Food) Security in Asia
Water-aid Program (1)	• Strategic Policies for Water-Aid Program
Water Education (2)	• Establishment of an online portal for Asian Water Education. • Developing target-specific education programs based on the needs of Asian countries.
Knowledge Base & Dissemination (1)	• Asia DYNAMIC HUB FOR WATER- The power of information: Proposal for enhancing knowledgebase and dissemination of the IWRM in Asia

圖 10、AWC 的 7 個特別委員會於 2016 年優先推動之專案計畫

七、水商業展(Water Business Forum)：

本次水商業展提供研討會，B2B、G2G 及攤位展示服務，本次共有 17 家廠商於會場中展示，所展示的攤位包括監測設備、智慧水錶、抽水馬達、汙水處理等。會場攤位布設(如圖 11)，李組長參加水商業展的相片(如圖 12)。

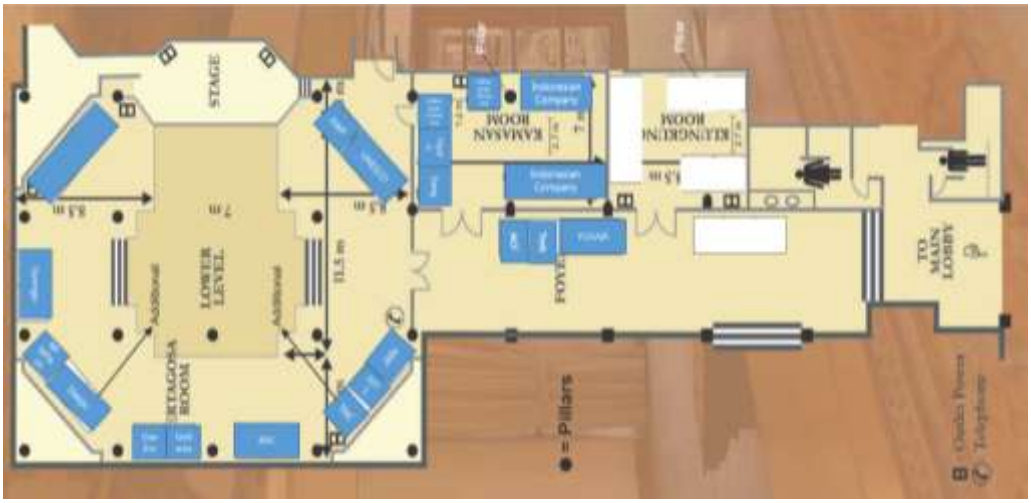


圖 11、會場攤位布設

圖 12、李組長參加水商業展

八、歡迎晚宴：

本次大會的歡迎晚宴由印尼公眾事務與住宅部 Ir.M.Basuki Hadimuljono 部長作東招待，Ir.M.Basuki Hadimuljono 部長於去(2015)年在韓國召開第七屆世界水論壇(WWF7)時和他換過名片，我向他提及當時的情境，他直稱許台灣在 WWF7 的亮麗表現，也參觀了水展的台灣館，對我國的優質企業(例如電子水錶、深水馬達等)留下深刻印象，他不僅是公眾事務的博士更多才多藝還會打鼓呢。與 Ir.M.Basuki Hadimuljono 部長合影(如圖 13)及 Ir.M.Basuki Hadimuljono 部長打鼓秀才藝(如圖 14)，晚宴不忘為台灣拚外交。

圖 13、與印尼 Ir.M.Basuki Hadimuljono 部長合影

圖 14、與印尼 Ir.M.Basuki Hadimuljono 部長打鼓秀才藝

九、文化之旅：本署未參加，搭乘飛機返國。

參、心得

一、本次李組長奉派出席亞洲水協會(AWC)第一次會員大會獲致成果，說明如下：

(一)透過軟技巧溝通，意外突破拿到國名是 Taiwan, ROC 的參加名牌。

(二)經濟部水利署及台大水工所成功加入 AWC 之活動會員。

(三)成功爭取水利署王署長瑞德、陳正工程司芳瓊及台大游景雲教授加入 AWC 下轄之策略及政策委員會，台灣地球觀測學會劉閱安教授成功加入智慧水管理委員會。

(四)在本次會議刊物-洞悉亞洲水資源 (Insight into Asian Water)，加入台灣篇介紹台灣防災及水利科技等技術，成功行銷台灣與世界接軌。

(五)帶回亞洲水協會組織章程、亞洲水協會第一屆全體會員會議大會手冊、洞悉亞洲水資源報告(Insight into Asian Water)、聯合國世界水發展 2016 年報(The United Nations World Water Development Report 2016)、導入智慧水管理開創水資源管理新紀元倡議報告(New Era of Water Resources Management with Smart Water Management Initiative)及水商業展中有關 17 家廠商展示的監測設備、智慧水錶、抽水馬達、汙水處理等資料，作國際合作政策研析之重要參考。

二、本次出席 AWC 第一次會員大會觀察到的現象，說明如下：

(一)AWC 之成立是由韓國(K-Water)一手主導，我經由認識 AWC 韓國秘書處的計畫經理 Joonhan Yoon 後，聊天得知

韓國近年透過發展 3C 科技及整治漢江、清溪川的經驗，加以整合發展出智慧水管理(SWMI)的技術，韓國就是要成立 AWC 的國際平台，整合國際資源，將韓國的智慧水管理技術援助亞洲落後國家，其實就是在搶地盤賣技術為韓國賺錢，而 AWC 以人道援助的大旗必須要有足夠資金，光靠韓國捐助是不夠的，所以必須拉攏世界銀行、亞洲開發銀行及中國大陸正在推動的亞投行的力量，才能竟其功。因此，由本次會議可看出韓國對中國大陸釋出非常友好的善意。

(二)本次中國大陸代表團出席了 15 位團員，其中團長水利部劉志廣司長、郝釗處長、水利研究發展中心金海副主任、北京清華大學水利學院王忠靜院長等 4 位訪問過台灣，他們私下表示，中國大陸也將藉力使力拓展其國際實力。

(三)2016 年兩岸關係出現微妙變化，由本次會議發展情勢可看出，韓國為了未來亞投行能挹注 AWC 資金拉攏中國大陸，或多或少壓縮了台灣參加 AWC 的空間。

三、本次出席 AWC 水商業展，看到世界各國紛紛發展智慧水管理技術的趨勢，而我國在智慧水管理(例如河川、排水、海堤區域管理、疏濬管理及行動水情...等)也多有成效及經驗，應多在國際上推廣。

肆、建議事項

一、韓國透過發展 3C 科技及整治漢江、清溪川的經驗，加以整合發展出智慧水管理的技術，並成立 AWC 的國際平台整合國際資源，拓展國際地位的經驗，值得我國借鏡。

二、我國水利署及台灣大學加入 AWC 下轄之策略及政策委員會，在 2016 年將優先推動「制定並實施有效的商業模式促進 AWC 的價值主張受世界各國重視及注意專案計畫，我國可朝此方向進行研究。另該委員會的主席是澳洲 Prof. Gary Jones (Chief ED of Australian Water Partnership)，副主席是韓國 Prof. Kihee Ryu (Professor of Seoul National University)，可進行利害關係人管理。

三、台灣地球觀測學會主席劉閱安教授加入智慧水管理委員會，在 2016 年將優先推動「訂定高效能改進技術的性能指標及智慧水管理的示範熱點研究(Developing a performance index for efficient improving techniques and implement of SWMs.)」，我國可朝此方向進行研究。另該委員會的主席是北京清華大學水利學院王忠靜院長，副主席是韓國 Prof. Boosik Kang (Professor of Dankook University) ，可進行利害關係人管理。

四、亞洲水協會第二屆全體會員大會將在 2016 年 7 月於新加坡 SIWW 會場舉辦，我國可提前因應。

五、第 1 屆亞洲國際水週(AIWW)將在 2017 年 10 月於韓國舉辦，我國可提前因應。

六、印尼公眾事務與住宅部 Ir.M.Basuki Hadimuljono 部長對我國水利科技及優質產業(例如電子水錶、深水馬達等，有深刻印象，建議可由相關企業主動與其聯絡。

附錄一、亞洲水協會組織章程(Constitution of Asia Water Council)

This Constitution is in accordance with Rules on the Establishment and Supervision of Non-profit Corporation under the Ministry of Land, Infrastructure and Transport and its Affiliated Organizations as well as Civil Act of the Republic of Korea.

Chapter 1、General Provisions

Article 1 (Name) The name of this council shall be "Asia Water Council" (hereinafter referred to as "AWC").

Article 2 (Basis of Establishment) AWC shall be established in compliance with Article 32 of Civil Law of the Republic of Korea.

Article 3 (Objective) AWC aims to raise global awareness of Asia's water problems and promote the sustainable development of Asia by resolving regional water issues. AWC shall also strive to achieve these aims by developing water-related policies and technology, promoting research and discussion, carrying out water projects and building a platform where diverse water-related stakeholders in Asia can participate.

Article 4 (Organization) AWC consists of a General Assembly, Board of Council, Advisory Board, Bureau, Special Committees, and Secretariat. AWC can add a temporary body if deemed necessary by the Board of Council (hereinafter referred to as "the Board").

Article 5 (Activities) AWC conducts activities specified in the following subparagraphs to achieve the objectives laid out in Article 3.

1. Lay the foundation for international cooperation to solve Asia's water problems and conduct activities to facilitate cooperation
2. Share each member country's data, statistics and new business information
3. Organize and support international conferences, workshops, seminars, research, education and training and water-related projects
4. Help member institutions obtain technologies and develop talented human resources by pursuing joint projects and personnel exchange
5. Serve as a hub of Asia in the attendance of the World Water Forum organized by the World Water Council
6. Operate a knowledge-sharing program utilizing advanced water-related technologies including smart water management technologies and use the Asian region as a test bed
7. Serve as a water-related think tank in Asia through research on advanced water management and policies
8. Conduct research for international standardization of water-related technologies
9. Identify pending issues in regional water management and publish a comprehensive report
10. Operate special committees to select, carry out and evaluate priorities for implementation
11. Provide diverse implementation modules including water-related technologies, policies and education
12. Carry out activities needed to host an Asia International Water Week
13. Pursue other water-related activity needed to achieve objectives laid out in Article 3

②AWC should obtain approval from the Board before pursuing for profit business or before conducting the activities specified in each subparagraph of paragraph 1. Any change in the above AWC activities also requires the Board's approval.

Article 6 (Location of Secretariat)
①The AWC Headquarters, which houses the AWC Secretariat, shall be located in the Republic of Korea and branch offices can be located within Korea or abroad if necessary.
②The Headquarters may only be transferred outside of Korea by approval of the General Assembly.

Chapter 2 Members and Membership Fees

Article 7 (Type and Qualification of Members)
①AWC members are classified into Founding Members, Active Members and Honorary Members.
②Founding Members, specified in the following subparagraphs, are individuals who contributed to the establishment of AWC.

1. Mr. Hoin Kang (Ministry of Land, Infrastructure and Transport, Korea)
2. Mr. Gyewoon Choi (K-water, Korea)
3. Mr. Youngmok Kim (Korea International Cooperation Agency, Korea)
4. Mr. Bindu N. Lohani (Former Vice President, Asian Development Bank)
5. Mr. Chen Lei (Ministry of Water Resources, China)
6. Mr. Ir. Basuki Hadimoeljono (Ministry of Public Works and Housing, Indonesia)
7. Mr. Khammany Inthirath (Ministry of Energy and Mines, Laos)
8. Mr. Shavkat Khamraev (Ministry of Agriculture and Water Resources, Uzbekistan)
9. Mr. Lertviroj Kowattana (Ministry of Agriculture and Cooperatives, Thailand)
10. Mr. N. Battsereg (Ministry of Environment, Green Development and Tourism, Mongolia)
11. Mr. Philippe Gourbesville (Polytech Nice Sophia University, France)
12. Mr. Liong, Shie-Yui (National University of Singapore, Singapore)
13. Mr. Kazumasa Ito (Tokyo City University, Japan)
14. Mr. Lim Kean Hor (Ministry of Water Resources and Meteorology, Cambodia)
15. Mr. Gerardo AI. Esquivel (Metropolitan Water Supply and Sanitation Authority, Philippines)

③Active Members are institutions which seek to achieve the objectives of Article 3 and are dedicated to fulfilling the obligations and responsibilities stipulated in this Constitution. Active Membership requires approval from the Board.
④Active Members are divided into six colleges as specified in the following subparagraphs.

1. Governments
2. Multilateral Development Banks and Export Credit Agencies
3. Public organizations
4. Enterprises
5. Academia and Research organizations
6. International organizations and Civil society

⑤Honorary Members are individuals with significant social achievements or people who can contribute to AWC's objectives and businesses. Honorary Membership requires approval from the Board.

Article 8 (Right of Members) ①Members can receive materials and publications produced by AWC and review materials concerning AWC operations.
②Active Members have the right to vote for and be elected to the Board, and hold the right to speak and vote about AWC's operations and activities by attending the General Assembly.
③Founding Members and Honorary Members have the right to speak about AWC's operations and activities by attending meetings of the Board and the General Assembly.

Article 9 (Obligation of Members) The obligations of members are as follows:

1. Observe AWC's Constitution
2. Maintain reputation of members
3. Report as stipulated in AWC's Constitution
4. Implement matters decided by the General Assembly and the Board

Article 10 (Membership Withdrawal and Expulsion) Members who desire to withdraw from AWC can do so by submitting their request in writing. Members who commit any of the acts outlined in the following subparagraphs can be expelled by the Board after review.

1. Failure to fulfill member obligations
2. Tarnishing AWC's reputation or committing an act contrary to AWC's objectives
3. Violation of AWC's Constitution or decisions
4. Failure to pay membership fees for more than three years

Article 11 (Reinstatement) Regulations outlined in Article 10 shall be followed if a person or an organization who withdrew or was expelled from AWC desires to be reinstated.

Article 12 (Membership Fees) ①Members must pay all membership fees of the current year to maintain membership rights in accordance with Article 8.
②Members must pay all outstanding membership fees by the day before the opening of the General Assembly to be eligible to vote during the General Assembly.
③Members must pay all outstanding membership fees two months before the opening of General Assembly to be eligible to run for an election during the General Assembly. However, if such General Assembly is held in the first half of a year, members are not required to pay the membership fee of that year before the General Assembly.
④The Board may decide to exempt a member from payment of membership fees or to reduce the fee amount.
⑤The Board shall set the modalities for payment of the membership fees for the coming year at its final meeting of the previous year.

Chapter 3 General Assembly

Article 13 (Convocation of the General Assembly) ① The General Assembly is classified into an Ordinary General Assembly and an Extraordinary General Assembly.
② An Ordinary General Assembly is held every year while an Extraordinary General Assembly is convened by the President in any of the cases outlined in the following subparagraphs.

1. The Chair acknowledges its need
2. The Board gives approval
3. More than a third of members submit a request in writing

③Notification of holding the General Assembly Meeting should be sent to all members 30 days prior to the date of the meeting in formal writing and should include agenda items.
④The Board shall decide the date and venue of the General Assembly.
⑤The Secretary General should submit proceedings to the members in writing within 30 days of the General Assembly and obtain approval from the members.

Article 14 (Decision Making of the General Assembly) ①Matters for decision will be voted on by a majority of those present at the General Assembly and decided by a simple majority. However, in case of a tie, the Chair will make a decision.
②The President becomes the Chair of the General Assembly and, if the President is absent, the Vice President takes the Chair, in the order determined in paragraph 3 of Article 25.
③In principle, matters are decided through voting by a show of hands. However, decisions shall be made by secret voting if a majority of those in attendance desire it or if a vote

concerns personal information.
④If it is impossible to convene the General Assembly or in case of minor issues, decisions can be made in writing.

Article 15 (Matters for Decision by the General Assembly) The General Assembly decides matters outlined in the following subparagraphs.

1. Matters concerning appointment and dismissal of a Board Member
2. Matters concerning changes in the Constitution
3. Approval of accounting audit report, annual financial statement, sheet of final accounts, and purchase and expense budgeting for the following year
4. Approval of business plan in accordance with Article 37
5. Disposal or mortgage of a material asset in accordance with the laws of the country where the Secretariat is located
6. Transfer of the Secretariat to a different country in accordance with paragraph 2 of Article 6
7. Matters concerning dissolution of AWC
8. Other matters proposed by the decision of the Board

Article 16 (Voting Right of Members) ①Founding Members and Honorary Members as well as Active Members that have not paid any outstanding membership fees by a day before the opening of the General Assembly, do not have voting rights at the General Assembly.
②Members that cannot attend the General Assembly can delegate their voting right to other members by submitting a power of attorney to the Chair before the commencement of the General Assembly. A delegated member can only serve as a proxy for up to two organizations. Members that submit power of attorney are counted as having attended the General Assembly.

Chapter 4 Board of Council

Article 17 (Composition of the Board)
①AWC operates the Board which is composed of 25 Board Organizations.
②A Board Organization appoints one Board Member representing its organization and appoints one Alternate to substitute for the Board Member in case the Board Member cannot attend the Board.
③The term of the Board Member and Alternate is three years and they can serve consecutive terms.
④The Advisory Board and the Secretary General should attend the Board meetings, but they do not have voting rights.
⑤ K-water and a member who contributes 20% or more of the Secretariat's operating budget for three fiscal year through monetary or other material support will be given Statutory Board Member status.
⑥ A Board Organization given Statutory Member status according to paragraph 5 is given a seat regardless of the number of existing institutions or college designation. The number of member organizations given Statutory Member status because of monetary support will be decided by the General Assembly.

Article 18 (Convocation of the Board) ① The Board meets at least twice a year and the meeting is convened by the President in the following cases:

1. The President acknowledges its need; or
2. More than a third of Board Members submits a written request.

②The notification of holding the Board meeting should be sent to all the Board members 30 days prior to its opening in formal writing and should include meeting agenda items.
③The President shall decide the date and venue of the Board meeting.

④The President shall decide the meeting agenda by listening to the opinions of Board Members through the Secretary General. If there are different views on the agenda, a decision should be made through voting at the beginning of the Board meeting.
⑤The Secretary General should submit proceedings of the Board meeting to Board Members in writing within 30 days from the Board meeting and final proceedings should be approved in the next Board meeting.

Article 19 (Election of Board Organization) ①The Board Organizations are elected at the Ordinary General Assembly.
②Members that desire to run for Board Organizations should satisfy the conditions laid out in paragraph 3 of Article 12 and submit the candidacy registration form to the Secretariat two months before the opening of the General Assembly. However, new members should obtain membership approval from the Board three months before the opening of the General Assembly.
③Members that desire to exercise their voting rights to elect a Board Organization should satisfy the regulations laid out in paragraph 2 of Article 12. However, new members should obtain membership approval from the Board three months before the opening of the General Assembly.
④The number of Board Organizations per college in accordance with paragraph 4 of Article 7 is allocated in proportion to the number of members per college three months before the opening of the General Assembly, and each college is allocated three organizations at minimum to six at maximum.
⑤No more than two members from the same country should be included in any one slate within any one college, with the provision that international organizations are not considered to belong to any particular country.
⑥In exceptional cases or if allowance calculation in accordance with the regulations in paragraph 4 requires consultation, the Board shall make the decision.
⑦The Secretary General should notify all members that there will a Board Organization election and distribute the candidacy registration form three months prior to the opening of the General Assembly.
⑧After having completed candidacy registration, the Secretary General should arbitrate and review a list of candidates in accordance with paragraph 5. The President has final approval of the slate. The Secretariat should notify all members with the list of approved candidates.
⑨Members satisfying paragraph 3 shall exercise up to 25 secret voting rights in line with the allowance allocated per college according to paragraph 4.
⑩As a result of voting according to paragraph 9, candidates become Board Organizations in the order of the number of votes obtained as much as allowed per college. In case of a vacancy in a college, the new Board shall appoint a Board Organization.

Article 20 (Decision Making of the Board) ①The Board discusses matters when a majority of registered Board Members are in attendance and decides matters by a majority vote of Board Members in attendance.
②Board Members who cannot attend the Board can delegate their voting right to other Board Members by submitting power of attorney to the Chair before the commencement of the Board meeting. A delegated Board Member can only serve as a proxy for up to two organizations. Board Members who submit power of attorney are considered as having attended the Board meeting.
③The President becomes the Chair of the Board and, in case the President is absent, the Vice President takes the Chair, in order determined in paragraph 3 of Article 25
④In case it is impossible to convene the Board or in case of minor issues, decisions can be made in writing.

Article 21 (Matters for Decision by the Board) The Board decides following matters:

1. Matters to be laid before the General Assembly in accordance with subparagraph 8 of Article 15;
2. Date and venue of the General Assembly;
3. Appointment of accounting auditor;
4. Matters concerning business plan in accordance with Article 37;
5. Deliberation and confirmation of agenda items brought in by special committee in accordance with Article 35;
6. Change of a city within a country where the Secretariat is located in accordance with paragraph 2 of Article 6;
7. Matters concerning exemption from and reduction in membership fees;
8. Decision about membership fees for the following year;
9. Matters concerning Asia International Water Week;
10. Appointment of the Secretary General, decisions on his/her remuneration and supervision of his/her work;
11. Matters concerning approval and expulsion of members; and
12. Matters that the President acknowledges need to be decided by the Board.

Article 22 (Remuneration of Board Members) Board Member membership is an honorary position without remuneration. However, benefits and other necessary expenses for the President and the Vice President can be paid as provided by the Board.

Chapter 5 Bureau

Article 23 (Election of the Bureau) ①One President is elected among Board Members by voting at the Board.
②The Board elects four Vice Presidents and one Treasurer among Board Members by the recommendation of the President.

Article 24 (Term of the Bureau) ①The term of the Bureau is three years and Bureau members can serve consecutive terms.
②The President can appoint a Vice President in case of a vacancy. The term of a Vice President appointed to fill a vacancy shall be the remaining period of the predecessor's term.
③ If the Board Organization of a Bureau member loses its Board Organization status, the Board shall determine whether the Bureau member will continue his/her remaining term.

Article 25 (Duties of the Bureau) ①The President represents AWC and convenes the Board and the General Assembly.
②The Vice Presidents assists the President and, in case of a vacancy of the President, fulfills the duties of the President within the scope of delegated authority.
③The President determines the order of the Vice Presidents who will fulfill the duties of the President immediately after the Board to elect the President.
④ The Treasurer, assisted by the Secretary General, is responsible for the accounts of AWC.
⑤ The members of the Bureau are collectively responsible for preparing and executing the decisions of the Board of Council.

Article 26 (Decision Making of Bureau) ① The Bureau discusses matters when a majority of the Bureau members are in attendance and decides maters by consensus of the Bureau members in attendance.
② Bureau members who cannot attend the Bureau meeting can delegate their voting right to other Bureau members by submitting power of attorney to the Chair before the commencement of the Bureau meeting. Bureau members who submit power of attorney are considered as having attended the Board meeting.
③The President becomes the Chair of the Bureau and, in case the President is absent, the

Vice President takes the Chair, in the order determined in paragraph 3 of Article 25.
④In case it is impossible to convene the Board or in case of minor issues, decisions can be made in writing.

Article 27 (Matters for Decision by Bureau) ① Bureau decides matters concerning regulation enactment and amendment in accordance with Article 50.
② The Bureau members shall review membership applications and qualification of the statutory members and recommend new members and the statutory members to the board.

Chapter 6 Advisory Board
Article 28 (Composition of Advisory Board) ①The Advisory Board shall be composed of Central Governments, Multilateral Development Banks, and Export Credit Agencies.
②The President, Vice Presidents and Secretary General should attend the Advisory Board meeting.

Article 29 (Role of Advisory Board) ①The Advisory Board shall advise the Board on matters to be laid by the President.
② If a decision to be made by the General Assembly or the Board involves business between member countries or business requiring a considerable budget, the Secretary General should submit the matter to the President who brings the matter to the Advisory Board.

Chapter 7 Secretariat
Article 30 (Structure of Secretariat) ①The Secretariat implements matters decided by the General Assembly and the Board.
②The Secretariat should assist and support AWC bodies according to Article 4.
③The Secretariat shall be composed of the Secretary General, who shall oversee all operations, and paid staff members, who can be dispatched from external organizations.
④The Secretary General is appointed by the Board to serve a term of three years, and can serve consecutive terms.

Article 31 (Duties of the Secretary General) ①The Secretary General receives instructions on duties directly from the President and should report to the President.
②The Secretary General is responsible for effective implementation and operation of AWC strategies, policies and programs.
③The Secretary General is responsible for the financial management and accounting of AWC and should establish AWC's business and budget plan to be brought before the Board and General Assembly.
④The Secretary General approves staff recruitment of the Secretariat, which should be done within budget range approved by the Board and General Assembly.
⑤The Secretary General has the right to speak during the General Assembly, the Board and the Advisory Board but does not have a voting right.
⑥The Secretary General should submit an AWC activity report to the Board.
⑦In case of a vacancy of the Secretary General, the President appoints a temporary Secretary General by obtaining approval from the Board.

Article 32 (Code of Conduct of Secretariat) Matters concerning the Secretariat's personnel management, service and remuneration are stipulated as separate regulations in accordance with the laws of the country where the Secretariat is located.

Chapter 8 Special Committee
Article 33 (Types of Special Committee) ①AWC operates the following special committees.

1. Strategy & Policy Committee
2. SWMI Committee
3. Standardization Committee
4. Water-Energy-Food Nexus Committee
5. Water-Aid Program Committee
6. Water Education Committee
7. Knowledge Base & Dissemination Committee

②The Board can decide to add or remove types of special committees according to the business plan.

Article 34 (Operation of Special Committee) Regulations about the operation of special committees are defined separately by the Board.

Article 35 (Business Planning and Execution of Special Committee) Special committees should submit business plans and result reports to the Board, which should be submitted according to the request of the General Assembly or the Board.

Chapter 9 Finance

Article 36 (AWC Income) ①AWC income comes from the following sources:

1. Membership fees;
2. Subsidies by central and local governments;
3. Donations and contributions;
4. Business income;
5. Income from received projects; and
6. Other income derived from publications, forums and related activities.

②AWC can raise and operate funds to conduct a specific business in the following ways:

1. Special contributions by members;
2. Subsidies by central and local governments;
3. Special contributions of economic organizations and those who advocate the specific business; and
4. Income derived from AWC business operations.

③Funds should be managed separately from other accounts.

Article 37 (AWC Expenses) ①All AWC expenses should be budgeted.
②If the budget is not finalized before the commencement of the fiscal year, necessary expenses can be spent by the end of February of the following year in accordance with previous year's budget.

Article 38 (Fiscal Year) The fiscal year of AWC shall be between January 1 and December 31 every year.

Article 39 (Business Plan and Budget) ①For AWC operations, the Secretary General should draw up a business plan and budget for every fiscal year and submit it to the Board for approval. Then it should be submitted to the Ordinary General Assembly for final approval.
②The Board can supplement or revise the budget approved by the General Assembly. However, it should be approved during the following General Assembly.

Article 40 (Business Result and Settlement) ①After the end of every fiscal year, the Secretary General should complete the documents outlined in the following subparagraphs for the previous fiscal year by attaching an opinion on auditing, which should be submitted to the Board and General Assembly to obtain approval.

1. Accounting audit report

2. Annual financial statement
3. Settlement of accounts concerning revenue and expenditure
4. Plan for surplus or loss

②The Secretary General should complete business results and settlement within two months after the end of every fiscal year and obtain approval from General Assembly.

Article 41 (Surplus after Settlement) In principle, any surplus after settlement shall be carried forward to the following year.

Article 42 (Accounting Audit) An accounting audit shall be conducted once a year and the results will be reported to the President, General Assembly and the Board.

Article 43 (Regulations on Accounting) AWC's accounting follows Generally Accepted Accounting Principles of the country where the Secretariat of AWC is located and, if needed, standard, procedure, budget, settlement and accounting are stipulated as separate regulations.

Chapter 10 Asia International Water Week

Article 44 (Hosting of Asia International Water Week) AWC shall host an Asia International Water Week (AIWW) every three years in Asia, one year before the World Water Forum organized by the World Water Council .

Article 45 (Composition of Asia International Water Week) The special committees shall establish a plan for the organization and operation of Asia International Water Week, which should be approved by the Board.

Article 46 (Objectives of Asia International Water Week) The objectives of Asia International Water Week are as follows:

1. Raise global awareness of Asia's water problems by linking with the World Water Forum's agenda and seek solutions
2. Call for policymakers to put solution plans into action
3. Provide a platform to share the latest water-related technologies and information
4. Create an opportunity for shared growth by providing a venue for international cooperation among companies
5. Provide a venue for the preparatory meetings of the Asian region prior to the World Water Forum
6. Provide a venue to achieve the Sustainable Development Goals

Article 47 (Venue of Asia International Water Week) The host city and country of the Asia International Water Week will be decided by voting at the Board.

Article 48 (Award of Asia International Water Week) ①AWC can organize award ceremony and grant awards during Asia International Water Week.
②The size and procedure of the award ceremony will be decided by voting at the Board.

Chapter 11 Miscellaneous Provisions

Article 49 (Designation of Official Language) English shall be the official language used for all meetings and documents of AWC.

Article 50 (Regulation Enactment) AWC can enact regulations needed to enforce this Constitution, which should be approved by the Board.

Article 51 (Document Storage) AWC should keep documents produced by the approval of the Board and General Assembly in digital or printout form.

Chapter 12 Dissolution

Article 52 (AWC Dissolution) ① The General Assembly will approve AWC dissolution in accordance with subparagraph 7 of Article 15, and dissolution should be reported to the head of competent authorities according to the law of the country where the Secretariat is located.
② In case of AWC dissolution, the President becomes the liquidator.

Article 53 (Disposal of Residual Property) Residual property at the time of AWC dissolution should be donated to the central or local governments where the Secretariat is located or other organizations with similar objectives with AWC after obtaining approval of the General Assembly and in accordance with the laws of the country where the Secretariat is located.

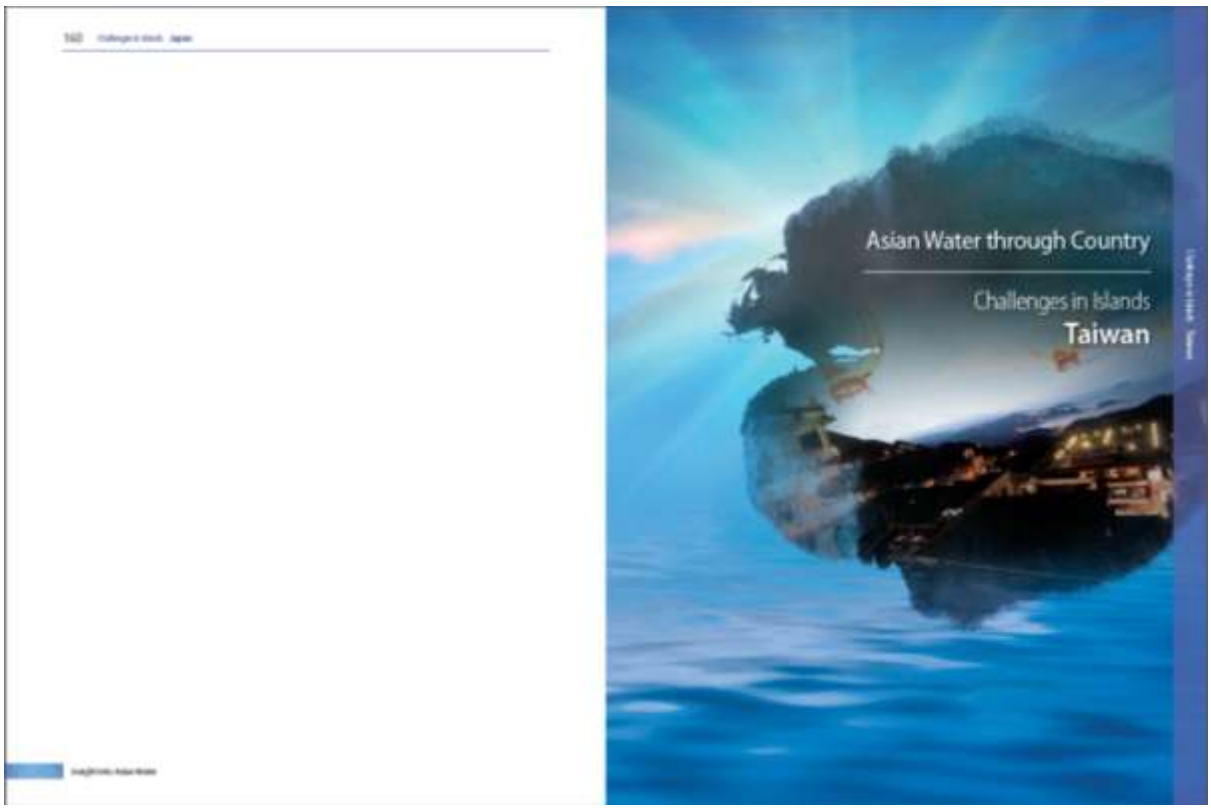
Supplementary Provisions

Article 1 (Enforcement Date) This Constitution goes into effect from the day it obtains the approval of the head of competent authorities and registration at a competent court in accordance with Articles 32 and 33 of Civil Act of the Republic of Korea.

Article 2 (Regulations) As for matters not stipulated in this Constitution, Civil Act of the Republic of Korea as well as Rules on the Establishment and Supervision of Non-profit Corporation under the Ministry of Land, Infrastructure and Transport and its Affiliated Organizations shall apply.

Article 3 (Exception to Election of Board Organization) ① The first election of the Board shall be exempt from the paragraph 4 of Article 19.
②The representatives of the Founding members' organizations shall be invited as the first Board of Council Members without an election process.

附錄二、洞悉亞洲水資源-台灣篇 (Insight into Asian Water-Taiwan)



Content

1. History of Water Resource Management in Taiwan, from Past to Present

The Republic of China, Taiwan, lies off the southeastern coast of mainland Asia. The territory comprises the islands of Taiwan, Penghu, Kinmen, Matsu and other smaller islands. The island of Taiwan makes up over 99% of the country's territory, covering approximately 36,000 square kilometers.

The island of Taiwan is in a complex tectonic area, with an extensively diversified topography and natural environment. Steep terrain and heavy rainfall causes the flooding is the most common disaster in Taiwan. Most of the flooding is induced by typhoons and storms in the summer season with concentrated monsoon rainfall and rapid flow. The uneven temporal and spatial distribution of rainfall means that the development and allocation of water resources is a serious challenge. In addition, rapid economic growth has intensified population density and led to rapid industrial and commercial development, all of which have driven further demand for water. Hence, from the past to present, water resource management in Taiwan has concentrated on two objectives: reducing the damage caused by flooding and developing water resources in response to growth.

1.1 A Brief Chronology of Water Resource Development

As in other countries, the development of water resources in Taiwan has focused on providing support for social and economic growth. In early days, irrigation was the primary focus as the wealth of the country increased, water was shifted from agriculture to industry and the domestic sector. At present, sustainable national development is the goal of water policy in Taiwan.

Water development can be traced back nearly 300 years to the period of Dutch occupation in the late Ming-Ching period (also known as the Cheng Chen-kung period). At that time, farmland irrigation systems were quickly developed to satisfy increasing agricultural demands following an increase in the number of immigrants coming to the island. Development included small-scale facilities as well as many large scale irrigation systems. The Japanese government ruled over Taiwan from 1895 to 1945. The objective behind the colonial economy was to support the economic and military development of Japan, while the development of water resources was aimed at maintaining stability in food production. This period saw the establishment of public and government irrigation systems, and also facilities such as the Taipei Canal System and the Chia-Nan Canal. Reservoirs, including Sun Moon Lake and the Wushetou Reservoir, were also constructed at this time to provide hydropower and a reliable water supply for irrigation and industrial use.

Irrigation systems were badly damaged in fighting during World War II as well as typhoons and storms that pummeled the island between 1941 and 1944. Following this war, the sovereignty Taiwan was transferred to the government of the Republic of China. Initially most of the work in the development of water resources was aimed at restoring food production. From 1952, the economic development of Taiwan involved import substitution industrialization in which labor-intensive light industry supplied domestic needs. Thus, the focus of water development involved the construction of irrigation systems and reservoirs to increase agricultural production, the income of which was used to support industrial development. Two major reservoirs, Shihmen and Tanxiguen, were completed in 1964 and 1973 respectively. The main purpose of these reservoirs was irrigation, however, changes in the economy led to the gradual expansion of hydropower and domestic water supplies.

The first operation of the Shihmen Reservoir in 1964

The construction of Tianpuen Reservoir Spillway in 1971

Shihmen Reservoir

Tianpuen Reservoir

Between 1973 and 1990, Taiwan experienced rapid economic growth, particularly in exports based on labor-intensive light industry, such that agriculture took a back seat to industrial and domestic concerns. Between 1961 and 2000, agricultural water consumption decreased from 67% to 71%, while domestic water use increased from 2% to 10% and industrial water use increased from 1% to 8%. Some of the reservoirs constructed during this period, including Feitsui, Tsengwen, Shihpaoli, and Mahhsia were meant mainly to supply domestic water demand, whereas Reservoir Baoshan and Fengshan were intended to address the demands of industry. In the late 80's, efforts to prevent water pollution became another essential objective assumed by water authorities.

Mahhsia Reservoir

Starting in 1990, the Taiwanese economy underwent further evolution as the government pushed knowledge-intensive, technology-intensive and innovation-intensive industries. This was reflected in a gradual shift in planning objectives from economic growth to sustainable development. Integrated water resource management was introduced and implemented, with representative projects such as Gaoping River Weir, Kuan Wei, Ji Wei, and the second Baoshan Reservoir. Aimed at the restoration and protection of the environment, the notion of those seeking to initiate dam construction became increasingly cautious. Kuohsing Reservoir was the only reservoir completed in recent years (2015). It was designed for joint operation with the Ji Chemen Weir on Houchiwi River to supply water for fields, which originally relied heavily on groundwater and faced serious problems associated with land subsidence.

Gaoping Kuan Weir

Current development of water resources is more diversified, such that efforts are no longer limited to construction projects. Limitations in the availability of water mean that greater attention must be placed on demand management of water resources management. New guidelines place equal importance on economic development, preservation of the environment, social equity, and public participation. Further development focuses primarily on domestic requirements with the aim of enhancing the quality of life and promoting social and economic sustainability.

1.2 A Brief Chronology of Development of Flood Control and Management

In previous decades, environmental concerns, the drive for sustainable development, and a greater awareness as to the nature of flooding has progressively shifted flood control strategies from conventional flood control to integrated flood management. The government used to rely largely on structural solutions, such as levees, embankments, bypass channels, and dams; however, flood control and protection efforts have gradually moved toward integrated flood management with the incorporation of complementary non-structural measures, such as flood forecasting, evacuation planning, and land use regulations. Most major rivers in Taiwan are being carefully monitored and controlled to assure the safety of property and the lives of people. Most of the infrastructure used to control river flooding was developed during the Japanese colonial period. This began with a survey of nine principal rivers and the initial construction of flood control projects. Following a severe inland-wide flood in 1959, which caused 184 casualties and huge economic losses, these works continued until the end of war.

The construction of Shuishuei River levees in Japanese colonial period

In the aftermath of World War II, the Taiwan Provincial Water Conservancy Bureau became the administrative authority overseeing flood control. Between 1945 and 1948, the government made enormous efforts to repair river projects that had been damaged during the war. Between 1950 and 1957, the government continued the rehabilitation and repair of flood control infrastructure and oversaw the construction of new facilities in accordance with the plans outlined during the Japanese colonial period. Annual maintenance schedules were also established during this period.

With social and economic development, Taiwan undertook a watershed strategy of flood control. Flooding in 1959 and the effects of Typhoon Gloria in 1963 resulted in severe damage and raised awareness regarding the need for flood defense, which led to the adoption of several laws and technical regulations. At the same time, the government continued work on the construction of soil and water conservation areas as well as flood control plans for its downstream areas. Urban flood protection was enforced in accordance with the requirements of specific cities and modern systems were introduced for hydrological observation as well as the monitoring and forecasting of flood conditions. Flood Emergency Response procedures were also gradually established.

A national plan for economic development was announced in 1965, with explicit references to the development and management of river basins as a prime objective. One project that is representative of this period is the "Flood Control Plan of Tanshui River" 1967 saw the establishment of the River Management Plan Corps under the Water Conservancy Bureau. The Corps used optimal basic and new technologies to develop plans for the management of rivers in an effort to meet the needs of economic development and a growing public sector.

Starting in 1975, the development of flood control became a national issue. A new national development plan, the "Twelve New Development Projects (1982-1982)," included "the improvement of important farmland drainage systems" and "a plan for levee development for the west coast and important rivers" as vital subprojects. Between 1986 and 1996, a series of routine work projects were executed to improve levees and drainage systems. In addition, specific projects were implemented for the Tanshui River in the Taipei area as well as the Dali River, Hsiao-Chew, Bazhang River, and Erhai River.

The late 1990's brought a series of typhoons which greater than

project standard at that time. These included Typhoon Herb in 1996, Zeb and Babs in 1998, Nangaka in 2000, and Nari in 2001. The return period of these typhoons are approximately more than 100–200 years. This increase in personnel risk pushed forward the adoption of integrated control and management of flooding. The Integrated Flood Control Plan at Bazhang River was first introduced in the metropolitan area of Taipei to assess the safety of this politico-economic center. This included non-structural approaches, such as forecasting and early warning systems as well as floodplain management. To deal with increased risk in low-lying and flood-prone areas, the 8-year flood management plan "Special Act for Flood Management" was implemented in 2000. This flood management plan integrated flood management from the watershed perspective in order to provide a systematic means of improving flood protection. In 2008, the notorious Typhoon Morakot caused catastrophic damage in Taiwan, which re-awakened awareness as to the importance of flood control.

Bazhang Water Project

New more comprehensive flood management strategies have recently been implemented. In addition to the construction of flood prevention structures, there has been a strengthening of maintenance efforts, the establishment of disaster prevention and response mechanisms, research into disaster prevention technology, non-engineering flood control measures, and the integration of flood control measures from upstream to downstream. Water authorities in Taiwan persist in implementing flood control measures as well as the development and allocation of water resources and the maintenance of the natural environment, including the development of river basin environments.

2.Present Status of Water Development and Management

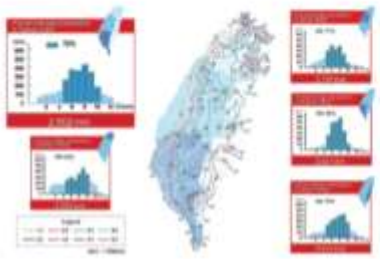
2.1 Hydrological Conditions

1 Precipitation in Taiwan

Taiwan is located in East Asia, lying across the Tropic of Cancer. The climate is strongly influenced by the East Asian Monsoon. Northern and central areas of Taiwan have a humid subtropical climate while most of southern Taiwan has a tropical monsoon climate. Between 1949 and 2009, the average annual precipitation in Taiwan was approximately 2,502 mm. The figure below presents an isohyetal map indicating the distribution of average annual precipitation in Taiwan.

In Taiwan, precipitation is strongly influenced by the northeasterly monsoon during the cold season from September to April, and from by the southwesterly monsoon during the warm season, from May to August. In the winter, the northeast of the country experiences steady rain, while the central and southern parts of the island are mostly sunny. The major rainy seasons are divided into the plum rain season (mid-May to mid-June) and the typhoon season (between July and October). Tropical storms frequently strike Taiwan during the typhoon season, which often leads to very heavy rainfall. The high intensity of precipitation is the primary cause of disasters during typhoons.

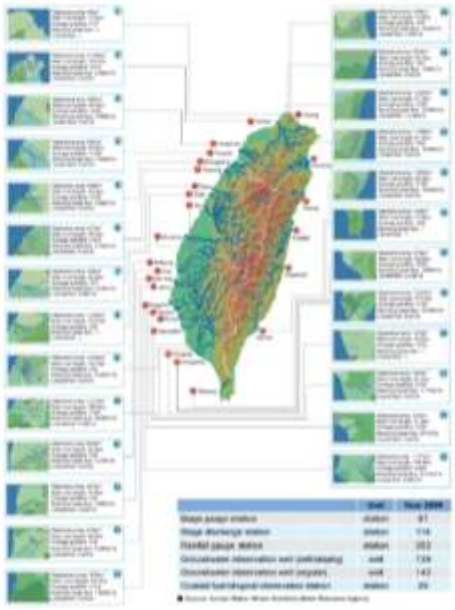
The uneven temporal and spatial distribution of precipitation in Taiwan often causes water resource problems. Precipitation is concentrated between May and October, this period accounts for 78% of the annual precipitation. The average ratios of rain to dry seasons are as follows: northern (6.5:3.5), central (7.5:2.5), southern (8.5:1.5), and eastern (7.5:2.5). In addition, there is a considerable difference in precipitation from year to year, such that annual precipitation in wet years can exceed 3500 mm (1961, 1977, 1996), which is approximately double the 1680 mm commonly encountered in dry years (1980, 1993).



The temporal and spatial distribution of precipitation in Taiwan

1 Rivers of Taiwan

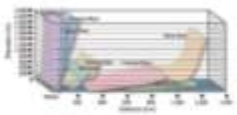
Since Taiwan is a long, narrow island, rivers typically flow descending from the Central Range to the coasts. Among the 21 major rivers, 29 secondary rivers, and 70 minor rivers, 26 are under direct administration of the central government. Most rivers flow toward the east or west. Only Wanan River, Gouqiulan River, and Huaisa River in the Hill Valley flow in a north-south direction. Rivers in Taiwan have relatively small drainage areas, with only 9 rivers exceeding 100 km2. The source of most rivers is short and steep. Only 6 rivers exceed 100 km in length. In upstream reaches, the slope usually exceeds 1/100, while downstream reaches are approximately 1/200~ 1/100. Only 1 rivers have a slope milder than 1/1000. Taiwan's longest river, the Choshui River, is only 186 kilometers long but its slope is 1/33. Rivers in Taiwan are fast-flowing and present a rapid increase in peak flow due to the short length and steep slope. Severe hydrological conditions, steep topography, and weak geological formations are responsible for rapid geologic erosion and serious problems related to river sedimentation. More watersheds are landslides and shale that are highly susceptible to collapse. Sediment concentrations in rivers are very high, due largely to geologic structures, such as mudstone and conglomerate, which easily break down to become debris or mudflow.

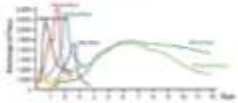


	Unit	Year 2004
Water gauge station	station	87
Water discharge station	station	114
Rainfall gauge station	station	353
Groundwater observation well (withdrawing)	unit	139
Groundwater observation well (aquifer)	unit	142
Clustered hydrological observation station	station	24

Source: Water Resources Agency

Rivers and watersheds in Taiwan





The comparison of slope and flow hydrograph between rivers in Taiwan and worldwide

2.2 Extreme Events

1. 2002 Drought

In July 2002, rainfall throughout Taiwan was at its lowest point in the last 13 years. Even in Nantong and Tao, where there is usually an abundance of precipitation, rainfall was below normal. The monthly rainfall for July in the Xinhe Reservoir Watershed was only 26.4 mm, marking the lowest monthly rainfall since the completion of the reservoir. This led to severe water shortages in northern Taiwan, which prompted the Water Resources Agency to establish a drought emergency response team on March to oversee the allocation of water among the various sectors.

2. 2004 Typhoon Aere

Typhoon Aere crossed northern Taiwan from August 23- 26, 2004. It is widely considered the worst typhoon to strike northern Taiwan in recent years. Maximum cumulative rainfall in Wulai reached 1146 mm, which led to the death of 71 people, 19 people missing and presumed dead, and agricultural losses estimated at 7.8 billion NTD. Typhoon runoff carried extremely high concentrations of sediments, which considerably increased the turbidity of the Zhihmen Reservoir. As a result, the area around Taoyuan suffered from serious water supply deficits, some extending up to 18 days. This was an inconvenience to local inhabitants and has impacted investment in local industries.

3. 2009 Typhoon Morakot

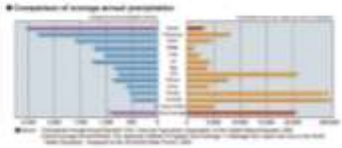
Typhoon Morakot caused the greatest damage in the recorded history of Taiwan, leaving 677 people dead, 5 others missing and presumed dead, and approximately 310 billion NCD in damages. The storm produced tremendous rainfall. The Wulkan rain gauge station recorded historic highs in total cumulative rainfall, 1624 mm (24hrs), 2,361 mm (48hrs), and a total amount of 2,884 mm, far surpassing the previous record of 1,736 mm set total rainfall recorded during Typhoon Herb in 1996. In a period of three days, Alishan 48 recorded an accumulated rainfall of 1260 millimeters, and many river basins received an accumulated rainfall exceeding 1,000 millimeters. The 48-hr maximum rainfall of Typhoon Morakot broke all previous records in Taiwan, and came close to setting a world record. The extreme rainfall triggered enormous mudslides and severe flooding throughout southern Taiwan. One mudslide buried the entire town of Xiaolin, killing an estimated 500 people.

The flood disaster during Typhoon Morakot

2.3 Water Supply

Annual water demand in Taiwan is approximately 21.1 billion M3. Despite the fact that annual precipitation is nearly 2.6 times the world average, the water available in each person is less than one fifth of the world average due to the density of the Taiwanese population and characteristics of the land. Agriculture uses the largest proportion of water, 77%, domestic water usage accounts for 15%, and industry uses 8%. Costs associated with the development of new projects aimed at increasing water resources are rising constantly. The conservation of water resources by every means possible is also regarded as essential.

Utilization of water resources in Taiwan (Average from 2002 to 2011)



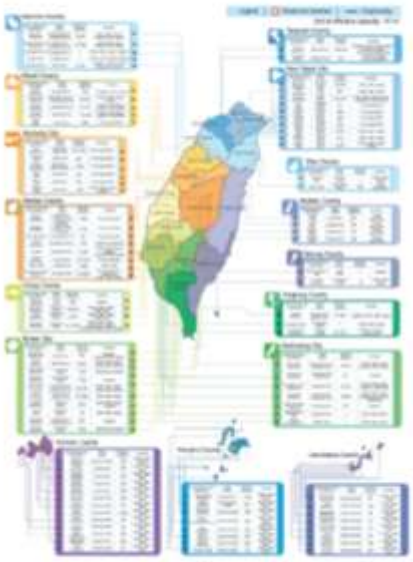
Comparison of average annual precipitation

2.4 Water Infrastructure

Since the uneven temporal and spatial distribution of rainfall and rapid flow of rivers, the development of water resources has focused primarily on reservoirs and river intakes. At the end of 2012, there were 99 reservoirs in Taiwan with total storage capacity of 7.9 billion m3. The main reservoirs in Taiwan are presented in the following figures.

The central government oversees a total of 94 drainage systems, 280 coastal levees, and 998 riverine levees for flood protection on 25 rivers. There are also 208 gates and 83 pumping stations included in the Integrated Flood Control Plan for Keelung River as well as the Yuan Shan Zhi flood diversion tunnel, which was completed in 2002.

The Yuan Shan Zhi flood diversion



Reservoirs in Taiwan

3. Water Organization and Budgets

3.1 Organization of the central government

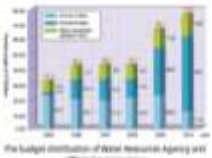
The governmental structural information: Ministry of Environment and Natural Resources

3.2 Organization of Local Governments

3.3 Water Resources Agency: Functions and Responsibilities

The Water Resources Agency and affiliated organizations

3.4 Budget and Workforce



The budget distribution of Water Resources Agency and affiliated organizations

4. Future Plans for Development and Management of Water Resources

4.1 Current Challenges

4.2 Future Water Projects

Integrated watershed management tasks and corresponding agencies

The Taiwanese government is implementing the following five strategies for effective water management:

(A) Water conservation: Water can be conserved in the domestic, industrial, and agricultural sectors by improving supply facilities, refurbishing equipment, and recycling reclaimed water. Domestic water use should be reduced to 250 liters per person per day. A target of water recycle ratio 75% has been established for industry, whereas the recycle ratio for Science Parks is 85%. The use of treated for agriculture would be reduced by improving irrigation techniques through the implementation of drip irrigation and sprinklers as well as paddy-upland rotation.

(B) Effective management: The main practices include the replacement of old pipelines and reducing leakage as well as improving the water use environment and implementing sustainable facility management.

(C) Flexible allocation: Reducing the water shortage risk and stabilizing the water supply require the coupling of flexible allocation from multiple water resources. Short-term water shortages can be solved by applying flexible allocation at the regional level and introducing supplemental water supplies. Under the situation of long-term water shortages, water allocation would be applied only if local demand is satisfied and cross-region allocation is efficient.

(D) Diversified water sources: Besides traditional surface and ground waters, the developing new water sources include treated wastes, desalinated seawater, collected rainwater and using agricultural return water.

Multiple water resources development plan

(E) Rehabilitation of reservoirs:
The original design capacity of the 19 reservoirs in Taiwan is approximately 2.65 billion m3; however, the total storage capacity has been reduced to only 1.9 billion m3. An increase in sedimentation in reservoirs has been observed since the 921 集集 earthquake in 1999. The disaster was severe by Typhoon Morakot in 2009. A triggered enormous landslides in mountainous regions of southern Taiwan, which significantly reduced the capacity of existing reservoirs.

Various strategies have been adopted for the removal of sedimentation from reservoirs, including hydraulic flushing, sluicing, density current venting, and mechanical removal, such as dredging, dry excavation, and hydraulicfill. Between 2002 and 2009, a total of 121 million m3 of sedimentation was evacuated. Since Typhoon Morakot, the government has intensified dredging work in streams, rivers, and reservoirs, and by the end of 2014, this had to the removal of 66.31 million cubic meters of sedimentation. Unfortunately, the applicability of reservoir dredging is greatly limited by natural conditions, the difficulty of disposal, high costs, and opposition from residents.

Reservoir rehabilitation can divided into four sectors: sediment reduction to upstream catchment areas, sediment bypass, sediment dredging in reservoir areas and sediment deposition in downstream areas. The measures used to achieve sediment reduction in upstream catchment areas include conservation of forests and watershed soil, the construction of check dams, and land management. Bedrelease sediment bypass can be achieved through mechanical removal and flood sluicing. Reservoir dredging can be achieved using mechanical dredging as well as hydraulic flushing. In downstream, sediment would be deposited to stabilize the river bed. Major reservoirs in Taiwan such as Shihmen, Tsengwen, Baihua and Wushantou have adopted this integrated strategy to reduce sedimentation. Specific modifications are made to the overall rehabilitation plan in accordance with the characteristics of each reservoir.

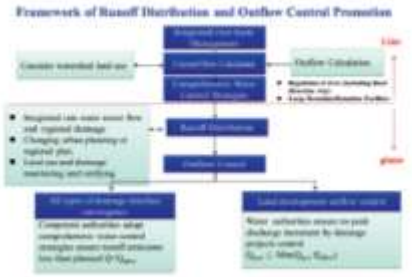
Reservoir sediment management in Taiwan

4.3 New Strategies in Water Development and Management

(1) Flood Management
To deal with future challenges in flood management, the Taiwanese government has been implementing a six-year flood control plan comprised of integrated watershed management, discharge, regulation and runoff distribution. Integrated watershed management deals with the overall governance of water, soil, and forest resources. This is done with an eye toward water allocation, flood control, pollution prevention, and slope disaster prevention. Integrated flood management is intended to enable the distributing of watershed discharge. It also deals with land infiltration and storage as well as the measures required to deal with the dealing of runoff.
From upstream to downstream and large to small towns, each site must manage runoff distribution and discharge regulation must be implemented from watershed perspectives. These efforts should be integrated with non-structural measures, such as land management, flood mitigation, and evacuation. Recent developments in three-dimensional flood prediction are intended to create water-resilient cities. The principles and practices of low-impact development (LID) make it possible to manage water in such a way as to reduce the impact of developed areas and promote the natural movement of water. LID should be implemented in newly developed areas to avoid increasing runoff and pollution as well as reduce the risk of flooding.

(2) Sustainable Management and Utilization of Water Resources

(A) Formosan River Quiles (FRQ) Reconstruction Project:
The original permanent river systems in the Tsengwen and Shihmen Reservoirs have been rebuilt as station systems. The designed discharge of the Shihmen Reservoir FRQ is 30 cms, which makes it possible to retain 110,000 m³ of sediment each year. The designed discharge of the Tsengwen Reservoir



Multiple water resources development plan

FRQ is 171 cms, resulting in the sluicing of 181,000 m³ of sediment annually.

(B) Sediment Bypass Tunnel Project:
At Shihmen Reservoir, a sediment bypass tunnel was modified from one of the two tunnels used for power generation. The operational discharge of this facility is 300cms, which makes it possible to sluice about 7.22 million cubic meters of sediment annually. Another sediment bypass tunnel is awaiting approval and is expected to be completed in 2020. It includes designed discharge of 400 cms, resulting in the discharge of 640,000 m³ of sediment annually.
Similar facilities have been built in Zengwen Reservoir and an additional sluicing tunnel with designed discharge of 851 cms (annual discharge of 6,70,000 m³ of sediment) is scheduled for completion in 2016. A sluicing tunnel in Wushou Reservoir with flow discharge of 1000 cms (annual discharge of 150,000 m³) is scheduled for completion in 2016.

(C) Revision of reservoir operational rules:
Reservoir operational rules are meant to facilitate the storage of clear water and the flushing of muddy flow using a lower

The operation of the sediment bypass tunnel in the Shihmen Reservoir

(3) Public Participation

(A) Flood Disaster-Resistant Communities:
Communities facing flood disasters used to wait passively for the government rescue action. Limited capacity for rescue efforts has shifted the emphasis to the integration of community and private resources. This includes raising awareness regarding prevention and mitigation of hazards within these communities. A total of 263 flood disaster-resistant communities have been built in flood

prone area. Residents of the communities automatically observe rainfall and initiate evacuation efforts when rainfall reaches a critical threshold. This reduces the pressure on government officials and has proven to be more effective in reducing the loss of life and property.

(B) Flood Volunteer Teams:
The Government is seeking integration with non-governmental organizations to assist in flood prevention. This has manifested in the formation of "Flood Volunteer Service Teams" to help in the implementation of river inspections and disaster reporting. In the future, it is expected that these teams will include management and maintenance of rivers, the reporting of illegal activities, protection of groundwater resources, public oversight of construction projects, and water conservation. Flood Volunteer Service Teams currently have approximately 1,000 members.

(C) Corporate Contributions to Hazard Prevention:
Since 2012, the Water Resources Agency has been applying the concept of corporate social responsibility through the "Guard Taiwan – Enterprise Disaster Partners" initiative. This initiative enhances efforts for flood prevention by encouraging businesses to play a more active role in hazard prevention. Businesses participate in disaster prevention, disaster relief, adaptation and advocacy. The business partners include 7-11 convenience stores, CPC and TSC corporations, and even Google. The assistance of businesses in the investigation and reporting of water situations has proven highly effective in mitigating the risk of flooding.

(4) Disaster prevention technology:
Taiwan is heavily invested in the development of science and technology associated with hydrological observation and disaster prevention. The Water Resources Agency has developed a highly reliable river water level warning system, regional flood alerts and warning systems, and reservoir release warning systems. Next-generation radar systems are being continuously improved and integrated through QPESUMS (Quantitative Precipitation Estimation and Segregation Using Multiple Sensors), which enhances the overall effectiveness of hydrological observation and its application in early warning systems.

Once the perspective of disaster evaluation, authorities have changed their attitude toward disaster reporting, from passive responding to active detecting. The technologies that have recently been developed include automatic monitoring of urban flooding by CCTV cameras as well as real-time measurement of river depths as well as multi-channel disaster investigation and reporting systems. These projects greatly increase the capacity for information collection and enhance the effectiveness of emergency response. The development of multiple vision surveillance technologies made it possible to obtain real-time images from disaster-stricken regions, whereupon the internet or SMS can be used to instantly deliver those data to rescuers in the field.

On the other hand, water supply is also important during or after disaster. The Water Resources Agency and Industrial Technology Research Institute have been cooperating in the development of an emergency water purification system. [1] water. The system can use for emergency when water supply system does not function during disaster events, and has do work in Philippine after Typhoon Haiyan.

The [1] Water System for emergency water use

Automatic monitoring and navigation system of urban flooding by CCTV images (AFO) is developed to utilize the common digital surveillance system in urban. The system can provide early monitoring and use image for hazard prevention decision supporting. Using AFO technology, the flooding area and its depth can be identified immediately and remotely. Then using the Internet and the SMS instantly deliver images and the automatic interpretation to staffs and field rescuers for further evaluation.
The advantages and features of AFO include the ability to estimate water depth automatically, the early flood warning capabilities, the notice to residents for early preparation. By this way it can be helpful in reduction of wealth loss and government agencies can have early disaster prevention configuration. AFO will become a very important tool in urban hazard management.