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「2014新加坡國際水資源週」

2014 Singapore International Water Week

服務機關：經濟部水利署
出國地點：新加坡
出國人員：楊偉甫署長、李友平組長
出國日期：103 年 5 月 31 日~6 月 5 日

報告日期：中華民國 103 年 7 月 14 日

摘要

2014 新加坡國際水週 (2014 Singapore International Water Week，簡稱 SIWW) 暨第四屆世界城市峰會 (World City Summit) 、第二屆清潔環境峰會 (Clean Environ Summit Singapore) 於本(2014)年 6 月 1 日至 6 月 6 日假新加坡金沙會展中心 (Singapore Convention and Exhibition Center - Marina Bay Sands)舉行，本署楊偉甫署長應新加坡公用事業局（Public Utility Board, PUB）邀請率同本署綜合企劃組李友平組長出席 SIWW 水務領袖峰會及參加其周邊相關活動。活動成果包括參訪新加坡參觀 ABC 水環境計畫及 Juron 水處理場帶回其設計參考準則資料，另於水務大會熱門議題研討會發表 Protecting Taiwan Source Water Quality Based on Local Community Participation、Promotion of Wastewater Reclamation/Reuse in Taiwan 及 Study on Strategy for Promotion of Water Reuse in Taiwan 等三篇論文，拜會新加坡公共事業局雙邊交流座談，由 PUB 陳玉仁副總裁接待，本署提供我國抗旱應變、工業用水輔導作為分享資料，楊署長出席韓國水協會舉辦之亞太水論壇高峰圓桌會議，針對台灣參與第 7 屆水論壇(WWF7)之準備情形及針對自來水供應、水質、下水道設備、再生水、氣候變遷、水災之研發情形進行說明，，獲得各國代表熱烈迴響。另因水利署希望能在明年 WWF7 大會中成功主辦研討會，將我國防災科技行銷國際，因此對 WWF7 籌備委員會委員之 K-water 主席 Gyewoon Choi 先生、K-water 的 Head Manager Tae-sun Shin 先生、WWC 的副主席 Dogan Altinbilek 教授及 APWF 主席 Ravi Narayanan 先生位利害關係人說明本署期望爭取主辦 section 之強力意願後，四位 WWF7 籌備委員會委員均表示支持與肯定，也表示願意協助台灣爭取主辦 section。

目　錄

壹、前言

一、本案緣起：

新加坡公共事業局(PUB)於本(2014 年 1 月 2 日)致本署楊署長邀請函，出席本年 6 月 1~5 日召開新加坡國際水資源週(SIWW)的水務領袖會議(Water Leaders Summit)，本署因與 PUB 交流多年，建立或伴關係，接受其邀請赴會，邀請函如圖 1 所示。

From: NG Han Tong
To: weiy@wra.gov.tw
Sent: Thursday, January 02, 2014 3:22 PM
Subject: Invitation to SIWW 2014 - Water Leaders Summit and Nominations for Aquarius Programme - Raising the Next Wave of Water Business Leaders

Dear Mr. Yang,

Attached in this email is a letter from Mr. Chew Men Leong, Chief Executive of PUB, for your consideration. We are writing to invite you to join us at the sixth edition of the **Singapore International Water Week (SIWW)**, held from 1 - 5 June 2014; to take part in the ***by-invitation*** **only Water Leaders Summit**, and to nominate one or two high-potential senior executives to attend the ***by-invitation*** **only Aquarius Programme**.

SIWW welcomed some 19,000 delegates from 104 countries at its last edition in 2012. At the Water Leaders Summit in 2014, you can look forward to meeting 400 top water leaders from around the world. A new key component of SIWW 2014 will be the Aquarius Programme, a premier leadership course for the leaders of today to groom the next generation of senior water executives- the leaders of tomorrow. The Programme will bring together an exclusive group of some 30 highly promising water leaders on 29 May – 2 June 2014 in Singapore, and is specially designed to instill in them a deeper appreciation of the dynamics in the global water industry and the Asian markets.

We look forward to receiving your nominations by the closing date on 31 January 2014. Thank you.

Warm Regards,

Ng Han Tong
Director, Waterhub
PUB Singapore

Singapore International Water Week 1 - 5 June 2014 | The Global Platform to Share and Co-create Innovative Water Solutions

圖 1、新加坡公共事業局致本署楊署長邀請函

二、2014 新加坡國際水週簡介：

新加坡國際水週(SIWW)是一個提供跨國共同分享合作、創造創新水問題解答的全球性平臺。從全球性水產業聚集在 SIWW 分享商機及透過商展介紹各國最新的水技術。因此，新加坡政府希望透過每 2 年辦理的 SIWW，達到是藉由跨國合作帶動該國水產業發展和水技術開發的目的。並透過該活動使參加水週活動的各國出席者，體驗新加坡「居住的實驗室」以學習新加坡如何管理水環境，促進新加坡成為適於居住的城市。SIWW 2014 更根據全球水產業趨勢及機會，以市政水、工業水、聯合城市環境水及未來水等 4 個議題為特色進行跨國討論，共同探索未來的挑戰和情景，並由各國在企業、科學、技術創新及政策發展分享最新資訊探索解答。

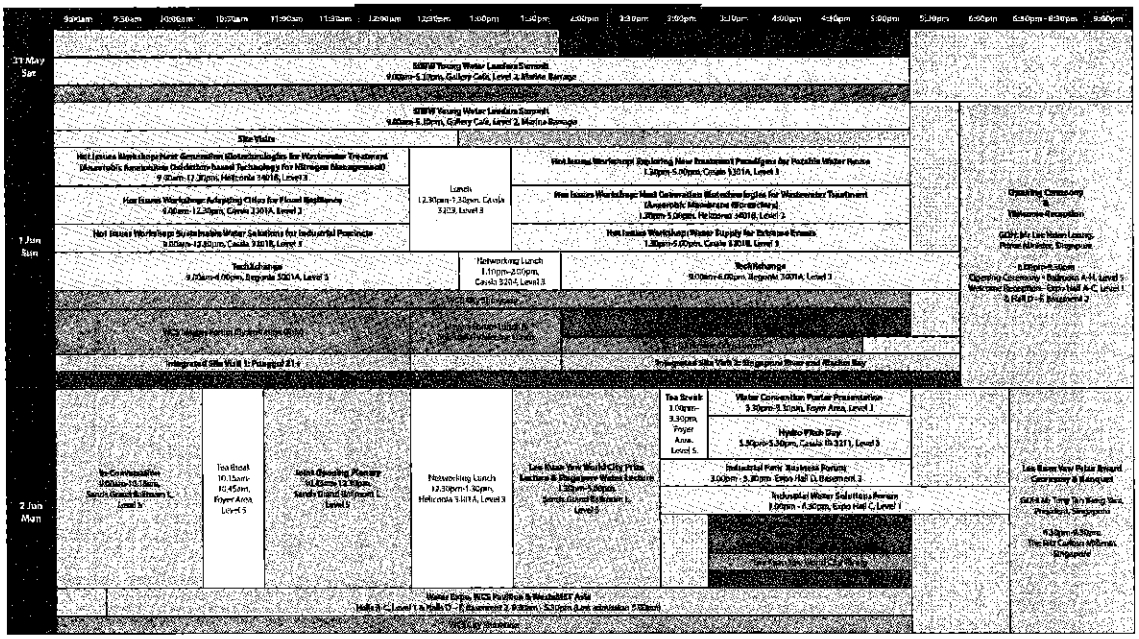
(一)會議地點：

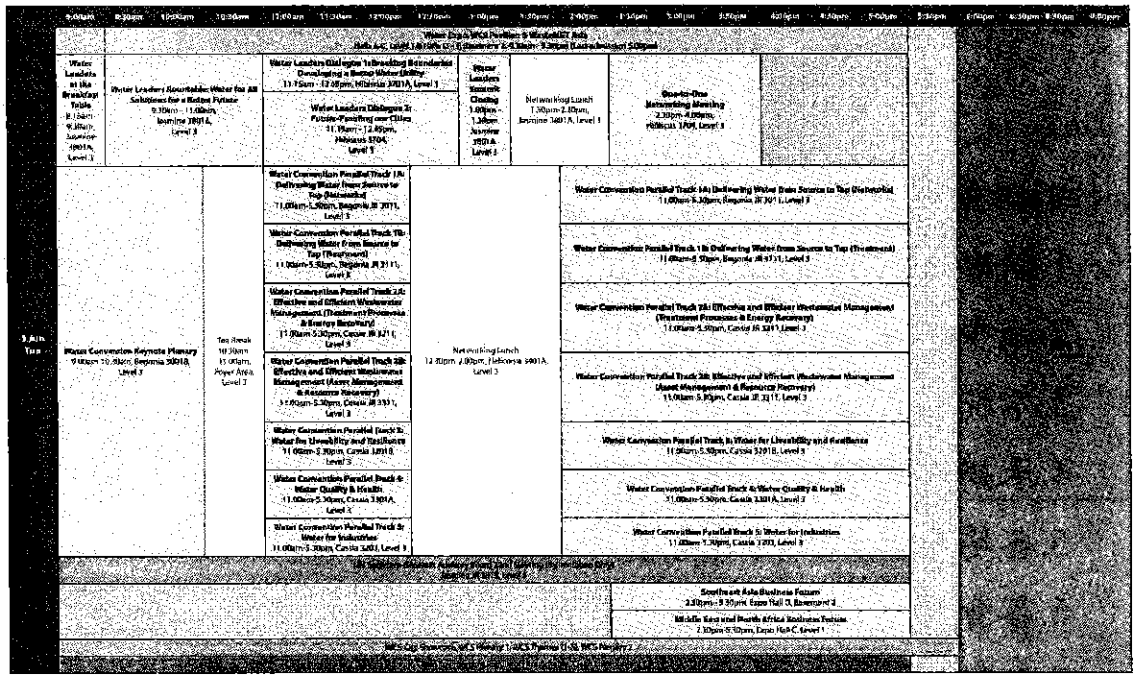
新加坡金沙會展中心(Singapore Convention and Exhibition Center - Marina Bay Sands)

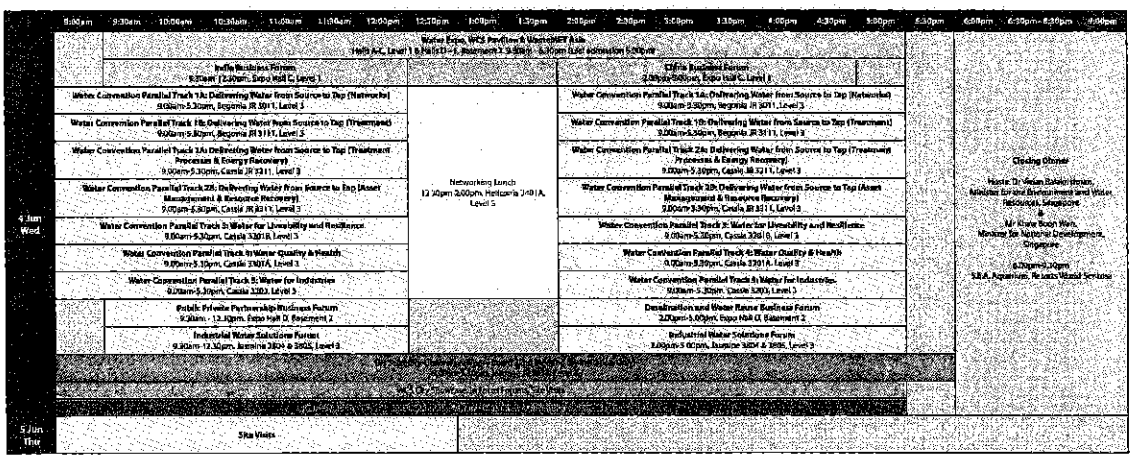
(二)活動項目：

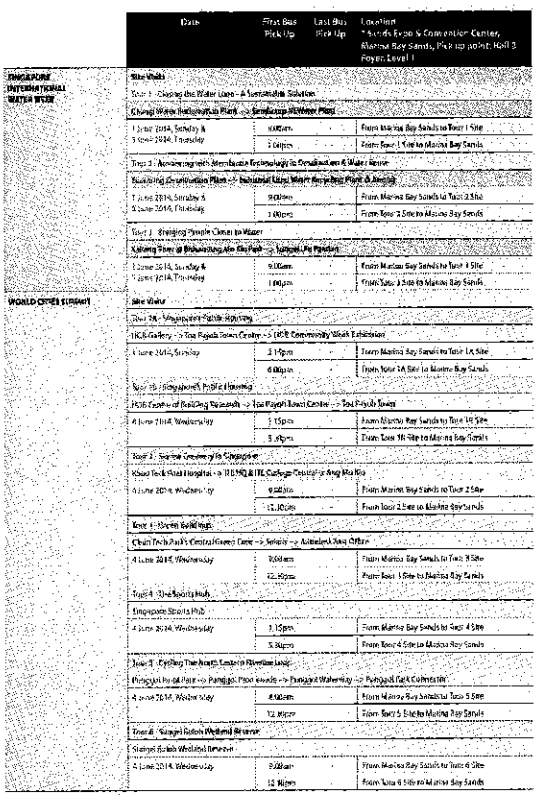
1. 李光耀水獎 (Lee Kuan Yew Water Prize)
2. 水務領袖峰會 (Water Leaders Summit)
3. 水務研討會 (Water Convention)
4. 水展 (Water Expo)
5. 水商務論壇 (Business Forum)
6. 水產業論壇 (Industrial Water Solutions Forum)
7. 水務青年領袖會議 (Young Water Leaders Summit)

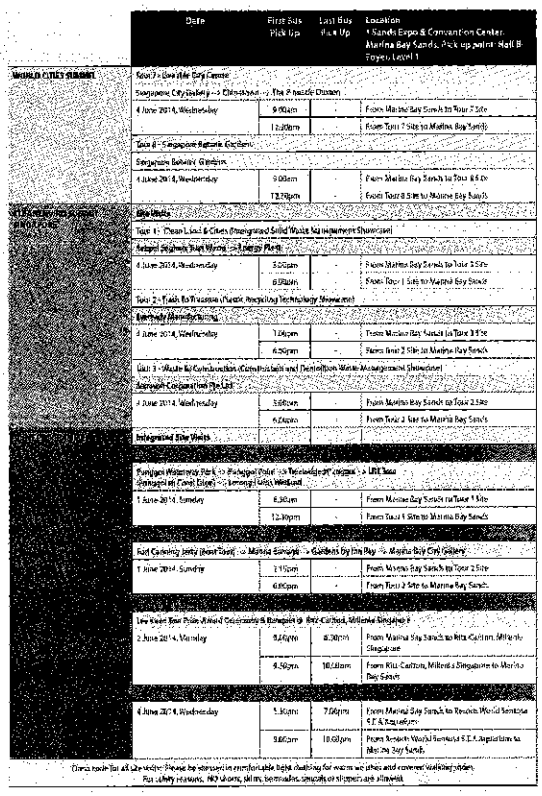
(三)活動流程：











(四)活動特色：

1.開會地點 Marina Bay Sands 最近獲得 BCA 綠色標記金質獎。

2.減少碳足跡。

3.不提供裝瓶水。

4.承辦宴席服務不使用一次性餐具。

5.各場地出入口均設有資源回收點。

6.各會議場地室內溫度不得低於攝氏 25 度。

7.鼓勵參展者、承包商、供應商均使用綠色商品。

本屆世界城市峰會(WCS)、新加坡國際水資源周(SIWW)和新加坡清潔環境峰會(CESS)聯合大會為目前世界上規模最大的綜合可持續發展方案展覽，總展出空間達到 3 萬平方公尺，設置 29 個展館，有超過 900 家企業參展。為期 5 天的大會期間，超過 40 位國家部長、130 位市長和城市領袖到新加坡與會，探討打造創新城市的最佳實踐方式和最優解決方案。，6 月 1 日至 5 日參加大會之總人數達到 2 萬餘人。

貳、出席 SIWW 活動報告

一、出席活動總覽：

本次出席 SIWW 活動自 5 月 31 日啟程至 6 月 5 日返國，共計 6 日，出席 SIWW 相關活動時間詳一覽表(表 1)，而出席團員楊署長、李友平於於 SIWW 大會註冊處報到詳圖 2 所示。本次出席 SIWW 活動任務包括下列各項：

1. 參觀 Bringing People Closer to Water
2. 出席水務大會熱門議題研討會(Water Convention Hot Issues Workshops)
3. 出席開幕式及迎賓酒會(特別來賓：李顯龍總理)
4. 出席水務對話(In Conversation)、全體會議(Opening Plenary)
5. 參觀 Juron 水處理場
6. 楊署長出席水務領袖會談 Water Leaders Summit Dialogue B(Future-Proofing our Cities)及水務領袖圓桌會議 Water Leaders Summit-Roundtable(Securing our Blue Asset for the future)
7. 出席水務大會(Water Convention)，水利署發表論文 Protecting Taiwan Source Water Quality Based on Local Community Participation.
8. 參加世界水協會(WWC)主辦「亞太水與綠色成長」的分享討論會(由 WWC 主席主持)
9. 拜會新加坡公共事業局(PUB)雙邊交流座談
10. 出席水務大會(Water Convention)，水利署發表論文 Promotion of Wastewater Reclamation/Reuse in Taiwan
11. 參觀水務博覽會(Water Expo)
12. 參加韓國水協會(K-water)舉辦之第七屆世界水論壇高峰圓桌會議(WWF7 High Level Round Table)

表 1、本案出席 SIWW 活動一覽表

日期	時間	署長行程	其餘團員行程
5月31日	**05:30** ~	桃園國際機場第二航站3樓 長榮航空櫃台集合	
Sat.	07:40 ~ 12:00	啟程：台北→新加坡 樟宜國際機場(長榮BR225，12:00抵達新加坡)	
(Day 1)	12:00 ~ 15:00	出關、駐新加坡代表處經濟組協助接機至飯店(Hotel Royal@Queens)	
	15:00 ~ 18:00	AECOM 仇博士安排參觀(仇博士至飯店接署長一行至Botanical Garden)	
	18:30 ~	駐新加坡代表處經濟組 安排餐敘(仇博士接至餐廳Long Beach @ Dempsey)	
6月1日	08:00 ~ 09:00	◎大會報到(Marina Bay Sands Singapore, Level 3 Foyer)	
	09:00 ~ 13:00	◎參觀行程(Site Visit 3): Bringing People Closer to Water(Hall C,門口	
Sun.	13:00 ~ 17:00	◎水務大會熱門議題研討會 (Water Convention Hot Issues Workshops) 建議參加Workshop 4: Water Supply for Extreme Events	
(Day 2)	18:00 ~ 20:00	◎開幕式及迎賓酒會 (晚上，特別來賓：李顯龍總理) 建議於17:30前抵達會場，因人數甚多晚餐或可至金沙酒店B1商場找餐廳用餐	
6月2日	09:00 ~ 12:30	◎水務對話 (In Conversation) 、全體會議 (Opening Plenary)	
Mon.	12:30 ~ 13:30	午餐	
(Day 3)	13:30 ~ 14:00	◎在展示會場之**明電舍**攤位集合。	
	14:00 ~ 14:50	參觀Juron水處理場。(憑**護照正本**進廠參觀!!)	
	15:30 ~ 17:00	回展示會場，並在明電舍攤位集會討論。 接待人員為永井社長、泊課長、廣瀨(技術人員) 、明電舍新加坡技術人員及台灣祥勝科技等人。	
	17:00 ~		
6月3日	08:00 ~ 09:30	◎水務領袖早餐	水務大會(Water Convention)
Tue.	09:30 ~ 11:15	◎水務領袖會談Water Leaders Summit Dialogue B(Future-Proofing our Cities)	◎發表論文THEME 4(李友平)：(11.45AM-12.00PM，地點:CASSIA RM 3301A, LEVEL 3)Protecting Taiwan Source Water Quality Based on Local Community Participation.
	11:15 ~ 12:45	◎水務領袖圓桌會議Water Leaders Summit-Roundtable(Securing our Blue Asset for the future)	
(Day 4)	12:45 ~ 13:30	午餐	
	14:00 ~ 17:00	◎世界水協會在**Room3911**有「亞太水與綠色成長」的分享討論會(President主	
	17:00 ~ 17:30	◎拜會PUB高層(地點：Level 3, **Angsana** Room 3D)	
	17:30 ~		
6月4日	09:30 ~ 09:45	◎發表論文THEME 2B(朱敬平)：(AM 9:30，會議室:CASSIA JR RM 3311, LEVEL 3)：Promotion of Wastewater Reclamation/Reuse in Taiwan	
Wed.	09:45 ~ 10:30	◎Industrial Water Solution Forum-Water for Electronics sector -台積電(TSMC)演講Sharing of water efficiency measures within TSMC，同場工研院梁德明組長主持Panel Discussion (MBS Level 3 MR 3904)	
	10:30 ~ 12:00	◎參觀水務博覽會(Water Expo)、水務大會 (Water Convention) 建議至Theme 3: Water for Liveability and Resilience (CASSIA RM 3201B, LEVEL 3)	
(Day 5)	12:00 ~ 13:00	午餐	
	13:00 ~ 15:00	◎署長與組長一同參加WWF7 High Level Round Table by K-water(會議室:3602~3603 Ballrooms on Level 3)	◎海水淡化與水再生商務論壇(Desalination and Water Reuse Business Forum)
	15:00 ~ 17:00	◎參觀水務博覽會(Water Expo)(至17:00結束)	
	18:30 ~	◎署長回請駐星代表處晚宴(地鐵藍線DT18 Telok Ayer站，再步行500m地圖見附件)	
6月5日	09:00 ~ 11:00	前往機場	
Thu.	13:10 ~	返程：新加坡→台北(BR226，13:10~17:45抵達台北)	

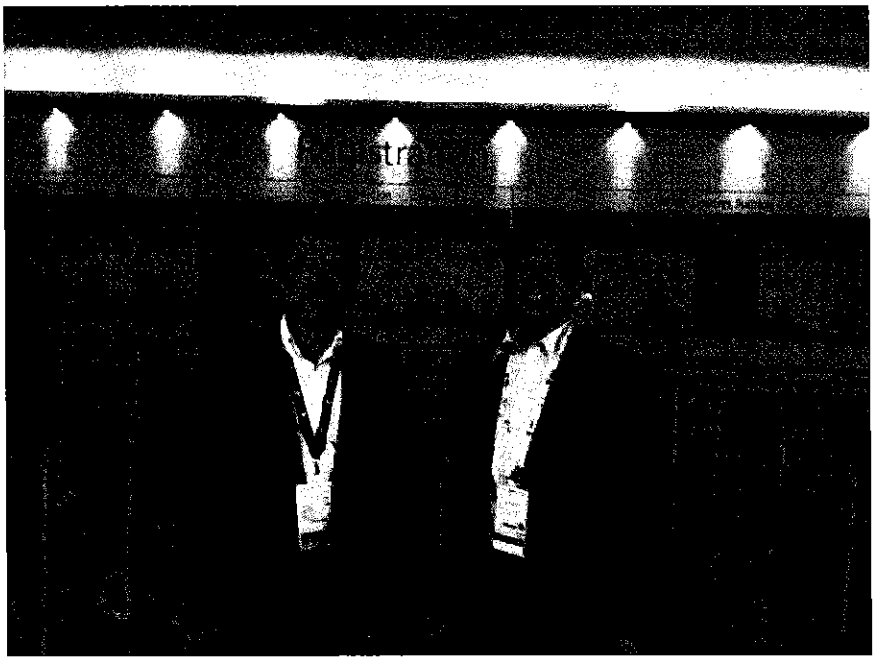


圖 2、楊署長、李友平於 SIWW 註冊處報到

二、出席活動成果報告：

(一)參觀 Bringing People Closer to Water(ABC 水環境計畫)：

新加坡的 ABC Water Programme 是一個永續的水資源管理策略，它由三個核心理念所構成：

1.ACTIVE：提供新的社區活動空間、讓人們更靠近水、發展人們對當地水域的認同。

2.BEAUTIFUL：將各地的水道與水塘以都市地景的視野作整體規劃、創造城市水域的新美學吸引力。

3.CLEAN：改善水質、加強水資源觀念教育、重建人與水的關係。

ABC Waters Programme 是新加坡政府近年來大力推動的環境與水資源政策，並以此為原則，結合各領域專家，在新加坡各地的鄰水區域針對各地特色作出因地制宜的規劃。

ABC 水環境計畫係位於新加坡西北方 Kallang 河流域，該流域面積 563 公頃，其中 ABC 計畫位於該流域的 Bishan 公園，公園河流長度 3 公里，面積 62 公頃，流域位置圖如圖 3 所示。

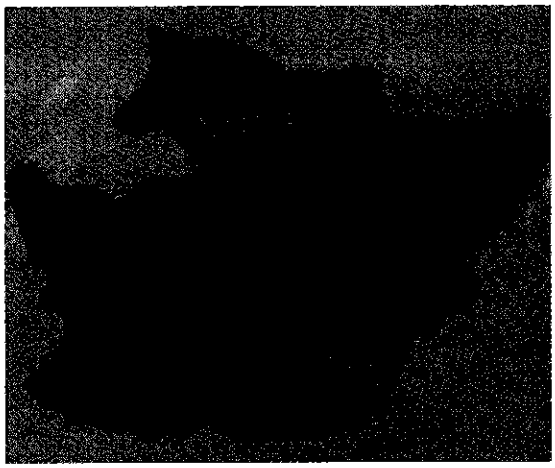


圖 3、Kallang 河流域位置圖

計畫目標如下：

1.以水岸縫合(river seamlessly)整合公園及河川，營造更多綠帶及藍帶。

2.使都市親近水與自然，使社區居民養成愛護水資源及擔任認養責任。

計畫範圍於計畫執行前後的對照圖如圖 4 所示，計畫範圍的水岸縫合執行前後的對照如圖 5 所示。

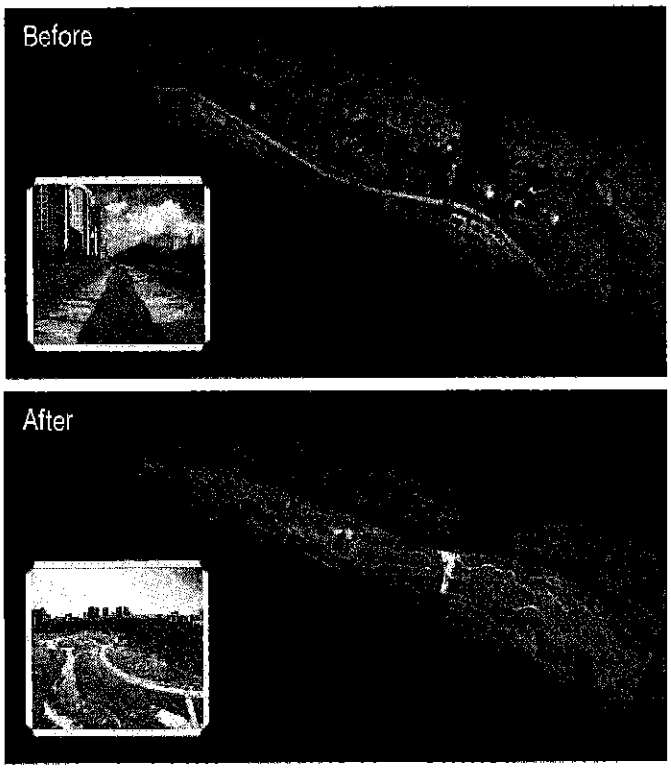


圖 4、ABC 計畫執行前後對照

圖 5、ABC 計畫水岸縫合執行前後對照

圖 6、ABC 計畫成果

圖 7、參觀 ABC 水環境計畫合影

(二)出席水務大會熱門議題研討會(Water Convention Hot Issues Workshops) -Extreme event workshop：

菲律賓奎南區區長 Rolando Abrenica 發表海燕颱風應變經驗(Response to Typhoon Haiyan)：

1.2013 年 11 月 8~9 日海燕挾帶強風和暴雨重創菲律賓奎南(Guinan)，造成 3,633 人遇難，1,179 人失蹤，經濟損失 2.27 億美元。「海燕」為有紀錄以來最強的颱風之一，而且是登陸時最強的，最大風速達 315 公里/時，捲起 5 公尺高的巨浪，湧入內陸，造成暴潮和暴風摧毀民房、路樹和車輛船舶，且渡船服務停駛、數百航班停飛、學校停課。

2.菲律賓政府應變作為：

(1)災前應變作為：

- 7 日 18:00 為止，疏散約 4000 人至各地避難中心。
- 7 日 17:00，發出最高級別的四號風暴信號。
- 預置救災人力、資源於可能受災區。
- 動員 32 架飛機、直升機和 20 艘船舶於中部地區待命。

(2)災後應變作為：

- 9 日預置軍警人力開始災區復原。
- 11 日總統艾奎諾宣布國家進入災難狀態。
- 11 日 C-130 馳援塔克羅班市(Tacloban)，除運送物資外，也撤離弱勢民眾至馬尼拉。
- 國際金援總額已達 5400 萬美元。
- 援助國家涵蓋美洲、歐盟、中東、亞洲、澳洲等國家和各個民間團體。
- 美英日出動航空母艦在內的船艦支援災區。加上國際馳援，救災資源包括人員 17,460 名、車輛 830 輛、船舶 44 艘和 30 架飛行器。

3.致災原因研判：

(1)直接原因：破紀錄暴風造成高強度暴潮

(2)間接原因：部分災區未從10/15 保和(Bohol)地震中復原的主要災區

- 塔克羅班市(Tacloban)：主要人口集中在低窪地區，易受暴潮影響，本次海水深入內陸約 1 公里。(如圖 7)
- 登陸點奎南(Guinan)：近海房屋多為鐵皮建築，難以承受高強度衝擊。
- 勘災、救援進度緩慢：通訊處所遭到破壞，難以確認災區情況。

4.海燕颱風事件可供我國借鏡事項：

(1)台灣為天災好發之海島，因應水災、風災來襲前、中、後之應變處置，已有標準作業流程並行之有年，規劃較許多國家完善。

(2)海燕颱風侵襲菲律賓事件，因颱風強度無前例可循，仍可作為借鏡：

- 強化宣導、正確認知防災標準-對於未知規模的天然災害，應使民眾了解現有防災標準及風險評估，於災前強化安全意識。
- 災前依據現有資訊，妥善分配資源及人力至各地方政府離災優於防災、防災重於救災- 完善預防措施，取代人員傷亡。

圖 8、海燕颱風侵襲奎南區塔克羅班市(Tacloban)海水深入內陸約 1 公里

(三)出席開幕式及迎賓酒會(特別來賓：李顯龍總理)：

新加坡李顯龍總理在 SIWW 開幕致詞中表示，新加坡因為客觀地理原因，始終關注水資源和相關能源問題，致力於為國家和下一代打造可持續發展城市。本屆新加坡國際水

周將討論一系列世界範圍內熱門的城市可持續發展議題，同時會展中還加入青年領袖項目、世界市長論壇、清潔技術展示通道等新亮點。李顯龍向獲得李光耀世界城市獎的中國蘇州市及其他與會代表表示歡迎與祝賀。

圖 9、新加坡李顯龍總理 SIWW 開幕致詞

SIWW 出席開幕式及迎賓酒會會場出席人數眾多(如圖 10)，新北市陳伸賢副市長亦出席大會(如圖 11)，另本次出國團員合影(如圖 12)。

圖 10、SIWW 出席開幕式及迎賓酒會會場

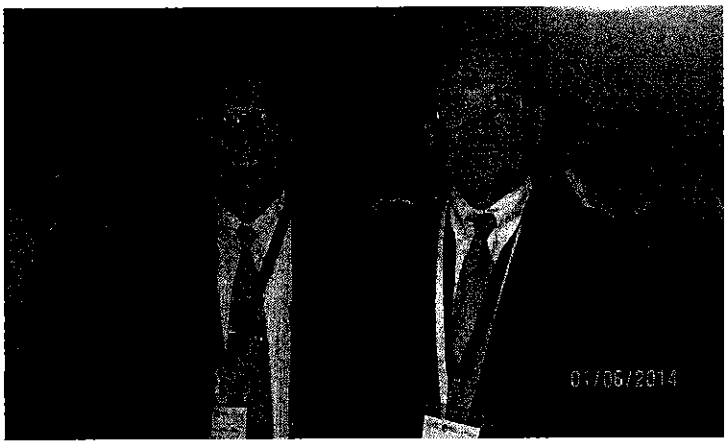


圖 11、本署揚署長偉甫與新北市陳伸賢副市長合影

圖 12、本次出國團員合影(左起中原大學游盛傑教授、本署李友平組長、揚偉甫署長、水利青年林亞震、中興顧問社朱敬平協理

(四)出席水務對話(In Conversation)、全體會議(Opening Plenary)：

主題：塑造我們的城市、水和環境成為一個適於居住及永續的未來(Shaping our Cities, Water and Environment for a Liveable and Sustainable Future)

全球 2/3 人口在 2040 年時將生活在市區，因此城市成長對許多國家的工業、運輸、農業活動造成極大壓力，現有的基礎設施包括水、衛生及居住深受影響且環境問題也逐漸

惡化。而對政府部門而言，公民對適宜居住和能耐災的城市期望及訴求日益提升，包括乾淨的環境、保證乾淨且民眾付擔得起水價的飲用水、安全衛生均是治理成效良窳的指標，且強化都市韌性調適氣候變遷成為新的挑戰。SIWW 邀請荷蘭、丹麥、中國、斯里蘭卡、日本、世界銀行等政府部門及專家學者發表意見(如圖 13)，高雄市劉世芳副市長亦出席大會(如圖 14)。

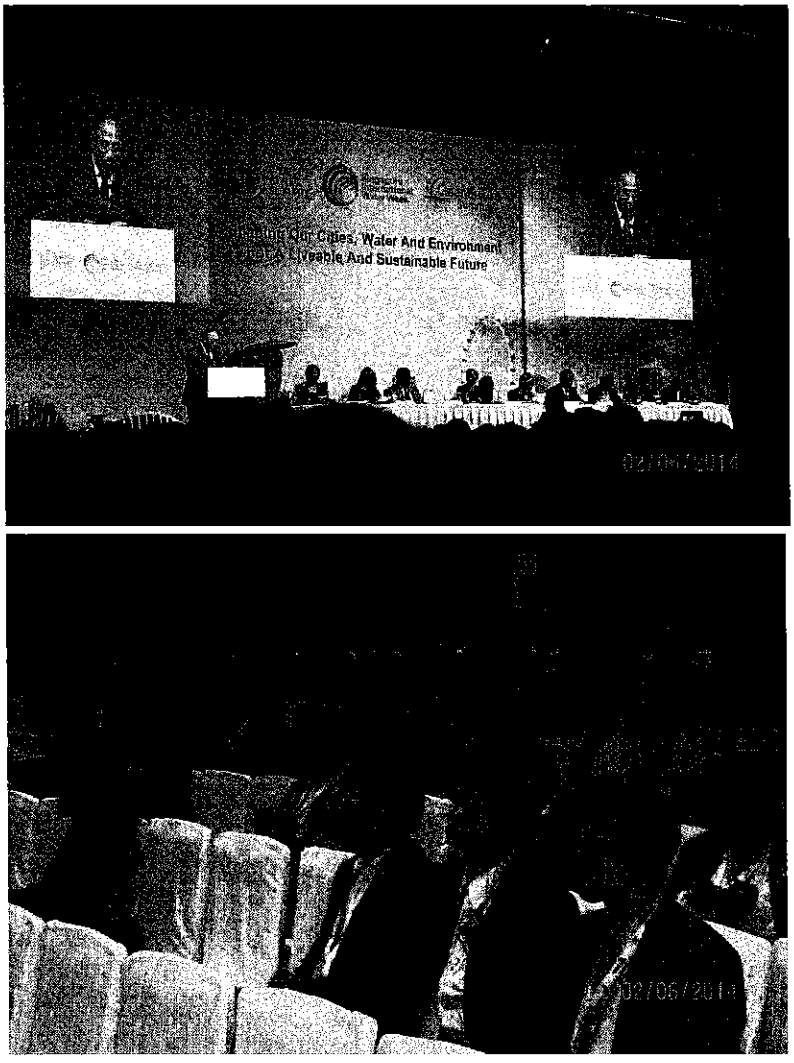


圖 13、水務對話及全體會議會場

圖 14、本署揚署長偉甫與高雄市劉世芳副市長合影

(五)參觀 Juron 水處理場：

這個占地 2600 平方米、設在裕廊供水回收廠內的工業用後水處理與循環示範廠，每天可處理與循環 100 萬加侖（相等一個半奧林匹克游泳池容量）的工業用後水。政府與私人企業合作設立新加坡第一個工業水回收廠，開啟工業用水再循環的新篇章。它是由公用事業局(PUB)與日本明電舍公司（Meiden Singapore）耗資約 1030 萬新幣建成，日後將成為建造大士供水回收廠內工業用後水處理設施的參考。大士供水回收廠預計將於 2022 年竣工。

這個示範廠是本區域首個結合兩項用後水處理技術的設施。陶瓷膜生物反應器(Ceramic Membrane Bioreactor，簡稱 MBR)與昇流式厭氧污泥床反應器(Upflow Anaerobic

Sludge Blanket，簡稱 UASB)的技術，能夠有效去除工業用後水中高達 97%至 99%的有機汙染物，並過濾和淨化水質。淨化後可立即再循環作工業用途，經這兩道工序再加上其他淨化過程處理後的工業用後水，因擁有更高的品質，可立即再循環作工業用途。這個示範廠每日處理的水將送往裕廊島供工業使用，例如作為工廠冷却用途。一般上，工業用後水經基本處理後，都會被排入大海中。本地每天需處理約 8.6 萬立方公尺的工業用後水。

公用事業局總裁趙文良出席開幕式時：「處理排入大海前的工業用水相當具挑戰性，這些用水中有很多有机污染物，会影响处理廢水的过程。」他指出，這個新廠卻能運用科技，讓本地有高品質的用水進行再循環，為新加坡提供新的選擇，讓工業如今也能循環使用工業用水，從而減少對其他水源的需求。趙文良也說：「這個新發展也能助新加坡目前的再循環水平，即使面對極端天氣如目前的乾旱情況時，鞏固我國的供水能力」。工業用後水送入這個示範廠後，會先經過 UASB 去除有機污染物。UASB 是通過培植適當的微生物來除去廢水中的污粒，處理過程中還能產生用來發電的沼氣（biogas），剩餘污泥則可用作肥料等，可說是善用每一份資源。加上它無需使用氧氣，因此比一般有氧生物淨化法節省約 30%至 50%的能源消耗。

用後水之後透過 MBR 科技，將經過另一層高效率的處理，快速得出水質透徹、品質穩定的工業用途再循環水。公用事業局首席科技監余海利說「相較於一般處理廢水所使用的聚合物（polymer）膜生物反應器，使用陶瓷質地是更持久也更適合的選擇。這是因為陶瓷質地膜能更有效地處理混

有油與化學物質的工業用後水，而且一般可耐上約 15 年，使用聚合物質地可能 5~7 年就得換一次。」本地目前每天的用水量約 4 億加侖，其中家庭用水占 45%，工業用水則占其餘 55%。參觀 Juron 水處理場之相片(如圖 15~圖 20)

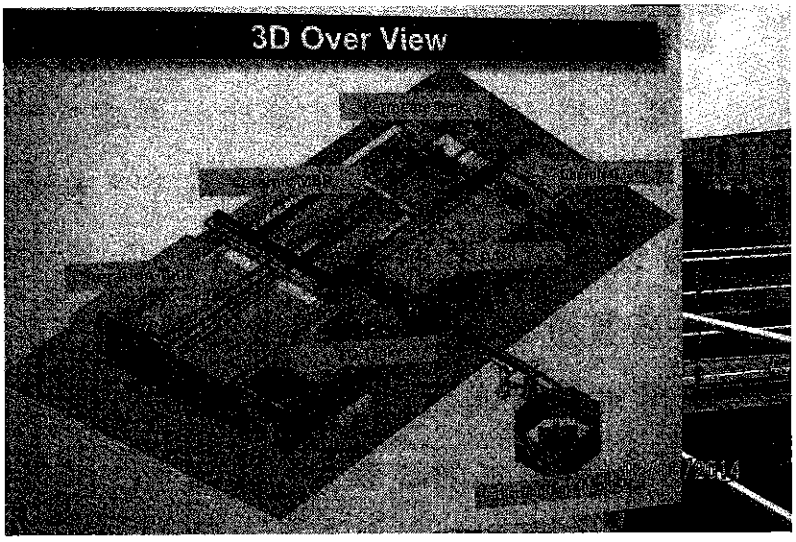


圖 15、Juron 水處理場配置圖

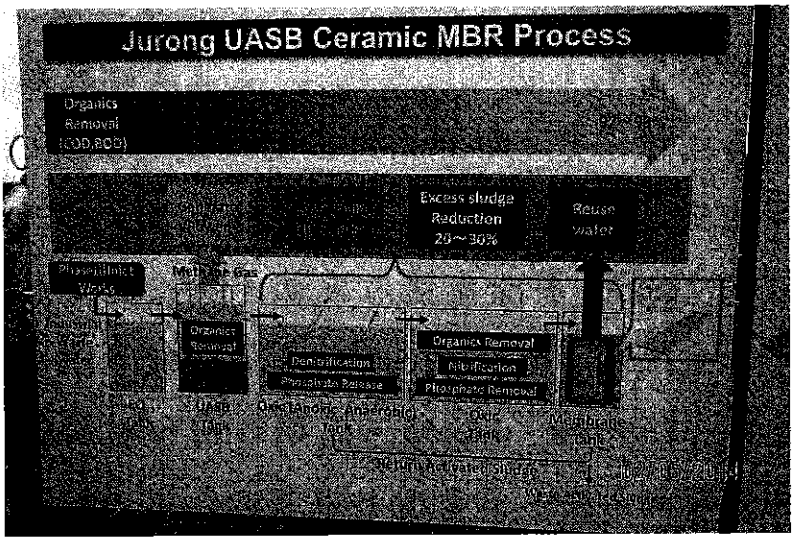


圖 16、Juron 水處理場 MBR 程序

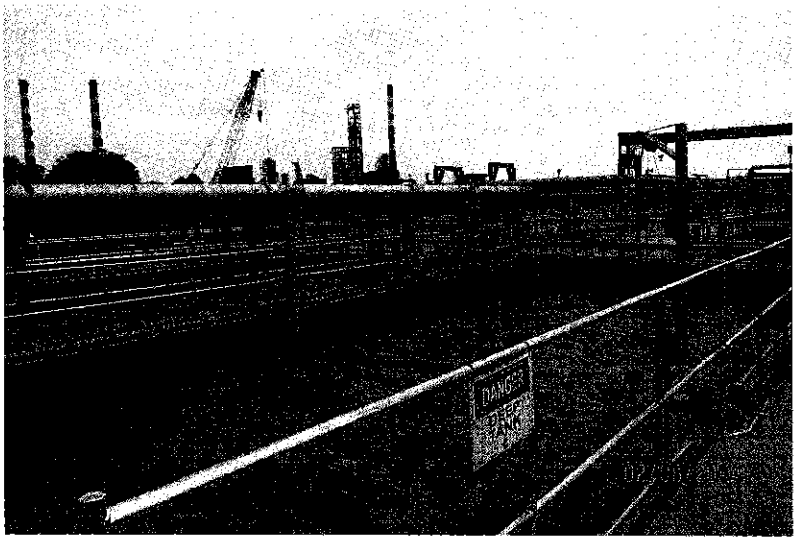


圖 17、Juron 水處理場現場反應槽

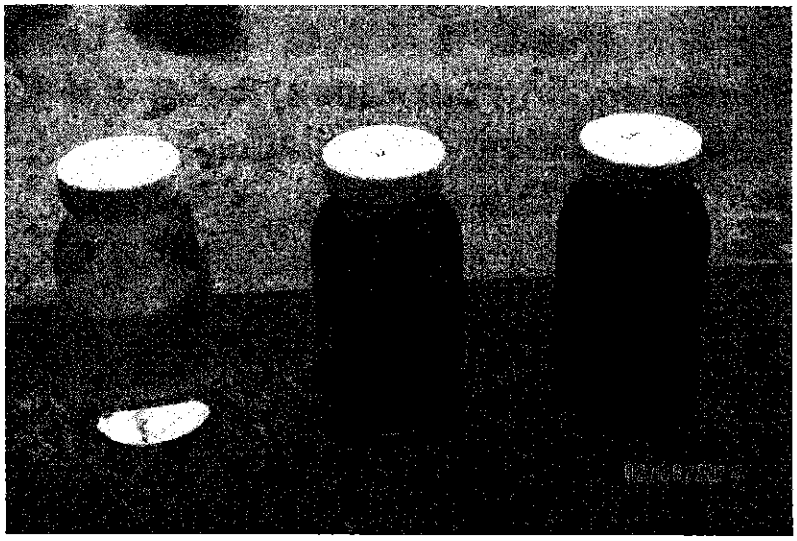


圖 18、Juron 水處理場處理過水質

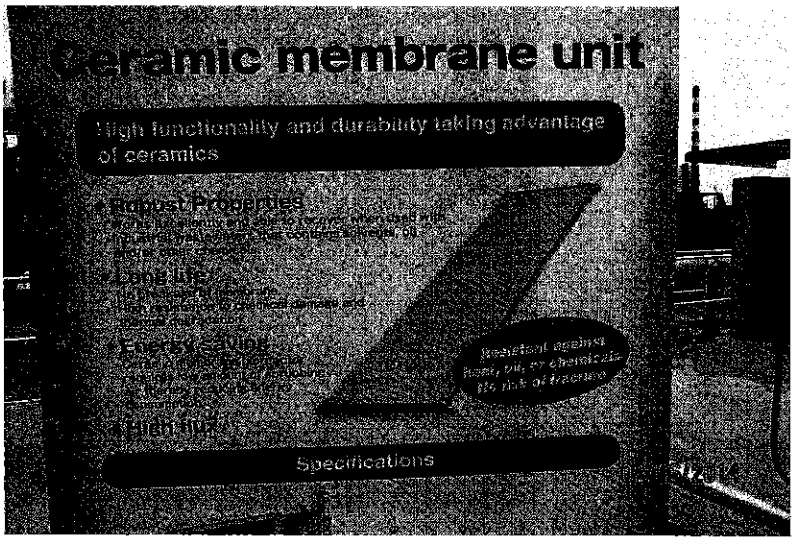


圖 19、Juron 水處理場陶瓷膜

圖 20、日本明電舍向楊署長介紹 Juron 水處理場

(六)楊署長出席水務領袖會談 Water Leaders Summit (Future-Proofing our Cities)及水務領袖圓桌會議 Water Leaders Summit-Roundtable(Securing our Blue Asset for the future)：

楊署長出席水務領袖會談，楊署長於水務領袖會談入口留影(如圖 21）分享我國再生水及海綿台灣經驗，供各國領袖參考，說明如下：

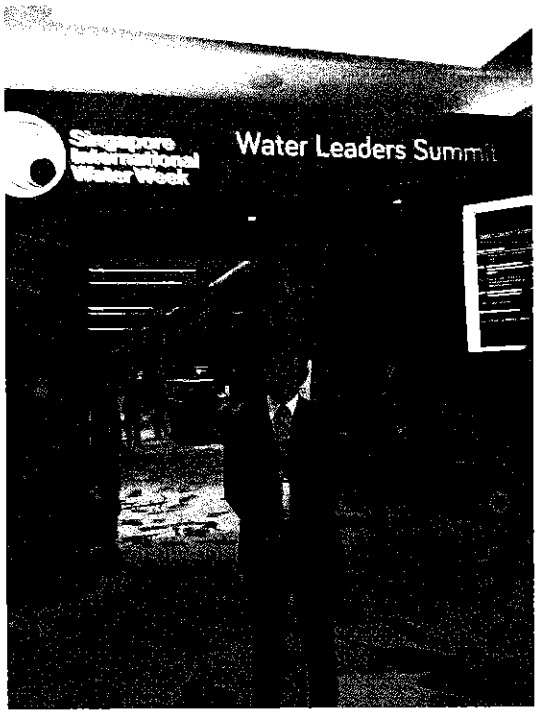


圖 21、楊署長於水務領袖會談入口留影

1.再生水：

台灣地區受氣候、地形影響，可運用之水資源有限，隨氣候變遷、工商業發展，水資源穩定供應已然成為未來之重要課題。受限於降雨量、降雨時空分佈、蓄水設施之限制，台灣水資源應以提升使用效率、開源及節流等方向進行。台灣自民國 90 年起，陸續成立水資源相關普查計畫，針對國內水資源利用現況、未來用水需求等進行調查與評估，並自 96 年起成立水再生利用發展相關計畫，確定台灣現階段水資源政策乃以「廢污水之回收再利用」為重點，以強調工業用水戶廠內廢水回收再利用、促成都市污水廠放流水回收再利用之建立為主，且為有利於廢污水再生利用之推廣及響應國際節能減碳政策，綠色技術之研發與應用亦為推動水再生利用時之重點。

台灣水再生利用乃以「民國 120 年供應 120 噸/日再生水，約佔公共給水量之 10%」為目標，分別來自於：都市污水廠放流水再生利用 70 萬噸、生活用水大戶自行回收量 10 萬噸、廢水廠放流水再生利用 10 萬噸及工業用水大戶自行回收量 30 萬噸，就現階段輔導及調查結果，節至去年底，台灣工業用水大戶自行回收水量已達 25 萬餘噸、生活用水大戶回收量約 5 千噸；另都市污水廠放流水再生利用方面，規劃以南部及缺水較嚴重之地區先行推動，現已由經濟部水利署及內政部營建署共同合作，規劃 6 座再生水示範廠，第一座再生水廠預計於 105 年完工，並供應約 25,000 噸之再生水，除再生水廠之興建外，亦規劃部分既有污水廠改善升級為再生水廠，如若各項推動

作業及工程順利進行，預計將可於民國 109 年產出約 280,000 萬噸之再生水；工業綜合廢水廠放流水之再生利用，則因水質特性較為複雜，尚在詳細評估及調查中。

考量國內民眾對使用再生水之接受度，目前再生水之主要應用標的乃以不予人體直接接觸之用途為主，並主要用應給工業使用，且為加速廢污水之再生利用，亦積極修訂再生水資源發展條例(草案)，同時藉技術輔導、用水計畫書與環評管制等方式，強制要求工業用戶進行水回收並使用再生水，提升整體水資源使用效率。

2.海綿台灣：

台灣因地狹人稠發展出許多都市化地區，水泥鋪面降低了地面的透水及儲水功能，導致熱島效應及淹水災情。

2014 年 3 月 22 日由數個環保團體發起「海綿台灣聯盟」，號召「打造海綿台灣」，將道路地磚改為可透水鋪面，以因應未來氣候變遷所帶來的環境衝擊與改變。據環保團體估算，如果五都道路全數轉型，約可增加城市生態面積 19～23%，更可降低都市熱島效應 1.6~2.4℃，固定二氧化碳約 60 萬公噸，效益驚人。國內既有案例簡介如下：

(1)台北科技大學：其校園地上鋪著透水的地磚，縫隙間還能長出草來，這種會呼吸的地面，讓校園在大熱天比不透水地面涼爽很多，地面溫度大約降低 7 oC，進入校園讓人感覺很舒適，更解決校園積淹水問題。

(2)新北市汐止區中正社區：為將原有柏油路面改為透水鋪面磚道，且收集入滲雨水供生態公園澆灌以節約用水，更降低地表溫度(圖 22 中透水孔洞有蚯蚓爬出)。

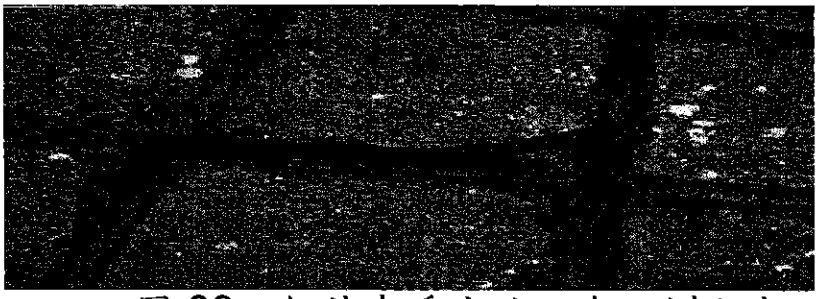
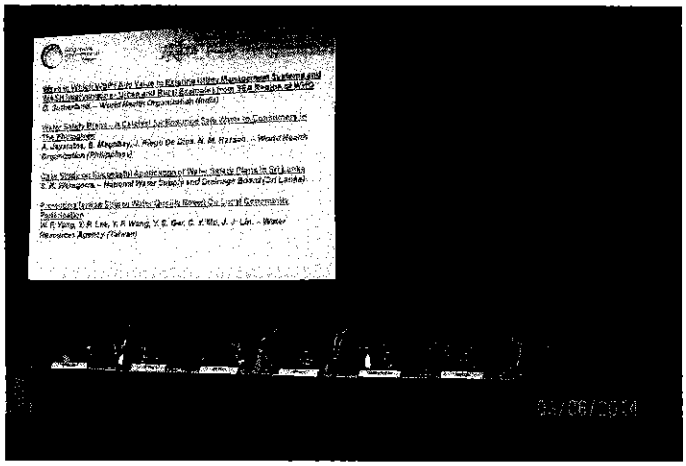


圖 22、相片中透水孔洞有蚯蚓爬出

(七)出席水務大會(Water Convention)，水利署發表論文 Protecting Taiwan Source Water Quality Based on Local Community Participation：

由本署李友平組長代表水利署發表「臺灣自來水水源水質保護社區參與機制 (Protecting Taiwan Source Water Quality Based on Local Community Participation) 」(如圖23)，論文全文及簡報詳附錄一，論文摘要說明如下：



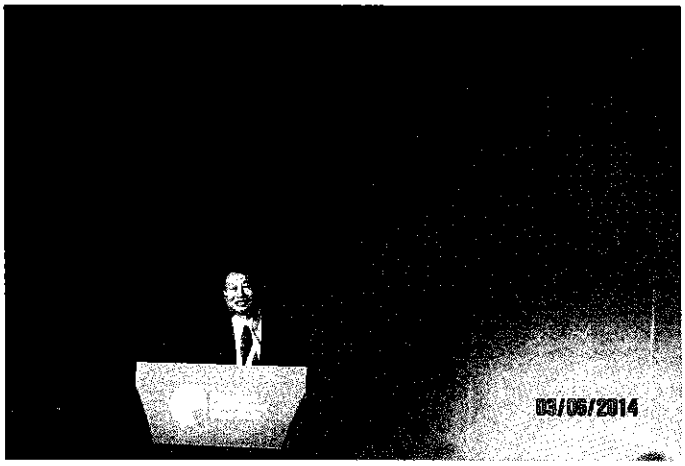


圖 23、李友平組長代表水利署發表論文

2002 年起自來水事業依自來水法申請劃定公佈「水質水量保護區」，並禁止或限制貽害水質與水量之相關行為。政府相關部會亦依相關法律，對位於「水質水量保護區」內之相關開發與土地利用行為，予以管制。對於這些受到開發限制的保護區而言，其限制目的不只是對於下游人民的生命財產之保障，同時也是確保水資源之保育與良好的水質水量。至 2012 年止，劃定之自來水水質水量保護區共 113 處，面積約為 8,972 平方公里，佔台灣總面積之 25%，為因應國內各地不斷要求因自來水法水質水量保護區劃設而受限之回饋聲浪，經濟部遵照行政院 2002 年 8 月 5 日核定「限制發展地區救助、回饋、補償處理原則」，及落實「受益者付費、受限者得償」之精神，在收支平衡及不增加國家財政負擔原則下，推動自來水法部分條文修正法案，經於 2004 年 6 月 30 日總統公布實施後，並於 2006 年 1 月 1 日起開徵水源保育與回饋費。經費之管理由各保護區成立專戶運用小組規劃運用，其成員由相關中央主管機關、保護區內相關縣市代表、鄉鎮代表、居民代表、公正人士等組成。用途則專供水質水量保護區內辦理水資源保育與環境生態保育基礎設施、居民公共福利回饋及受限土地補償之用。

自來水水質水量保護區之永續發展，除了仰賴管理單位的經營，保護區內居民的參與更不容漠視。管理單位一方面要兼顧水質水量環境之保育；一方面要照顧社區居民生活福祉，使管理目標涵蓋「生產(經濟)」、「生活(社會)」、「生態(環境)」三個永續發展面向，因此，保護區經營管理過程中納入公眾參與，增加雙向溝通機會與社會互動，預期可減少保育執行過程與當地社群產生的衝突；亦可藉助在地知識與在地力量，使人與水源保育共容於保護區中。

(八)參加世界水協會(WWC)主辦「亞太水與綠色成長」的分享討論會(由 WWC 副主席 Dogan Altinbilek 主持)：

由於 2015 年世界水協會(World Water Council, WWC)將於韓國大邱市舉辦第七屆世界水論壇(World Water Forum, WWF7)，因此，WWC 藉由 SIWW 會議舉辦「亞太水與綠色成長」區域論壇，以蒐集亞太地區之議題，會議邀請下列 3 篇論文發表如下：

1. 韓國 Mr. Tae-sun Shin (Head Manager, K-water)發表 Water and Green Growth with Korea's case study.
2. 亞洲銀行 Ms. Amy S.P. Leung (Director, ADB)發表 Green Cities for Green Growth.
3. 世界水協會 Proef. Dogan Altinbilek (Vice President, WWC)發表 Case study of Golden Horn.

前揭發表人中，韓國水協會(K-water)的 Head Manager Tae-sun Shin 先生及世界水協會(WWC)的副主席 Dogan Altinbilek 教授為 WWF7 籌備委員會委員，而水利署希望能在明年 WWF7 大會中成功主辦研討會，將我國防災科技行銷國際，因此在參加 WWC 主辦的「亞太水與綠色成長」的分享討論會，會中本署楊署長親自向 Tae-sun Shin 先生及 Dogan Altinbilek 教授兩位利害關係人說明本署期望爭取主辦 section 之強力意願後，兩位 WWF7 籌備委員會委員均表示支持與肯定，也表示願意協助台灣爭取主辦 section。本署楊署長與 WWC 副主席 Proef. Dogan Altinbilek 合照(如圖 24)，李友平組長與 K-water Head Manager Tae-sun Shin 先生合照(如圖 25)，做了很成功的利害關係人管理。該會議結束後，楊署長順道至 SIWW 舉辦之青年領袖會議訪視本署水利特使林亞震同學加油打氣(如圖 26)。

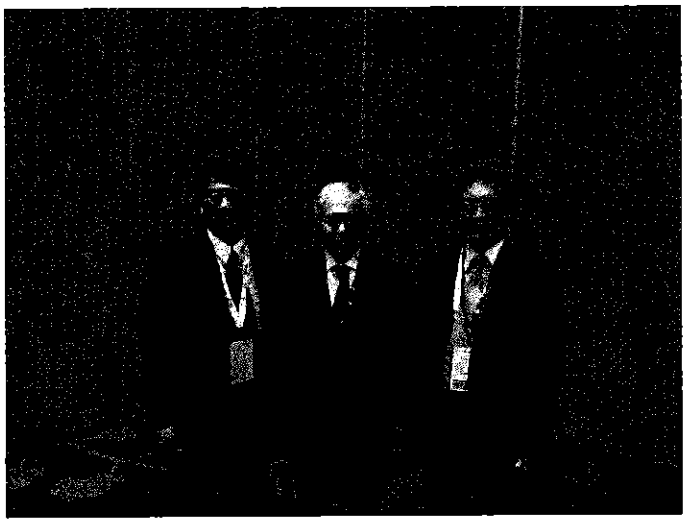


圖 24、楊署長與 WWC 副主席 Proef. Dogan Altinbilek 合照

圖 25、李組長與 K-water Head Manager Tae-sun Shin 合照

圖 26、楊署長與本署水利特使林亞震及新加坡毛斑良先生合照

(九)拜會新加坡公共事業局(PUB)雙邊交流座談：

本次 SIWW 主辦單位為新加坡公共事業局(PUB)，而本署與 PUB 已交流多年，為感謝其邀請本署楊署長參加 SIWW 領袖會議，行前電洽本署拜會該局之意，PUB 也特地安排雙邊交流會談，由 PUB 陳副總裁玉仁接待(如圖 27)。而 PUB 另希望了解我國抗旱應變及工業用水輔導之作為，本署亦準備資料於座談會中分享(分享資料詳附錄四)。另因 PUB 為推動新加坡科學園區之工業廢水回收，委託我國工業研究院材料與化學研究所計畫，協助其診斷及建立新加坡科學園區之工業廢水回收機制，因此座談會亦邀請工研院材化所王先知副所長及同仁與會(團體合照如圖 27)。

圖 26、本署楊署長與 PUB 陳副總裁玉仁合照

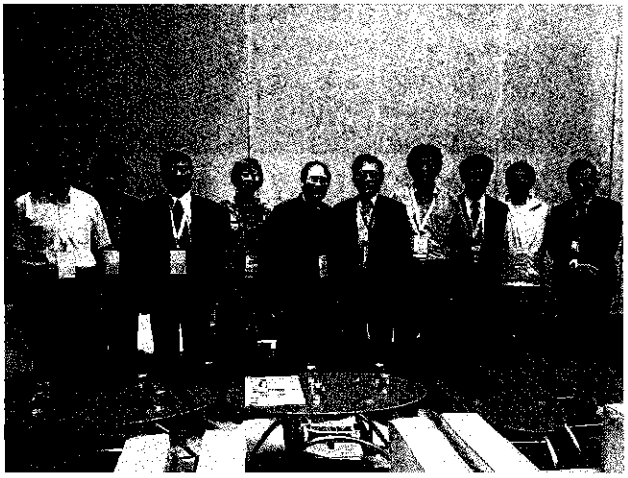


圖 27、水利署、PUB、工研院、中原大學、中興社團體合照

(十)出席水務大會(Water Convention)，水利署發表論文 Promotion of Wastewater Reclamation/Reuse in Taiwan：

由本署再生水協力團隊中興顧問社朱敬平協理代表水利署發表「台灣廢污水回收再利用促進計畫 (Promotion of Wastewater Reclamation/Reuse in Taiwan) 」(如圖 28)，論文全文及簡報詳附錄二，論文摘要說明如下：

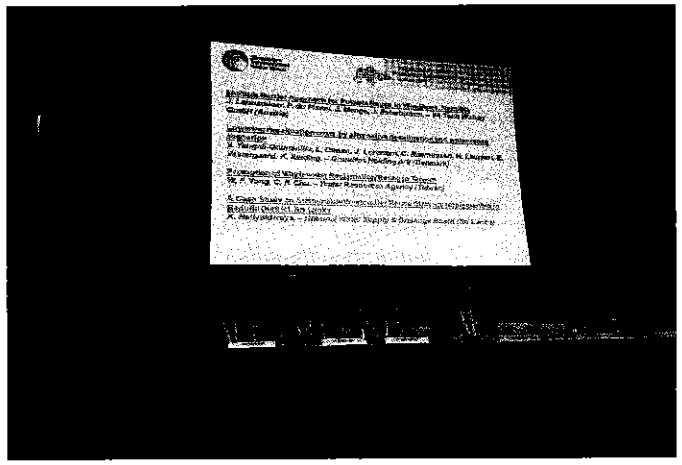


圖 28、朱敬平協理代表水利署發表論文

水利署也積極推動新興水源開發工作，在廢污水再生利用方面，全方位由強制法令獎勵措施、缺水地區重點推動、關鍵技術產業扶植及友善環境公眾宣導等 4 大策略積極推動。惟再生水事業推動受限於目前水價偏低影響業界使用再生水意願，如要順利推動，前期必須由公部門投資帶動，水利署非常欣喜近期營建署依據水利署調查規劃成

果，願意將鳳山溪、永康、福田、豐原、安平及臨海等 6 座污水廠由污水下水道經費出資優先推動，最快將於 2016 年即可開始使用再生水。而在海水淡化方面，因屬高耗能產業使得用水單價較高，必須到達一定規模的廠址才具經濟開發可行性，只有針對特定區域及廠商(例如高雄臨海工業區中鋼及台積電等高科技廠商)具推動潛勢，因此水利署推動策略將朝由開發單位興辦海水淡化廠供應產業用水或政府自辦海水淡化廠供應公共給水方向推動。

(十一)參觀水務博覽會(Water Expo)：

SIWW 水務博覽會為世界上重要及全面集中於創新、產品和服務的水商業展覽，約 2 萬人參加，展覽內容分類如下(如圖 29~33)：

- 集水區管理(Catchment Management)
- 乾淨節能運輸(Clean Transport)
- 氣候變遷及洪水管理(Climate Change and Flood Control)
- 工程顧問及服務(Consultancy and Engineering Services)
- 水壩及水力發電(Dam & Hydro Power)
- 海水淡化(Desalination)
- 廢棄物及回收再利用(Disposal & Recycling)
- 生態綠色產品(Eco-Products)
- 環境保護(Environmental Control & Protection)
- 設備/控制/系統/裝置(Equipment/Control/System/ Instrumentation)
- 公共基礎建設(Infrastructure)
- 水利產業相關產品及服務(Other Products & Services for the Water Industry)
- 幫浦及操作系統(Pumps and Process System)
- 公共衛生(Sanitation)
- 廢棄物控制及管理(Waste Control & Management)
- 廢水收集及處理(Wastewater Collection/Treatment)

•水資源分配(Water Distribution)

圖 29、SIWW 水務博覽會會場

圖 30、回收廢棄物製作空心磚供透水鋪面使用

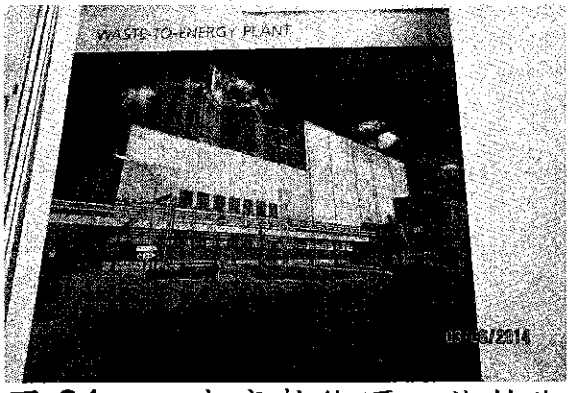


圖 31、工廠廢熱能源回收技術

圖 32、太陽能垃圾桶

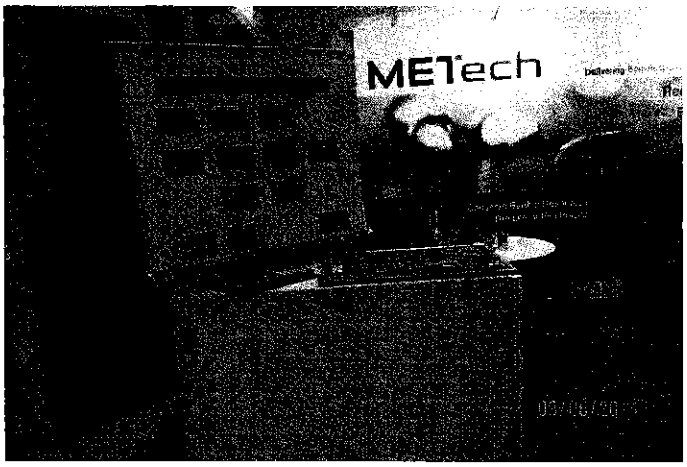


圖 33、IC 版回收及貴金屬提煉技術

(十二)參加韓國水協會(K-water)舉辦之亞太水論壇高峰圓桌會議 (WWF7-1st Asian Water High Level Round Table)：

1.緣起：

(1)2014 年 4 月 9 日接獲韓國 K-Water(Korea Water resources Corporation，韓國水資源公社)電子郵件，邀請本署楊署長參加 6 月 4 日於新加坡召開之「Asian Water High Level Round Table-Water Security-」會議。

(2)K-Water 並於 4 月 25 日以電子郵件寄信邀請信給楊署長並提供該圓桌會議較詳細資料。

2.K-Water 角色說明：

(1)K-Water 負責組織 WWF7 中區域（Regional process）及科學與技術程序（Science & Technology Process）。

(2)針對 WWF7-Regional process 其主要工作在負責整合亞洲地區區域水議題，經其評估在氣候變遷下，區域水安全,Water Security 問題是影響區域發展及區域間應互相合作的議題，因此 k-water 邀請及鼓勵亞洲地區的負責水安全議題的相關組織代表共同參與此圓桌會議，藉討論水安全的相關議題以獲取共識共同解決區域的問題，會議共識並將與 WWF7 其他 process 連結。

3.本署楊署長於高峰圓桌會議中針對下列議題，說明台灣之研究發展及辦理情形(如圖 34 及附錄五)：

(1)台灣參與第 7 屆水論壇 WWF7 狀況。

(2)Sanitation – 自來水供應、水質、下水道設備、再生水(Water supply, Sewers, Reclaimed Water)。

(3)Climate Change -氣候變遷。

(4)Water Disaster -水災。

圖 34、楊署長於高峰圓桌會議說明台灣研究發展情形

4.本次會議邀請之領袖合照及人名對照相片(如圖 35)。

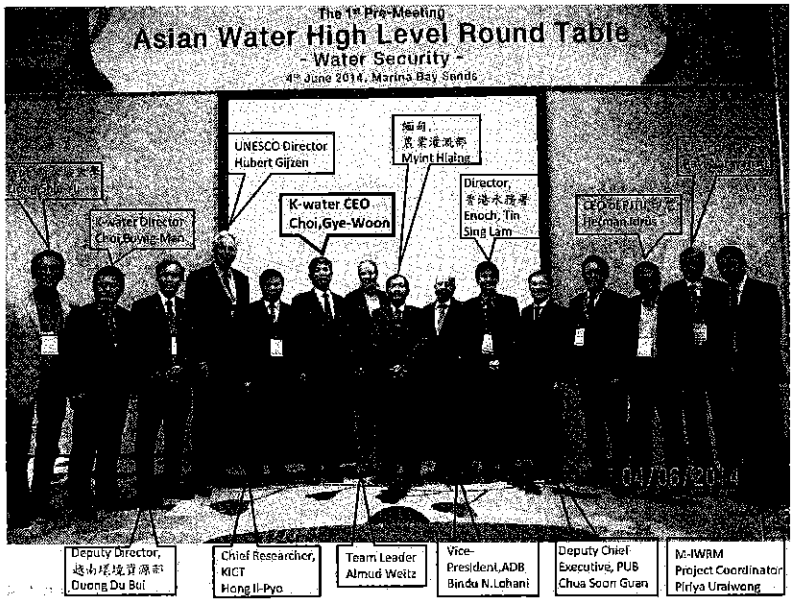


圖 35、第一屆亞太論壇高峰圓桌會議領袖合照及人名對照

5.難能可貴的是本次高峰圓桌會議，本署楊署長是以中華民國經濟部(Ministry of Economic Affairs, R.O.C.)之名義代表出席(如圖 36)。

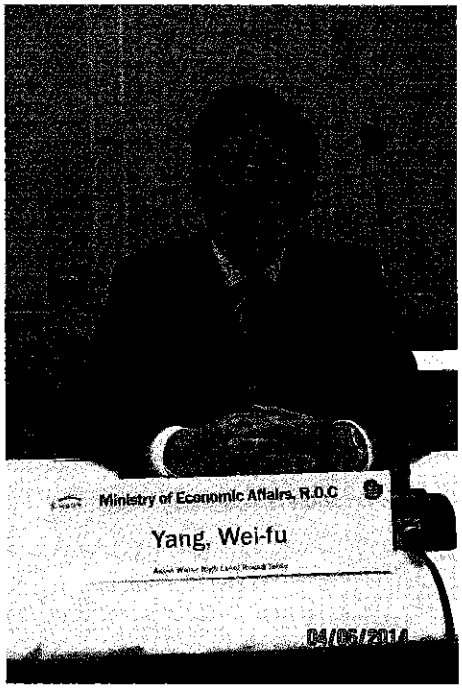


圖 36、本署楊署長以中華民國經濟部之名義出席會議

6.本次高峰圓桌會議是由韓國水協會(K-water)的主席 Choi,Gyewoon 先生主辦，另亞太水協會(APWF)主席 Ravi Narayanan 先生均為 WWF7 籌備委員會委員，而楊署長兩位利害關係人說明向水利署希望能在明年 WWF7 大會中期望爭取主辦 section 之強力意願後，兩位委員均表示支持與肯定。楊署長與 K-water 主席 Gyewoon Choi 先生合照(如圖 37)，楊署長與 APWF 主席 Ravi Narayanan 先生合照(如圖 38)。

圖 37、本署楊署長與 K-water 主席 Gyewoon Choi 先生合照

圖 38、本署楊署長與 APWF 主席 Ravi Narayanan 先生合照

參、研習心得

一、新加坡主辦國際水週(SIWW)活動將第四屆世界城市峰會(World City Summit)及第二屆清潔環境峰會(Clean Environ Summit Singapore)，除舉辦領袖會議、論壇、研討會、商務會展及結合國際會議 WWF7 一併舉行，新引 2 萬餘名各國專家齊聚一堂，為未來水問題提供跨國合作平台，值得我國未來辦理國際會議之參考。

二、參訪新加坡參觀 ABC 水環境計畫帶回該計畫之設計準則，可提供我國正推動之流域綜合治理計畫(6 年 660 億)之參考。

三、參觀新加坡 Juron 水處理場帶回相關參考，可提供我國正推動鳳山溪再生水廠供臨海工業區工業用水使用計畫推動之參考。

四、本署於水務大會熱門議題研討會發表 Protecting Taiwan Source Water Quality Based on Local Community Participation、Promotion of Wastewater Reclamation/Reuse in Taiwan 及 Study on Strategy for Promotion of Water Reuse in Taiwan 等三篇論文，蒐集各國專家意見供計畫推動參考。

五，拜會新加坡公共事業局，由 PUB 陳玉仁副總裁接待，本署提供我國抗旱應變、工業用水輔導作為分享資料，新加坡亦對該國於今年初遭逢 50 年來最嚴重之乾旱之因應對策做經驗分享，對雙方跨國合作及情誼聯繫有正面意義。

六、水利署指派所培育之水利特使-林亞震同學，參加 SIWW 舉辦之青年領袖會議發光發熱，對本署培育水利青年有實質助益及參考。

七、本署楊署長出席韓國水協會舉辦之亞太水論壇高峰圓桌會議，針對台灣參與第 7 屆水論壇(WWF7)之準備情形及針對自來水供應、水質、下水道設備、再生水、氣候變遷、水災之研發情形進行說明，獲得各國代表熱烈迴響。

八、因水利署希望能在明年 WWF7 大會中成功主辦研討會，將我國防災科技行銷國際，因此對 WWF7 籌備委員會委員之 K-water 主席 Gyewoon Choi 先生、K-water 的 Head Manager Tae-sun Shin 先生、WWC 的副主席 Dogan Altinbilek 教授及 APWF 主席 Ravi Narayanan 先生位利害關係人說明本署期望爭取主辦 section 之強力意願後，四位 WWF7 籌備委員會委員均表示支持與肯定，也表示願意協助台灣爭取主辦 section。

附錄一、Protecting Taiwan Source Water Quality Based on Local Community Participation

YI-FONG Wang*, YUE-SU GER*, CING-YUN MU** and JHE-JHENG LIN*

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(E-mail: *jackie@gis.tw*)

Abstract

In order to encourage communities to actively participate in water resource conservation, Water Resources Agency has been adopting both 'command-and-control approach', such as regulations and executive orders, and 'economic approach', such as incentives and counseling, to make sustainability policies more effective to be put into practice. With rich experience of community building for past decades, the Agency also helps those communities in protection areas to drive the development of "economy, life and ecology"; meanwhile, they can enhance the water conservation.

There are three phases of project delivery including investigation of community resources, preparation of community building proposal, and promotion by organizing related activities. The scope of project covers a variety of social-economic issues including water conservation, environmental protection, ecological restoration, industrial management, etc. Several deliverables have been accomplished by the end of this project, such as research and investigation, tourism guiding, DIY, specialty exhibitions and sales, education, advocacy and other activities related to community building. By means of exhibition of these accomplishments, we can demonstrate fruitful achievements of water conservation by Water Resources Agency.

This mechanism is expected to achieve the following benefits: 1) To revitalize local industries and implement water conservation in protection areas of water quality and volume, 2) To promote correct concepts of water

conservation through community building activities, and 3) To stimulate the energy of water conservation from community residents and put into practice through observation, discussion and experience sharing.

Keywords
Tap Water Act, Protection area of Water Quality and Volume, Water Resource conservation, Community Building.

Overview

Taiwan Water Corporation delimited and announced "Protection Area of Water Quality" according to the Tap Water Act to prohibit or restrict behaviors that may deteriorate the water quality and volume. Relevant government agencies also supervise relevant development and land use activities in those areas in accordance with laws and regulations. The purpose of prohibitions of restrictions in these areas is not only to protect life and property in the downstream, but also to ensure water conservation and good water quality and volume. In response to continuous appeals from the public of compensation for economic loss in these areas due to the above-mentioned restrictions as well as in the balance of payments but without increasing the burden on the country's finance, the Ministry of Economic Affairs initiated the amendment of the Tap Water Act in order to conform to the "Principles of the Relief, Subsidy and Compensation for restricted development areas" approved by Executive Yuan on 5 August 1991 and fulfill the spirit of the "beneficiaries pay, restricted people get compensation". After the revised provisions announced by the President and implemented on June 30 2004, the government started to collect water resources conservation and compensation fee on January 1 2006. Up to 2012, delimited water conservation areas reached a total of 113, with an area of approximately 8,972 square kilometers, accounting for 25 % of Taiwan's total sites. The subsidy is managed by a special project team established by each conservation area. Whose members come from government representatives of conservation areas, township representatives, resident representatives, and impartial persons. The subsidy is exclusively used for water resources conservation, environmental and ecological conservation infrastructure, public welfare of residents, and compensation for economic loss due to restrictions conservation areas.

In addition to efforts by government, participation of residents in conservation areas is also important for sustainable development of tap ware quality and quantity conservation. Also the government takes responsibility of water

conservation; while considering the welfare of community residents. In order to fulfill spirit of "production (economic)", "life (society)", "ecology (environment)." Public participation from conservation areas will play an important role to increase communication and social interaction, which is expected to reduce conflicts between the government and residents; Local experiences and forces are useful to harmonize the human life and the nature in those conservation areas.

Research purpose and questions

Purpose

Water resource conservation and compensation fee are compensatory policy approach based on laws and regulations, which provide economic incentives for residents in conservation areas. However, the proportion of these funds distributed in "conservation" or "compensation" often becomes an issue that environmental and social groups dispute about. In addition to disclosure of the use of the funds through websites or government publications, this study organized several participation observation and study group discussions through community building, workshops, seminars and related activities to enable stakeholders such as community residents, environmental groups, resource users, local governments, research institutions or related industries to understand the use of the funds by means of public participation which will benefit the future effort for water resource conservation.

Research questions

1. How to create a public participation mechanism to establish the partnership between government officials and residents in conservation areas?
2. Does any new communication channel appear after having public participation?

Research methods

Study area

Both selection and registrations are applied to decide study areas. At the stage of selection, Qingtan of the Xindian river, Kaoping River, Shih-Men Reservoir, Liyutan reservoir, Bansin Water Treatment Plant, Tseng-Wen Reservoir, Fensang Reservoir, Nan-Hua reservoir, Shigang Dam, Lantan, and Jen-Yi-Tan were selected as study areas based on the amount of funds allocated in 2011.

Next, at the registration stage, the study team distribute the application form to all communities according to the website of "Taiwan Community Platform" of

Taiwan's Ministry of Culture. Eventually, located in above conservation areas, Dapu Tourist Association of Dapu Township in Chiayi County that belongs to Tseng-Wen Reservoir and Guanshan Community development Association of Tainan Nanhua District that belongs to the Nanhua Reservoir are chosen to participate the experiments.

Investigation strategy and qualitative research

Action Research

This experiment is jointly participated by the study team and stakeholders in study areas with an aim for seeking solutions to problems of local production, life and ecology and keep to guide the mission in order to establish an excellent mechanism for public participation.

Data Collection

This study adopts qualitative research methods, including participant observation, literature analysis, interview, and focus group discussion. The use of multiple research methods helps to obtain complete information to represent the actual situation.

Data Analysis

This research used the qualitative research model for data analysis and interpretation, and then reduced data collected from literature review and field survey to display and verify in order to draw the conclusion (Li in 2003).

Investigation process

There is continuity in the workflow of fieldwork. Researchers might have to return to study areas and gather information at any time due to lack of data. In order to facilitate the understanding of research focus at each stage, the research process is divided into three stages: The first stage of the investigation began from April 20 to June 30 2012 with the aim of clarifying local problems and establishing partnerships with each other. In order to further understand the local historical sites and environmental resources, this research uses participant observation, interviews, literature review to collect information about community resources as well as establishes relations with the community through community resources survey, community development programs, community development activities and community promotion.

The second stage of the investigation began from July 1 to September 30 2012 with the aim of making plans and action together, resolving local issues, and establishing the mode of communication. From issues closely related to the resident living, researchers identify issues in line with water conservation and development objectives to further assist in community development activities

such as planning research surveys, guided tourism, DIY experience, featured product display and sales, education promotion through workshops and seminars with themes of water conservation, environmental protection, ecological restoration, and industrial operations.

The third stage of the investigation began from October 1 to December 30 2012. This research observed and recorded communication patterns of local stakeholders and their willingness to participate in public affairs through workshops and seminars. This is used as the basis to improve the communication between local residents and government officials in order to encourage public participation in water conservation achievement display to highlight the effect of water conservation community development.

Results and Discussion

Dapu Township in Chiayi County

Regaining past tourist prosperity and creating the direction of community development

In Dapu Township in the past, raft fishing was prevalent and shops and stores brought considerable tourism revenue. However, after a number of recreational activities around the reservoir including raft fishing were prohibited in order to sustain the water quality of the Tseng Wen Reservoir and the number of tourists plummeted, which has serious impacts upon industries and economy of the village. The agricultural development also declines due to lack of counseling, which resulted in high rate of emigration. Despite the fact that raft fishing is prohibited, the tourism and recreation resource in the neighbor of Tseng Wen Reservoir remain potential. Through discussions with community leaders, the research team found that it can be wise and beneficial to continue developing tourism industry, but how to find out the tourist attraction except raft fishing is an important issue for Dapu's future.

In recent years, community actively promote eco-tourism, especially firefly watching. Members of several community also receive training courses of eco-tour guide organized by Siraya National Scenic Area Administration. In 2007 and 2008, Tropic of Cancer Environmental Art Action Plan of Chiayi County invited artists to stay and create artworks, which triggered the community to consider the possibility of art as the strategy to initiate "Sustainable Rural Development." Driven by these training courses and programs, some residents begin to devote themselves to driftwood creation and tour guide services, which leads to shape the idea of art village.

In addition, White Horse Pavilion of Dapu is a good paragliding base,

surrounded by beautiful scenery of the Tseng Wen Reservoir, which attracts many paragliding enthusiasts. In order to promote this activity and boost tourism, Dapu Township Office, the Siraya National Scenic Area Administration, and the South Region Water Resources Office jointly organize reservoir tourism Festival every year. It consists of agricultural products display and sales, bamboo craft shows, game fishing, paragliding performances, and musical events, which successfully attract tourists and highlight features of Dapu.

As mentioned above, tourism is an important local industry of Dapu and one of important visions of the community. However, how to continue water and ecological conservation while developing the tourism industry, how to effectively integrate resources of Dapu to improve the environment quality become important issues for Dapu Community. This research suggests that the community can continue community development workshops to establish consensus in order to clarify and revise the vision of community development. Community development plan should be made as the guideline for future development.

Possessing the basis for community development, but need to strengthen the organizational capacity

To assist local development, the Siraya National Scenic Area Administration and the South Region Water Resources Office provided resources for Dapu in recent years, but it lacks an appropriate organization for implementation. In order to utilize all resources, community members who actively participate in public affairs established the "Dapu tourism Promotion Association" in September 1999, which plays an active role as a local development cooperation platform. After the association was founded, the government agencies introduced several projects for Dapu, including "National Creative Bicycle Competition", "Singang Matsu parade in Dapu activity", "Dapu Old Street reform," "ecological building of purple-spotted butterfly Road".

After discussion, among the team and leaders of Tourism Promotion Association, we think that the current problem of local development in Dapu is not the lack of resources, but the lack of clear vision of community development as well as lack of continuity in the planning and overall thinking instead. Therefore, how to foster the ability to integrate resources and organizational capabilities of community organizations in order to reach a consensus and lead the long-term development of the community is one of the important issues of community development.

As mentioned above, after establishing the direction of community development

through workshops, this research suggests that the community can combine the vision for the development of education promotion plan and talent training programs to foster community managers to have the vision and ability of drawing all kinds of plans to assist in community development. By gradually developing community manager talents, enhancing organizational capabilities and the ability of resource integration, various resources can be integrated to assist the long-term community development.

The Guanshan village of Nanhua district in Tainan City

Mostly state-owned lands which restricts community development

Most lands of the Guanshan area are owned by the government, which are under administration of National Property Administration and the Forest Bureau. Residents rent these lands for farming or afforestation to earn their livings. Therefore, the community development faces two major questions: 1. Legality of the lease, 2. Restrictions of construction. In the process of community interviews, residents said that renting state-owned lands become more and more difficult in recent years due to laws and policies modified after typhoon Morakot. When the management of the public lands was transferred from the Tainan County Government to the National Property Administration in 1996, a lot of residents who actually lived and farmed here did not continue the land lease. Afterward, the state-owned lands were only allowed to be used for agricultural practices. As for the new construction of farmhouse, the buildable areas were primarily limited to lease contracts signed in the very early stage. Additionally, many new constructions as well as the living spaces of many residents were deemed illegally, and it had, therefore, led to lawsuits and problems that remained unresolved even after repeated petitions.

After the Typhoon Morakot, because the Guanshan area is located in the Class 2 “water quality and quantity protection area” in the "Regional Reconstruction Master Plan under the Premise of Conserving National Land " (hereinafter referred to as the reconstruction master plan) approved by the Executive Yuan, granting, disposition, and fresh letting or leasing are prohibited according to the provisions of the reconstruction master plan. Therefore, the Ministry of Finance approved that lease, leasing, lease by tender, and operation of entrusting through bidding of national non-public use land within the reservoir watershed administered by the National Property Administration are suspended from October 1 2011. At present, in addition to the existing lease, residents can no longer legally rent state-owned land for farming.

In addition to the legality of residence or farming, another major topic of

community development is restrictions on the building development. Because the Guanshan village is also located in the water quality and quantity protection area, hillside conservation zone, and Category 2A strategy partition of reconstruction master plan, all kinds of development behaviors are prohibited except agricultural facilities, so that the community cannot do any new construction. It is a big problem for the development of eco-tourism or other industries for the community.

For the purposes of community development, restricted housing, farming and construction behaviors indeed seriously affect the life of residents. For example, due to inability to receive the building permit, whether tourist service facilities or factories required for the development of brown sugar industry, etc., are impossible to build in the Guanshan community.

For communities with multiple constraints like Guanshan, which is located in the water quality and quantity protection area, hillside conservation zone, disaster potential area, restricted development area, this research suggests there should be more detailed plan for land use on the premise of taking care of both residents' livelihoods, water and soil conservation, and environmental protection. If there is indeed the need of village migration because of fragile geology, high-hazard risks or other factors unfit for human habitation, the community shall propose more holistic complementary measures which take the living of residents into account through more in-depth community communication process. If there is still the possibility to find a balance among living, farming and national land conservation, the goal shall be set to build ecological communities and lead the development of the community by a more detailed land use plan. Meanwhile, the existing regulations shall untie the limitation of the land use plan or give special consideration case by case in order to give the Guanshan community space and opportunity for the long-term development.

Overused pesticides may damage soil and the water quality

Sugar canes and Ma bamboo shoots originally dominated crops of Guanshan area. In recent years, the government subsidizes farmers to transfer to plant mango so many sugar cane fields have been replanted mango trees. However, the main two species planted here—Irwin mango and Jinhuang mango needs fertilization and pest control which degraded water quality of the reservoir and also affect the surrounding environment. Additionally, the use of herbicides also impedes the soil and water conservation and damages the ecological environment, which does not match the vision of Guanshan village to become an ecological community.

The cultivation of mango involves the industrial development of the community. To promote the ecological community, Guanshan also actively tries to find a way out for community industries in recent years in addition to promotion of firefly watching. The community finds the brown sugar industry from the community history, which can protect the environment and have economic benefits. Currently, the community has three brown sugar factories, including Fei Long Brown Sugar, Brown Sugar Grange, and Augoora Brown Sugar. Due to the television advertisement, the report of television programs, the use of Chikan Sugar, Red Brick Pudding, and Wu Baochun bread, these brown sugar workshops gradually become famous. However, the shelf life of brown sugar is short, and the current channels and sales still cannot support most farmers of the community to transfer to brown sugar industry. How to increase channels, improve brown sugar prices and sales to attract farmers are currently important issues for the community to develop brown sugar industry and improve the water quality of the reservoir affected by the pesticides.

In the past, the cultivation of sugar cane or mango were both guided by the government policy. Since the government can protect the revenue of transfer, farmers are certainly willing to invest. Therefore, the research suggests that the government can encourage mango farmers to transfer to plant sugarcanes in plains areas and ma bamboo shoots in hilly areas through policies. Meanwhile, farmers shall be subsidized with the manual weeding to reduce the use of herbicides. As for the implementation, the authorities can coordinate the agricultural sector to assist in brown sugar production and sale, the development of local brands to increase output and sales of Guanshan brown sugar in order to lead farmers to crop type transfer through the market mechanism; Or the government can directly subsidize farmers to transfer to plant sugar canes and ensure the procurement to increase their willingness of crop type transfer.

In addition, because the Guanshan community is a scattered village of which the domestic sewage is discharged into the nearby farmland, ditches, the pollution problem is not serious. However, the government still can encourage residents to make of household homemade environmentally friendly lotion (green enzymes, oil soap, etc.) to reduce the pollution of domestic sewage.

Disagreement with conservation and compensation fee usage: difficult to form the community consensus

In the past, the Guanshan area had strong community cohesion, excellent achievement in community development. Community organizations and schools cooperated to promote eco-tourism, environmental education, and ecological

community for many years and accumulated a lot of experiences and reputation. However, after the Typhoon Morakot destroyed many facilities and residents disagreed on the allocation of water resources conservation and compensation fee in recent years, the deposit account management team cannot come to consensus. As a result, the community begins to have differences of opinion, and the enthusiasm of residents for participation in public affairs is gradually reduced. The reduced community cohesion influences the community development.

The formation of community consensus requires more communications. Therefore, how to restore the community communication mechanism, to recall the community's sense of identity, to strengthen the cohesion, and to seek for consensus programs of community development are currently important issues that the Guanshan community is facing. This research suggests organizing community vision workshops to discuss vital issues such as the development of community industries, the legality of housing to facilitate communication within the community. This process can inspire the community identity of residents and find back the past enthusiasm to build the ecological community together.

The government shall supervise the use of water resources conservation and compensation fee to see if some individuals or private groups make profit from it to ensure the fairness of its use so as not to deepen community barriers.

Conclusions

Whether the Guanshan Village or the Dapu Township, the major problem of the community development lies in the lack of collective communication platform, the lack of community consensus, and insufficient collective strength. This study contributes to the formation of collective discussion, cohesion of consensus for development through community workshops in order to promote the follow-up work. However, developing a community-level water conservation program cannot be fulfilled in one step. So it is necessary to help communities develop a communication platform with public sectors by developing community workshops, proposing a vision and strategy for future community engagement; meanwhile implementing water conservation education programs for community residents in order to understand the importance and methods of water conservation. Constructing community-based water conservation facilities to meet the requirements of communities and preparing both the information folders and interpretive signs of water conservation are just a beginning to promote community development. The government still needs to keep cooperation with the community in order to continue to promote software and

hardware programs to fulfill the water conservation purpose. After observations, this study concludes the following recommendations:

1. Although the concept of water conservation is accepted by communities, it is still not easy to implement in the living of residents and needs ongoing education and promotion. The future water resource conservation community building plan shall be based on education and advocacy as well as user experience so that the community residents can have a sense of participation which further promotes interaction between community members and enhances community cohesion and identity in public affairs. After the concept changes, the promotion of all programs will be more smooth.
2. Lack of tap water is a frequent problem in water quality and quantity protection areas. In addition to mountain springs and small water, the government may promote the installation of rainwater retention system. In the future, the government can subsidize households in these communities to install rainwater retention system for irrigation and toilet flushing, which can reduce the stress of residents for water consumption during the dry seasons.
3. Most water quality and quantity protection area belong scattered villages where the installation of sewage system and sewage treatment plants is not suitable. Therefore, the natural purification system (artificial wetland) and environmental cleaner shall be promoted in order to reduce the contamination of household sewage.
4. The protection of water source is closely related to living style of residents. For example, excessive use of pesticides and fertilizers will easily contaminate soil and water quality. Although the Water Resources Agency shall be responsible for management and conservation of reservoir watersheds and water conservation and protection, industrial upgrading and reduction of pollution sources need more concerns by relevant units. Government shall strengthen transverse cross-departmental communication and implement simultaneously multiple approaches such as industry guidance, land use, and sewage treatment in order to achieve maximal results with little efforts.
5. Formation and operation of water conservation volunteer teams need to respect the willing of community organizations due to the nature of volunteer. However, both Guanshan Village and Dapu Township are quite large, and thus it is difficult to maintain a frequent patrol. Furthermore, patrol activities conducted in some areas are so difficult due to insufficient financial resources. Therefore, this research suggests that the authorities shall provide resources according to the actual needs of the community through programs in order to improve the

willing of the community to organize a volunteer team to protect the water resources and the environment.

6. Overall, the promotion of water resource conservation firstly needs to clarify the real needs of the community and to consider community features and local conditions in order to discuss with the community to develop programs which meet community needs for community development. The professional team shall analyze community issues, assist in providing professional advice, and be the community empowerment. The implementation of community development program shall be centered on the community and lengthen the timeline of promotion. Only cooperating with communities in the long term and developing the ability of self-organization, communication, coordination, integration of resources, and proposal of the community can really help the sustainable development of the community.

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Protecting Taiwan Source Water Quality Based on Local Community Participation

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Water Resources Agency, MOEA, R.O.C

Speaker : Leo, Y-P Lee

經濟部水利署
WATER RESOURCES AGENCY

經濟部

Outline

I. Preface

II. True value of mankind

III. Protecting Taiwan Source Water Quality

IV. Study area: Dapu Township

V. Conclusion

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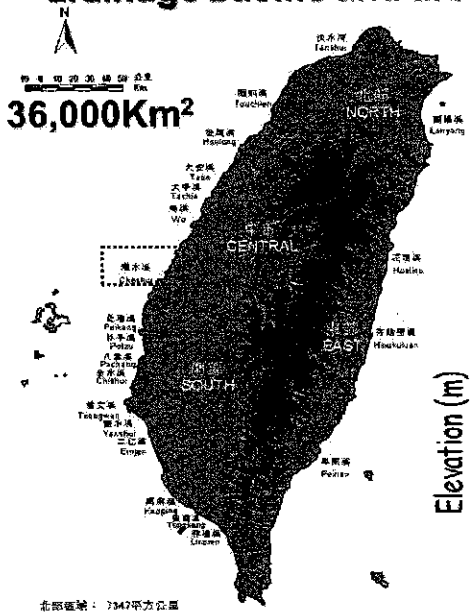
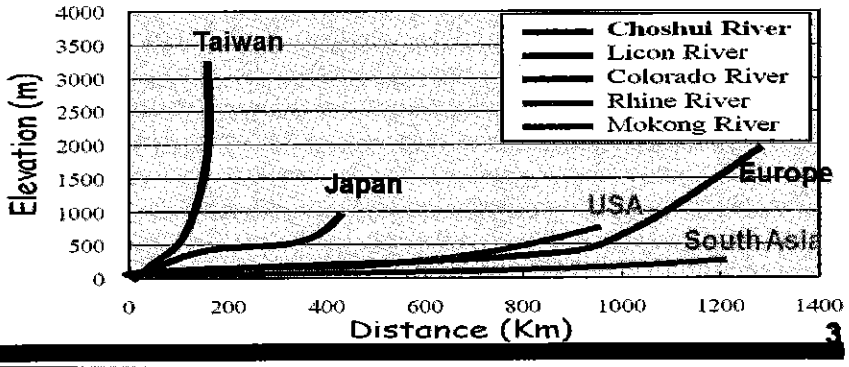
I. Preface

1.Topography

- **Taiwan is a mountainous island, the rivers are short with small drainage basins and are steep with rapid flows.**



Topography	Altitude (m)	Occupancy (%)
mountains	>1000	39
hills	100~1000	32
plains	<100	29



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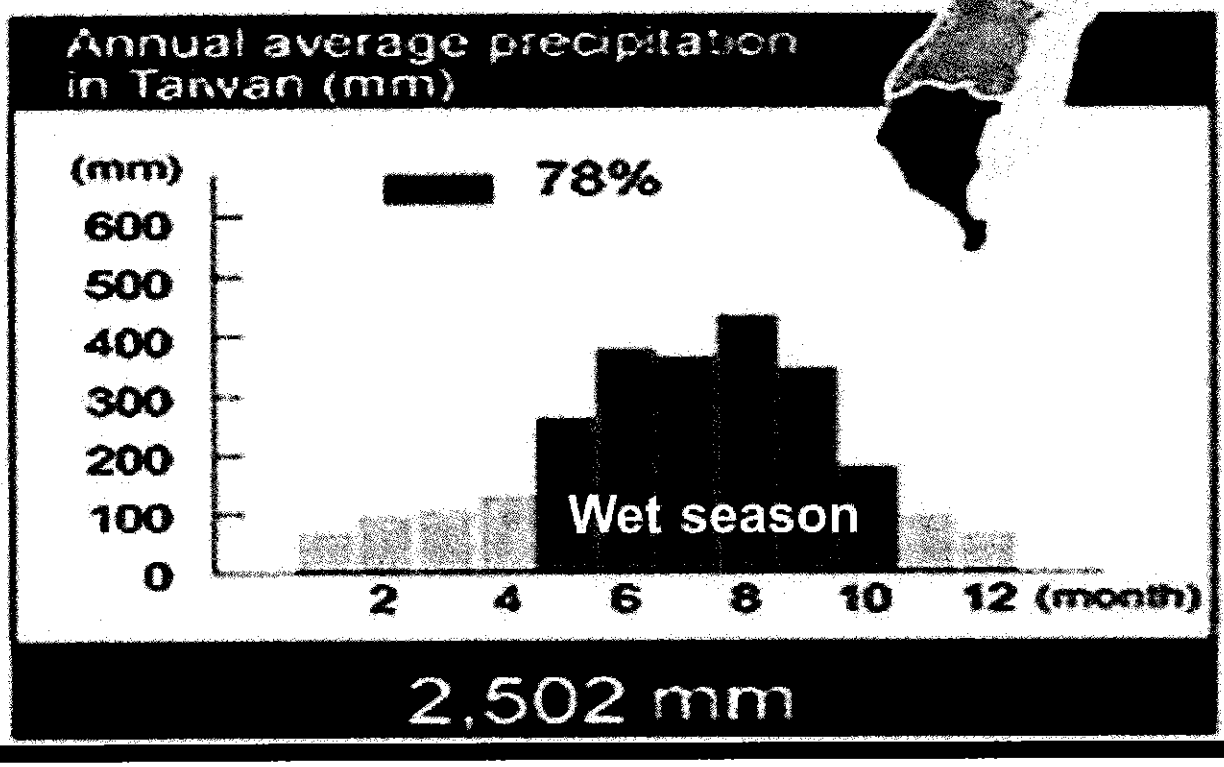
2. Precipitation:



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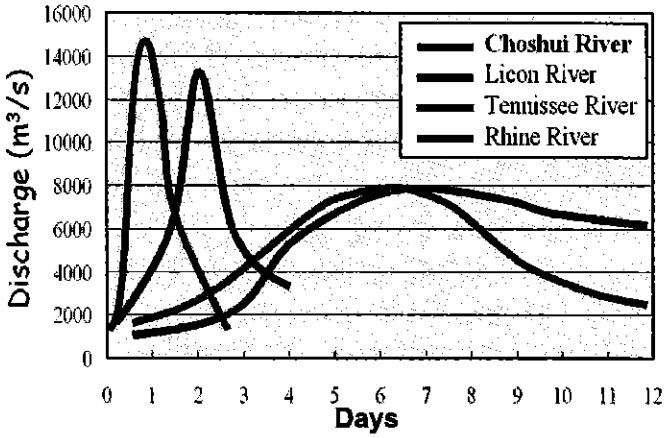
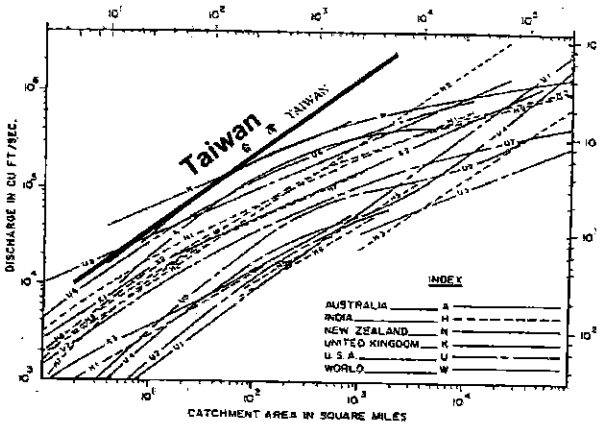
3.Floods:

1. **The duration of flood is very short , it only takes 10~30 hours to reach the peak flow.**
2. **The specific peak flow (peak flow per unit drainage area) reaches to 33 cms/Km^2.**





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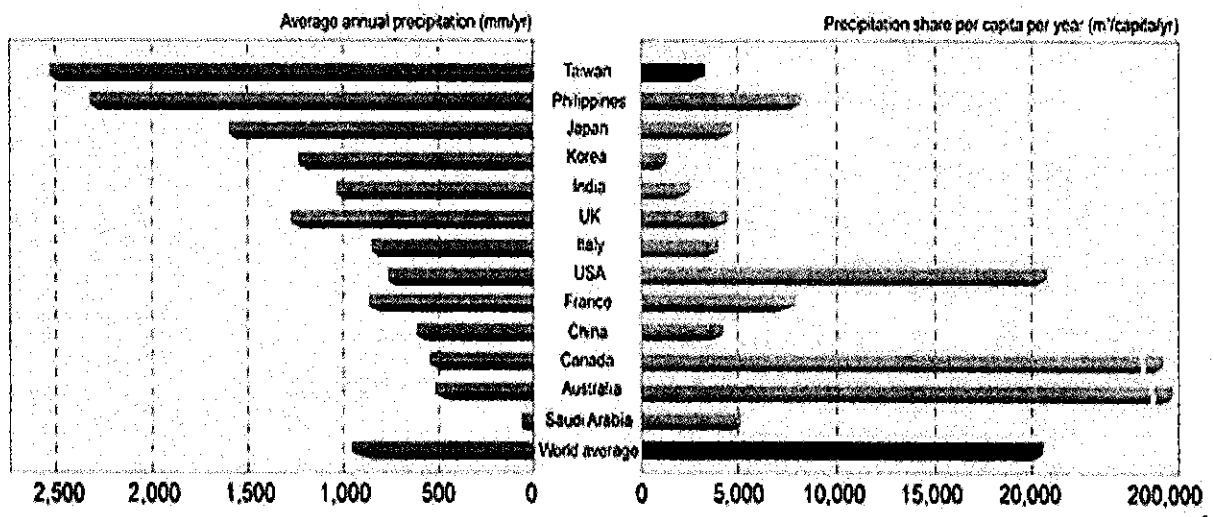
4. Precipitation share per captia:

1. **The precipitation in Taiwan is 2.5 times to the world average.**
2. **The Precipitation share per captia is 0.2 times to the world average.**
3. **Taiwan is a water shortage area.**



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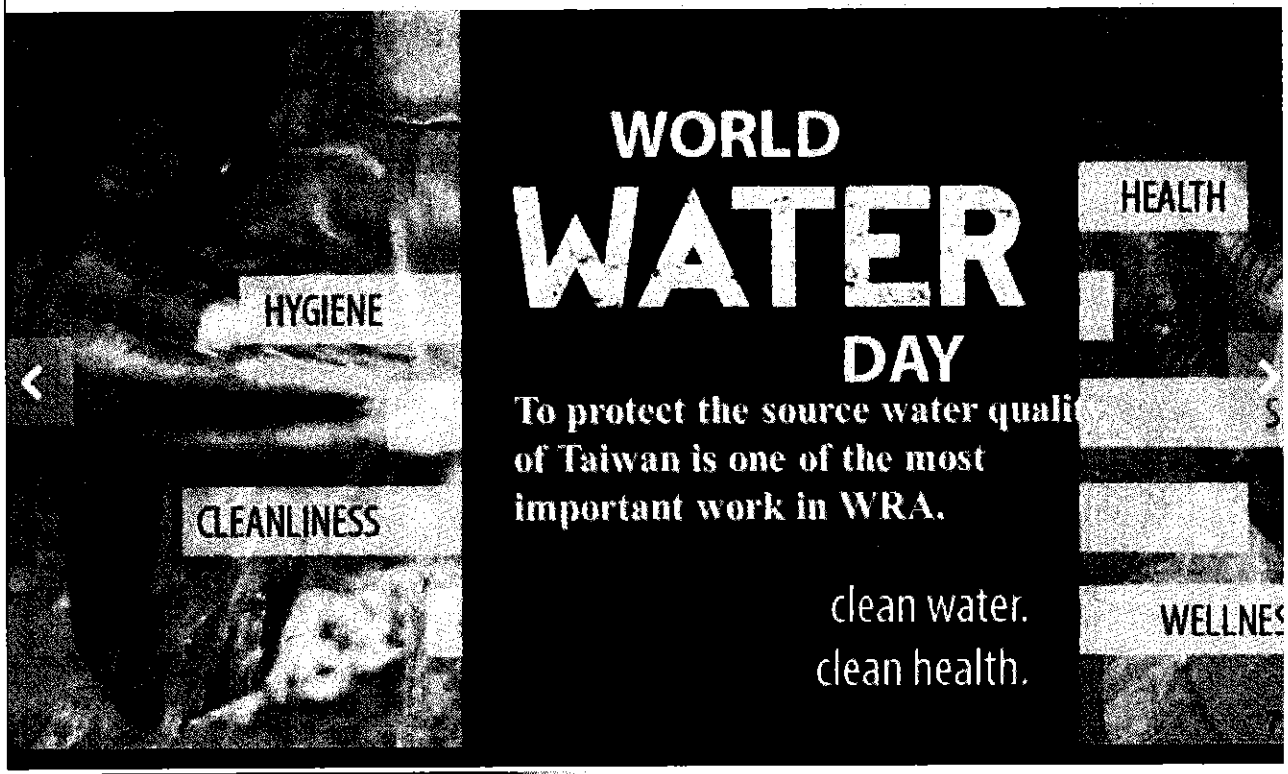
II. True value of mankind



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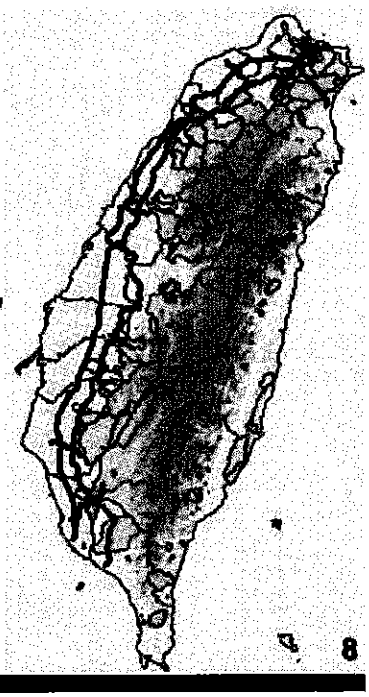
III. Protecting Taiwan Source Water Quality

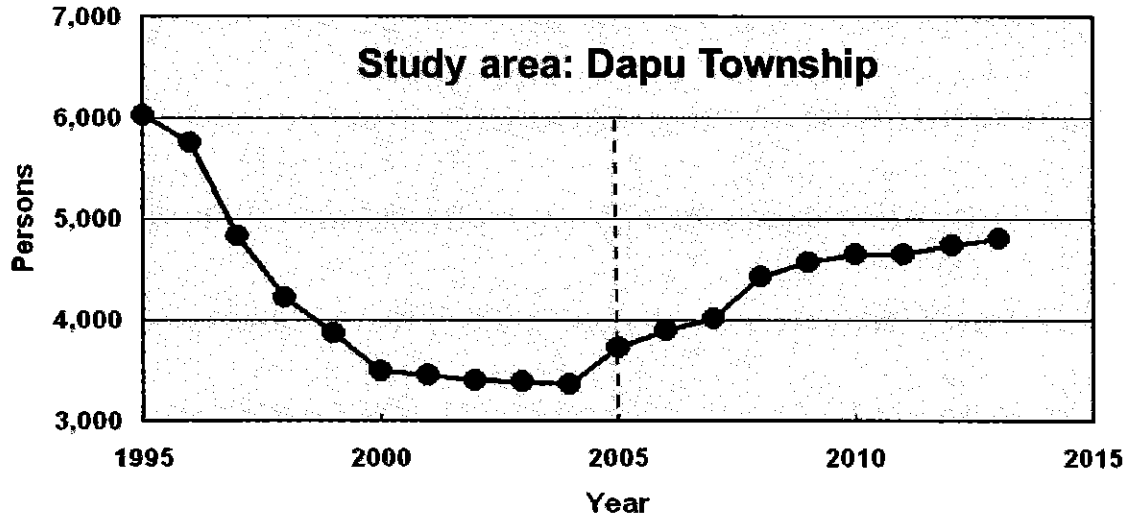
1.To delimited and announced "Protection Area of Water Quality" :

- **In order to ensure water conservation and good water quality and volume for people's health, we delimited and announced "Protection Area of Water Quality" to prohibit or restrict behaviors that may deteriorate the water quality.**
- **Up to 2013, delimited areas reached a total of 113, with an area of 8,972 Km^2, that is 25 % of Taiwan's territory.**
- **Relevant government agencies supervise the development and land use activities based on laws and regulations in those areas.**



2. Induced Problems:

- The restrictions of the development and land use activities will induced their economic loss, the young people who lived in the delimited areas will move away their hometown.
- People appeals from the public of compensation due to the above-mentioned restrictions.



3. The way to solve problems:

(1)We invited the stakeholders in study areas with an aim for seeking solutions to problems of local production, life and ecology and keep to guide the mission in order to establish an excellent mechanism for public participation.

(2)To create a public participation mechanism to establish the partnership between government officials and residents in conservation areas.

(3)To collect water resources conservation and compensation fee for providing economic incentives for residents in conservation areas.

(i) Conform to "Principles of the relief, subsidy and compensation for restricted development areas" and fulfill the spirit of the "beneficiaries pay, restricted people get compensation".

(ii) The subsidy is exclusively used for water resources conservation, environmental and ecological conservation infrastructure, public welfare of residents, and compensation for economic loss due to restrictions conservation areas.

(4)In addition to disclosure of the use of the funds through websites or government publications, this study organized several participation observation and study group discussions through community building, workshops, seminars and related activities to enable stakeholders such as community residents, environmental groups, resource users, local governments, research institutions or related industries to understand the use of the funds by means of public participation which will benefit the future effort for water resource conservation.

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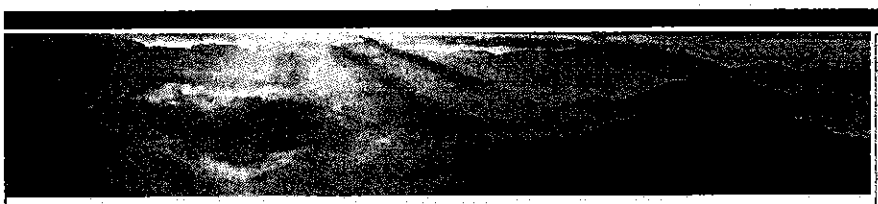


IV. Study area: Dapu Township

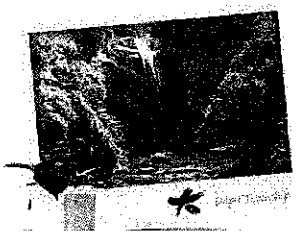
Areas: 173km²

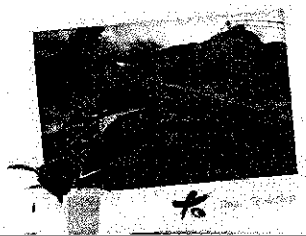
agricultural region: 5.2%

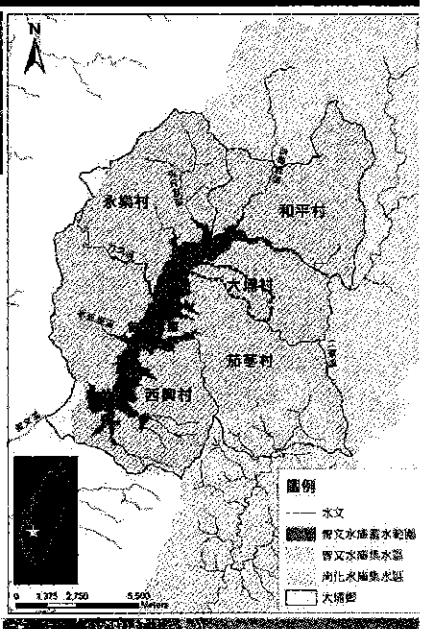
forest region: above 90%

Residents: 4,619 (up to 2014)

Agricultural produce:







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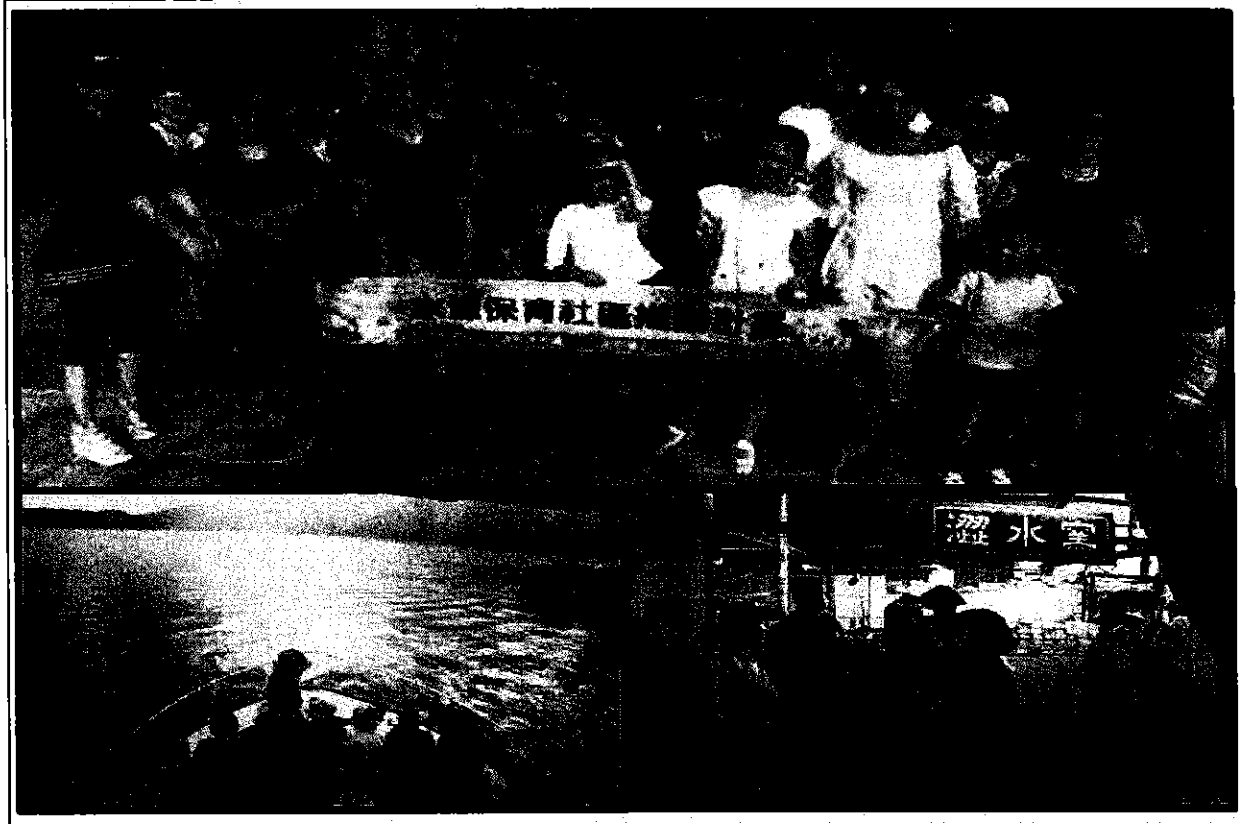

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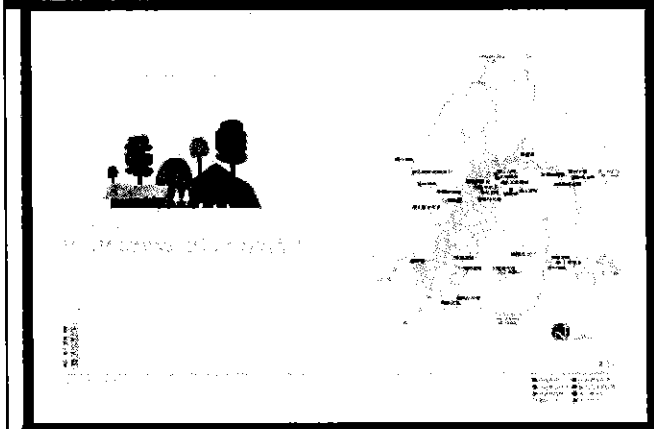

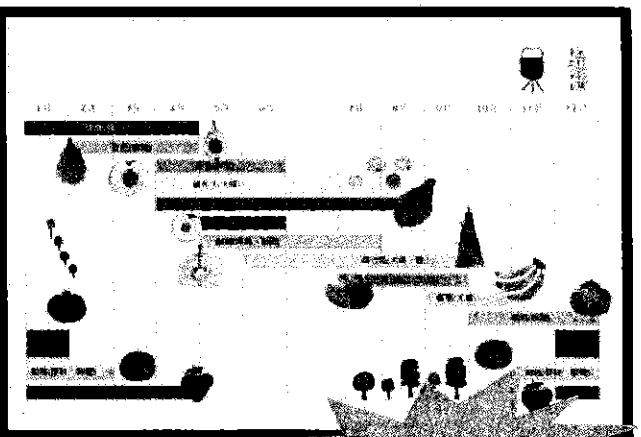

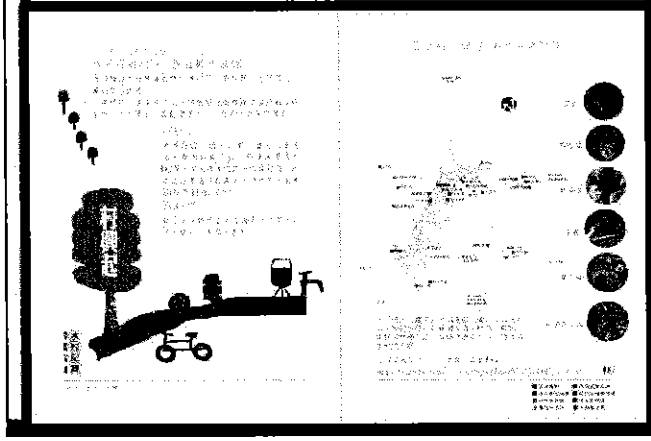

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V. Conclusions

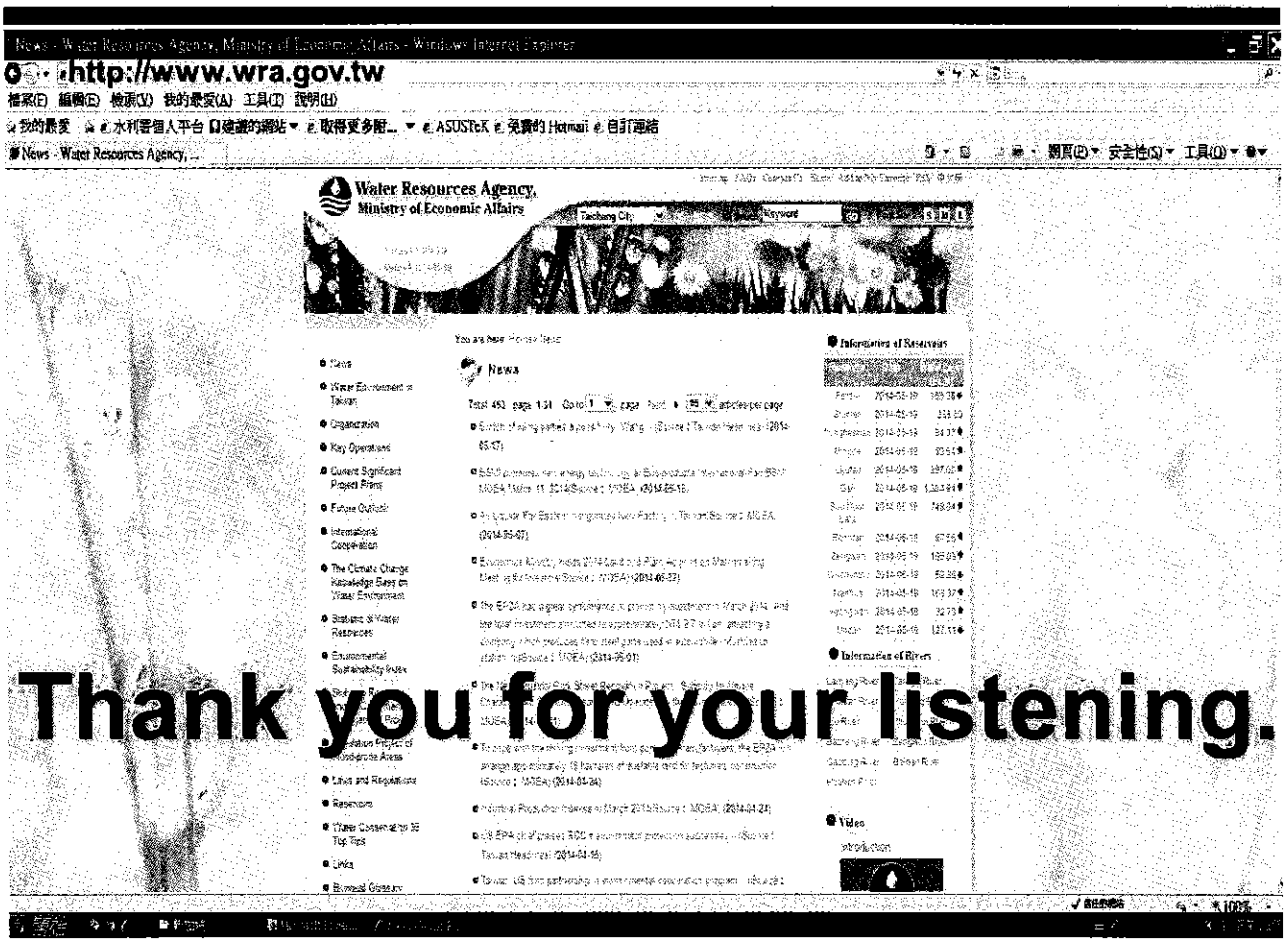
1. In order to encourage communities to actively participate in water resource conservation, WRA has been adopting both "command-and-control approach", such as regulations and executive orders, and "economic approach", such as incentives and counseling, to make sustainability policies more effective to be put into practice.

2. With rich experience of community building for past decades, WRA also helps those communities in protection areas to drive the development of "economy, life and ecology"; meanwhile, they can enhance the water conservation.

3. Experience sharing:

(1) The promotion of water resource conservation firstly needs to clarify the real needs of the community and to consider their features and local conditions to develop programs which meet their needs and developments.

(2) The implementation of community development program shall be centered on the community and lengthen the timeline of promotion. Only cooperating with communities in the long term and developing the ability of self-organization, communication, coordination, integration of resources, and proposal of the community can really help the sustainable development of the community.



附錄二、Promotion of Wastewater Reclamation/Reuse in Taiwan

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Abstract

Development of traditional water source in Taiwan has become more difficult than ever due the strong public concerns. Seeking alternatives like reclaiming wastewater and promoting water reuse seems feasible and costs less than seawater desalination. Water resource extracted from wastewater reclamation/reuse is termed as "reclaimed water" in Taiwan. In 2011, Water Resource Agency (WRA), Ministry of Economic Affairs (MOEA), Taiwan has set a target to elevate the usage of reclaimed water in Taiwan to 1.2 million cubic meters per day (CMD), roughly 10% of the supply from the all water treatment plants in Taiwan, or 3% of the total water consumption in Taiwan. In Ministry of Economic Affairs, "Task Force of Wastewater Reclamation Promotion" is founded to have a "top-down" promotion of using reclaimed water. A technical support project is established as well to have systematic investigation using the questionnaires and on-site visits, to figure out the trend of using reclaimed water and the amount growth. The project also intends to provide technology service to improve the water efficiency of the heavy users, including the industries, domestic users and wastewater treatment plants. Until the end of 2012, the total usage of reclaimed water in Taiwan is 152,062 CMD, including 119,659 CMD from industrial users, 1,560 CMD from domestic users, 23,772 CMD from municipal wastewater treatment plants, and 7,071 CMD from industrial park wastewater treatment plants. It is still far away from the aforementioned target (1.2 million CMD). To further elevate the usage of reclaimed water, several important schemes of effluent reclamation from wastewater treatment plants are highlighted by Water Resource Agency. The promotion of wastewater reclamation and water reuse will find its own way in Taiwan that leads to success.

Keywords

Water deficiency; reclaimed water; Water Resource Agency; wastewater treatment plant

1. BACKGROUND

Climate change in the recent decades may lead to water crisis in Taiwan because of prosperous development of industrial sections. Meanwhile, development of traditional water source in Taiwan has become more difficult than ever due the strong public concerns. Reallocating the surplus water resource for agricultural irrigation of paddy fields to industries or domestic users raises another controversial issue, including the possible damage to the ecology and underground aquifer, and depriving the farmers of rights. The situation in Tainan (Southern Taiwan) is a typical case (Figure 1). Traditional water resource facilities like *Transbasin Diversion Tunnel* of Tsengwen Reservoir have been interrupted due to the strong opposition from the publics. However, in year 2031, if the construction of planned water resource facilities is not on schedule, the water deficiency in this region will grow up to 377,000 m^3 per day. This will largely damage the local economical activities.

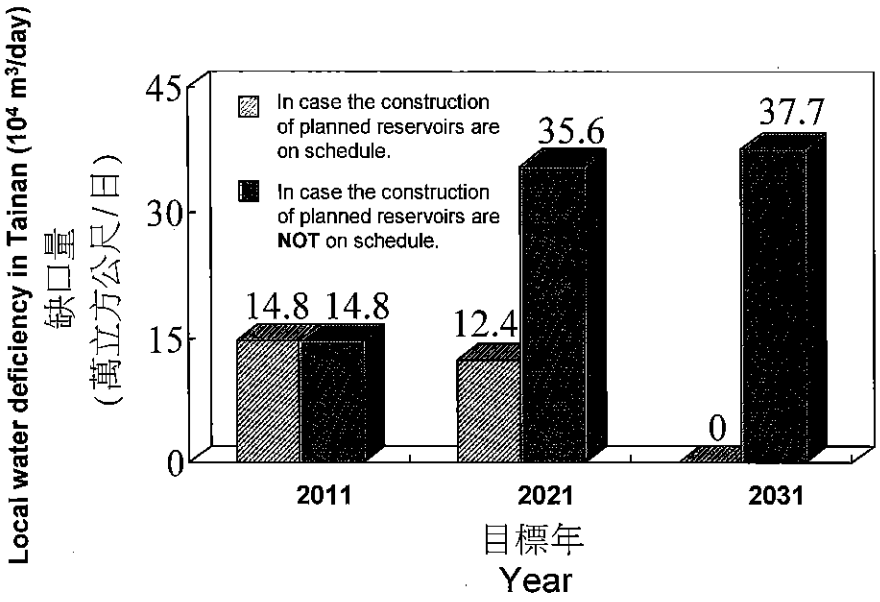


Figure 1 An example: Water deficiency in Tainan City (at Southern Taiwan)

2. THE DEFINITION OF RECLAIMED WATER

Seeking alternatives like reclaiming wastewater and promoting water reuse seems feasible. According to the successful experience in United States and Singapore, it costs less than seawater desalination, and the destruction of ecology is less significant, too. In this study, the water resource produced from wastewater reclamation and water reuse is termed as "reclaimed water". It becomes a potential alternative of water resource development in Taiwan.

In 2011, Water Resource Agency (WRA), Ministry of Economic Affairs (MOEA), Taiwan has

set a target to elevate the usage of reclaimed water in Taiwan to 1.2 million cubic meters per day (CMD), roughly 10% of the supply from the all water treatment plants in Taiwan, or 3% of the total water consumption in Taiwan (Figure 2). Reclaimed water here includes four portions:

(1) Reclaimed effluent of municipal wastewater treatment plants (WWTP) – reaching 700,000 CMD in year 2031;

(2) Reclaimed effluent of WWTP's of industrial parks – reaching 100,000 CMD in year 2031;

(3) Reclaimed wastewater of domestic users (like universities, museums and so on) – reaching 150,000 CMD in year 2031;

(4) Reclaimed wastewater of industrial users (like factories, harbours and so on) – reaching 250,000 CMD in year 2031.

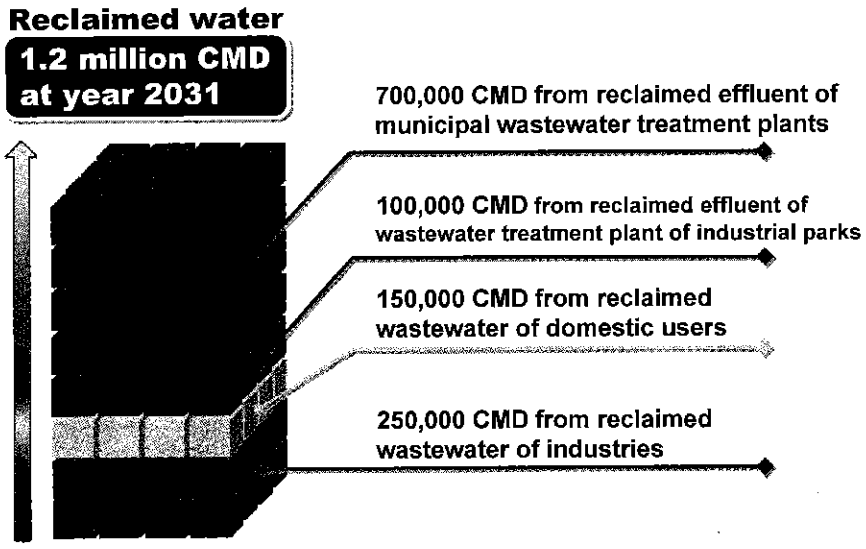


Figure 2 The Target of 1.2 million CMD Reclaimed water at 2031

In portions (1) and (2), effluent means the sewage or wastewater treated by primary and secondary treatment units, and complied with the "Effluent Standard" in Taiwan. Reclaimed effluents of WWTP's are typically those effluents further treated through a tertiary treatment, like sand filter, and then used in the plants for landscaping or machine cleaning. In a few cases, more advanced treatment like membranes may elevate the effluent quality to the level equivalent to the national standards (like Drinking Water Quality Standards in Taiwan). Portions (3) and (4) indicate the reclamation of wastewater generated from the manufacture processes in factories or the miscellaneous usage. Figure 3 depicts a more exact definition of reclaimed water of portions (3) and (4). It includes the wastewater streams that are first treated and then recycled. Those recycled streams without treatment, or the recirculated streams in cooling towers, are not counted in the reclaimed water of portions (3) and (4).

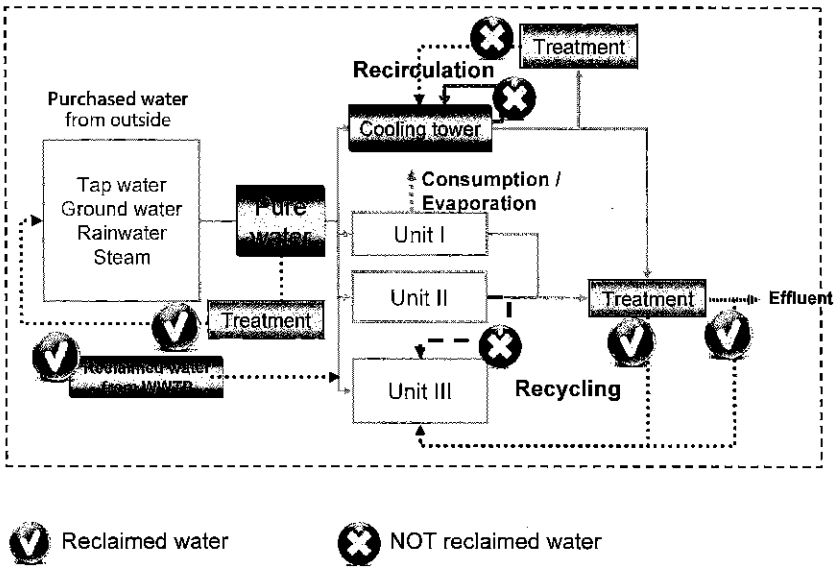


Figure 3 The definition of "reclaimed water" in Taiwan

3. CURRENT STATUS OF THE USAGE OF RECLAIMED WATER

To have more systematic statistics on the growth of reclaimed water, a survey has been conducted to collect the required information since March 2012. The information will be the reference for drafting the policies of water resource development. Using the questionnaire to investigate the water usage of large industries and domestic users, until October 2012, the total reclaimed water in Taiwan is 152,062 CMD, including 119,659 CMD from industrial users, 1,560 CMD from domestic users, 23,772 CMD from municipal WWTP's, and 7,071 CMD from industrial park WWTP's (Figure 4). It is still far away from the aforementioned target (1.2 million CMD)[1].

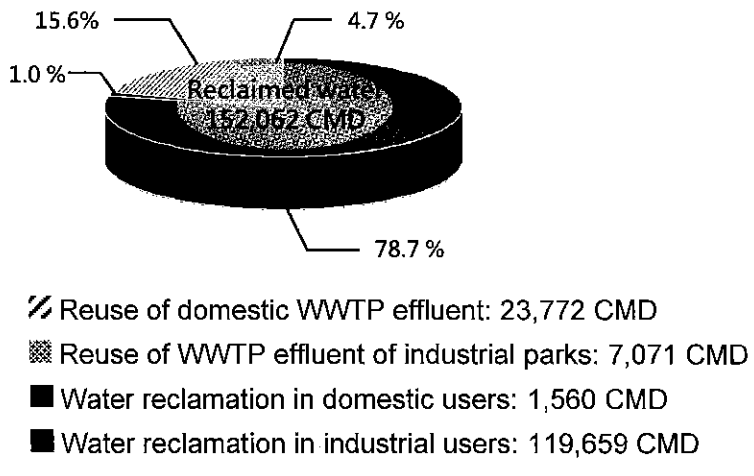
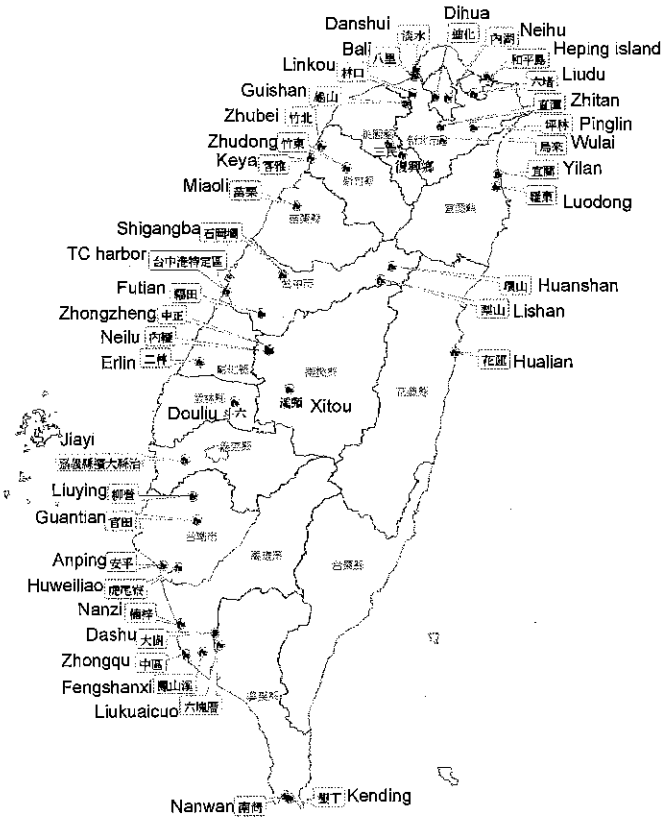


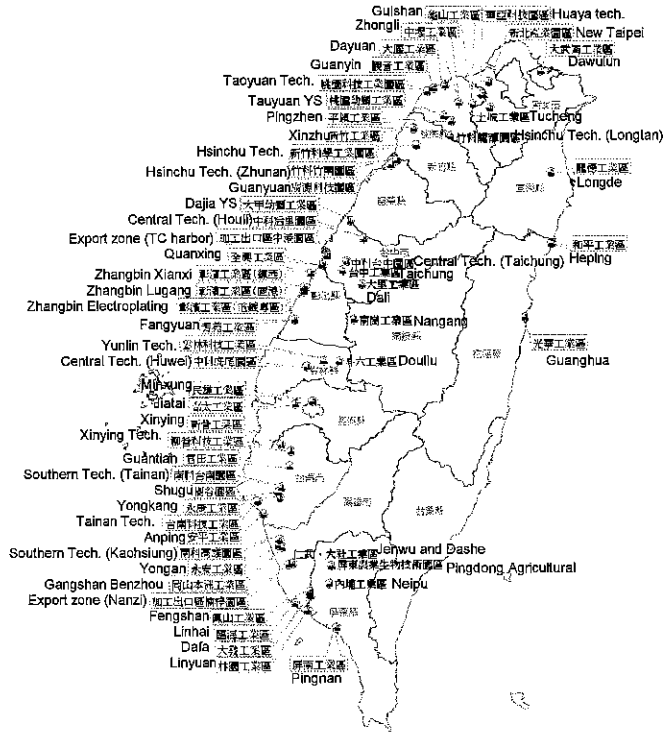
Figure 4 The amount of reclaimed water in Taiwan in 2012

Noticeably most reclaimed water is produced from the industrial users. They recycle their wastewaters or specific water streams from manufacture process. A variety of units are used in this reclamation, including chemical coagulation, activated carbon adsorption, ion exchange, and membrane filtration. The reclaimed water is generally redirected to the public water utility (PWU) for usage in the factories. For the domestic users, the reclaimed water is generally used for landscaping or toilet flushing. The units of reclamation are simpler than those in industries. The typical units are sand filter and chlorine disinfection.

We also conducted a survey in regard of WWTP's and their effluents, a source of reclaimed water. In 2012, the statistics shows that the total design capacity of 64 municipal WWTP's in service is 3.67 million CMD, while the treating effluent is 2.86 million CMD (78% of the design capacity). The plants with effluent reuse more than 1,000 CMD include Dihua (Taipei), Bali (Taipei), Taihu (Jinmen), Fengshanxi (Kaohsiung), Douliu (Yunlin) and Dashu (Kaohsiung). The sum of water reuse is 23,772 CMD (Figure 5a). For the 55 industrial park WWTP's in service, the total design capacity is 1.22 million CMD, while the treating effluent is 672,000 CMD (Figure 5b). The effluent reuse for the 55 plants is 7,071 CMD. Most WWTP's of industrial parks reclaimed their effluents using sand filter and disinfection for the miscellaneous usage in the plants. For example, Zhongli industrial park WWTP recycled its effluent for 1,500 CMD for washing and foam suppressing. One of the significant cases is the effluent reclamation plant in Nanzi export industrial park. Taking the mixed industrial wastewater as the source, this plant produces 1,800 CMD using fibre filter, ultrafiltration (UF) and reverse osmosis (RO) for supplying the industries in the park. The reclaimed water is then supplied to the semiconductor factories for the manufacturing (Figure 6 and Figure 7).

An analysis on the current quality of effluent of municipal WWTP's showed that the major pollutants that may interfere the reuse the microorganisms and nitrogen. It may cause serious biofilm growth and clog the reclamation units. It also causes unexpected risk for the users. Disinfection units like ultraviolet (UV) and denitrification biological units like membrane bioreactor (MBR) can be applied to remove the pollutants [2]. For WWTP's of industrial parks, the main barrier is the conductivity, heavy metals, colloids and dissolved organics. The conductivity generally ranges from 2,000 μS/cm to 9,000 μS/cm, nearly 10 to 45 times higher than the tap water. Ultrafiltration (UF) followed by reverse osmosis (RO) are generally adopted to remove these pollutants [3, 4].





(a) (b)

Figure 5 The wastewater treatment plants in service (a) Domestic WWTP's; (b) WWTP's of industrial parks

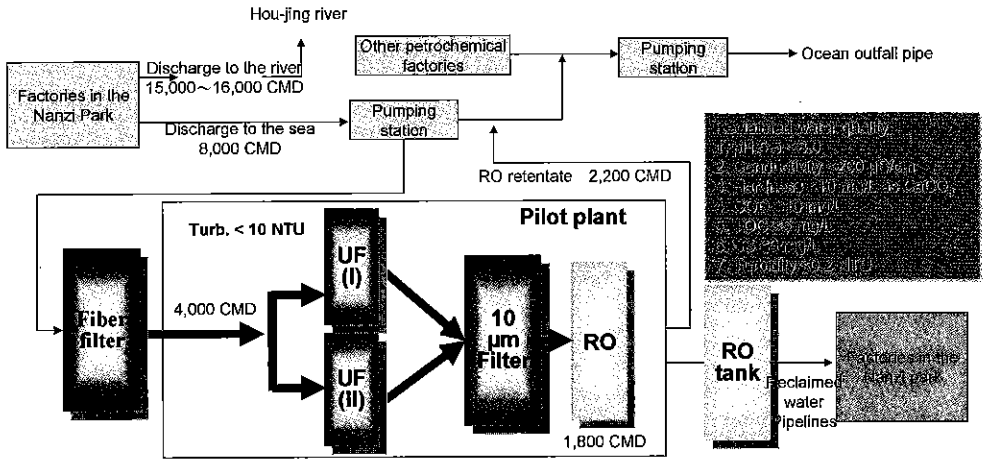


Figure 6 Effluent reclamation plant of Nanzi export industrial park: the process

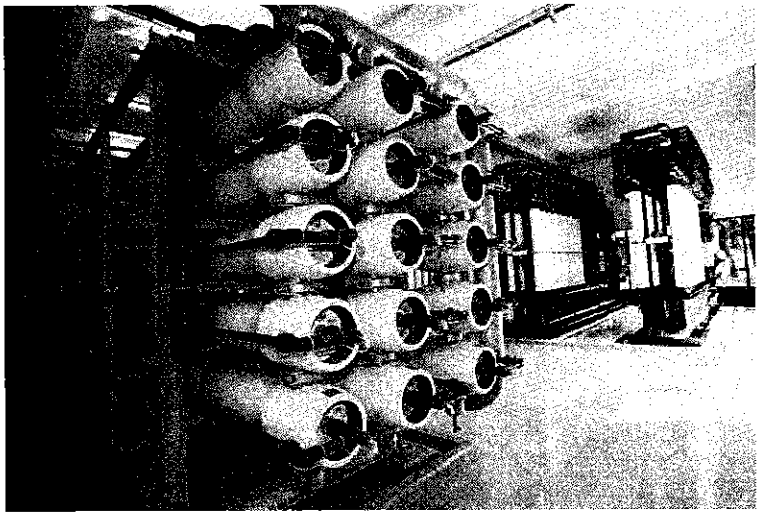


Figure 7 Effluent reclamation plant of Nanzi export industrial park: the UF and RO modules

4. IMPORTANT SCHEMES OF EFFLUENT RECLAMATION UNDER PLANNING

In the near future, several large WWTP effluent reclamation projects have gradually been commenced, mainly to compensate the water scarcity in western Taiwan, especially the enormous requirement from large factories. The forthcoming effluent reclamation projects include (1) Zhongli municipal WWTP for supplying the Guanyin and Taoyuan technology industrial park (Taoyuan); (2) Fengyuan municipal WWTP for supplying the Central Science and Technology Industrial Park (Taichung); (3) Futian municipal WWTP for supplying the Taichung Harbour Industrial Park (Taichung) [5]; (4) Yongkang and Anping municipal WWTP

for supplying the Southern Science and Technology Industrial Park (Tainan); (5) Fengshanxi municipal WWTP for supplying Linhai Industrial Park (Kaohsiung); (6) Zhanghua Coastal Industrial WWTP to supply the factories in the park (Zhanghua); (7) Southern Science and Technology Industrial Park to supply the factories in the park (Tainan) (Figure 8). In the aspect of industrial WWTP's, it includes the cases like Hsinchu Science and Technology Industrial Park and Erlin park of Central Science and Technology Industrial Park. These projects will provide reclaimed water with the same quality to the tap water to the industrial users, and largely decreases the loading of regional tap water supply. As generally suggested in literatures [6], the reclaimed water of the aforementioned projects will be produced from UF-RO or membrane bioreactor (MBR)-RO process. The cost of reclaimed water typically ranges from 0.4 to 0.6 US dollar per cubic meter, which is higher than the city water tariff (0.3 US dollar per cubic meter). Although the cost is higher, the industrial users are now looking for "water insurance" to lower the risk in drought seasons by using more reclaimed water for manufacturing. An emerging market of wastewater reuse is gradually formed in Taiwan.

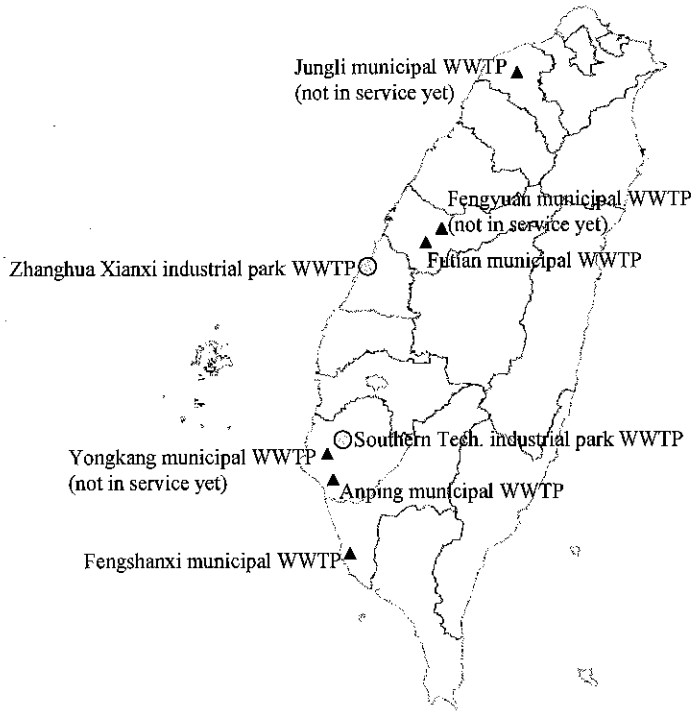


Figure 8 The forthcoming effluent reclamation projects in Taiwan

5. THE RELEVANT POLICIES TO PROMOTE THE USAGE OF RECLAIMED WATER

For integration's sake, "the Task Force of Wastewater Reclamation Promotion" was established in Ministry of Economic Affairs to have a "top-down" promotion of using reclaimed water. Meanwhile a service corps was set up to have systematic investigation of the growth of reclaimed water usage, as well as to provide technical supports to improve the

water efficiency and energy efficiency of heavy users, including the industries, domestic users and wastewater treatment plants. There are several major barriers for promoting reclaimed water:

(1) In Taiwan, due to the low tap water tariff (NT$ 11/m^3, or 30 US cents/m^3), the reclaimed water is basically more expensive than the tap water. It decreases the intention of the industrial users to apply reclaimed water immediately.
(2) According to the strict law of hygiene and public health, an independent pipeline is always necessary because the reclaimed water cannot be mixed and pumped with the tap water, even the reclaimed water is purified using RO modules. The construction of this extra pipeline further increases the cost.
(3) Currently MOEA is the water resource authority. On the other hand, the local city and county governments own the municipal WWTP. There may always be controversial issues to argue which the optimal way is to use the effluent from WWTP.

MOEA is now amending the exist laws and going to legislate a brand new act: "Promotion Act of Reclaimed Water Resource". Until March 2013, the act is still under discussion and drafting. The primary idea is that in the regions with serious water deficiency, the local government should provide the effluent with no charge. When confirming the users that should use reclaimed water (usually the newly founded factories), MOEA may establish the effluent reclamation plant as well as the pipelines. The facilities are then transferred to local governments or private sections for further operation. The users pay the tariff to cover the capital investment and operation cost.

According to the inventory and investigation in this study, it is very common that the industrial users recycle their own wastewater, especially the semiconductor-related factories. Facilities like reverse osmosis and ultrafiltration are generally adopted to filtrate the impurities. In general the cost to recycle one ton of reclaimed water in the factories is higher than NT$ 30/m^3 (one US dollar per ton) [7]. Although the concept and cost are widely accepted by the industries, their willingness to apply the reclaimed water from the municipal WWTP's outside the factory is low. Apparently the cost is not the only factor. The major barrier is the lack of confidence of users, including the water quality and stability effluent from the municipal WWTP's. It takes more efforts to establish the tools and monitoring system that can be accepted by the industries, to ensure the quality of reclaimed water. Health risk assessment, on the other hand, is also a proper tool to persuade users that the safety of reclaimed water is acceptable.

6. CONCLUSIONS

Reclaimed water is an important alternative for replenishing the water scarcity. Until the end of 2012, the total reclaimed water in Taiwan is 152,062 CMD. It is still far away from the

preset policy target (1.2 million CMD). To effectively promote the water reuse and reclamation, in Ministry of Economic Affairs, "Task Force of Wastewater Reclamation Promotion" is founded to have a "top-down" promotion of using reclaimed water. A technical support project is established as well to have systematic investigation using the questionnaires and on-site visits, to figure out the trend of using reclaimed water and the amount growth. To further elevate the usage of reclaimed water, several important schemes of effluent reclamation from wastewater treatment are highlighted and promoted by Water Resource Agency. If successfully, these projects may supply reclaimed water with the same quality to the tap water to the industrial users, and largely decreases the loading of regional tap water supply. It also largely increases the usage of reclaimed water to more than 300,000 CMD. Although the high cost of reclaimed water in relative to natural source makes the promotion difficult. From the other angle, industrial users may look for "water insurance" to prevent the risk in drought seasons. A new market of effluent reclamation is now emerged in Taiwan.

7. REFERENCE

(1) WRA, The Inventory and Promotion of Wastewater Reclamation/Reuse Project. Water Resource Agency 2012, Taipei, Taiwan (in Chinese).

(2) C. P. Chu, C. M. Wu, Y. S. Wu, C. C. Lin, Y. J. Chung, Structural Analysis and Dewatering Characteristics of Waste Sludge from WWTP MBR. Separation Science and Technology 2007, 42, 3713.

(3) H. H. Chen, H. H. Yeh, S. Shiau, The Membrane Application on the Wastewater Reclamation and Reuse from the Effluent of Industrial WWTP in Northern Taiwan, Desalination 2005, 185 (1–3), 227.

(4) C. P. Chu, S. R. Jiao, J. M. Hung, C. J. Lu, Y. J. Chung, Reclamation of the Wastewater from the Industrial Park Using Hollow-Fiber and Spiral-Wound Membranes: 50-CMD Pilot Testing and Cost Evaluation, Environ. Technol. 2009, 30 (9), 871.

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(6) B. Durham, S. Rinck-Pfeiffer, D. Guendertc, Integrated Water Resource Management - through reuse and aquifer recharge. Desalination 2003, 152 (1-3), 333.

(7) C. P. Chu, S. R. Jiao, H. M. Lin, C. H. Yang, Y. J. Chung, Recycling the Wastewater of the Industrial Park in Northern Taiwan Using UF-RO system: In-Situ Pilot Testing and Cost Analysis, J. Water Supply Res. Technol. AQUA 2007, 56 (8), 533.

經濟部

Promotion of Wastewater Reclamation/Reuse in Taiwan

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Ministry of Economic Affairs, Taiwan

經濟部水利署
WATER RESOURCES AGENCY

June 4, 2014

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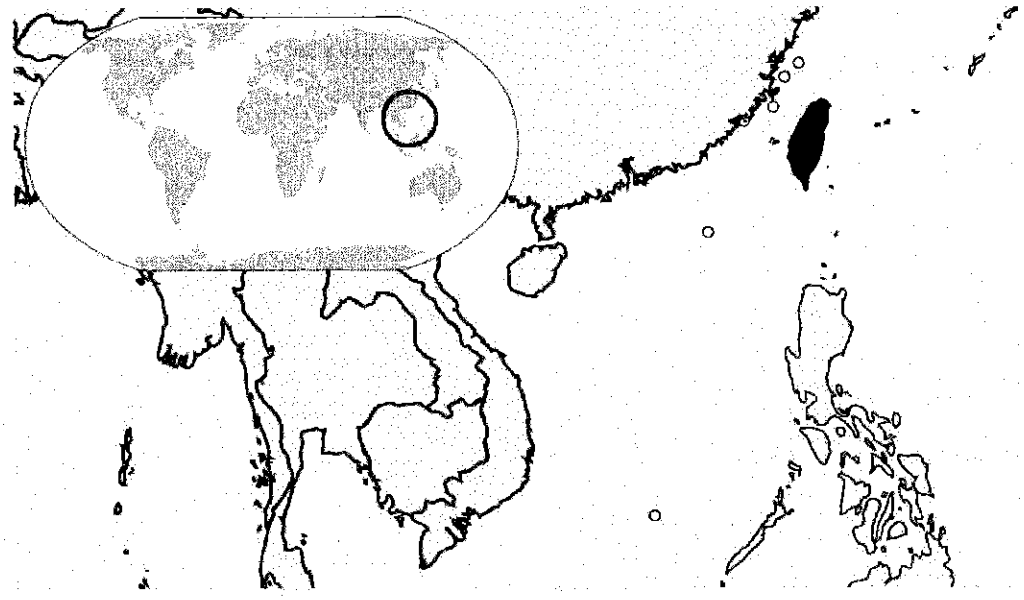
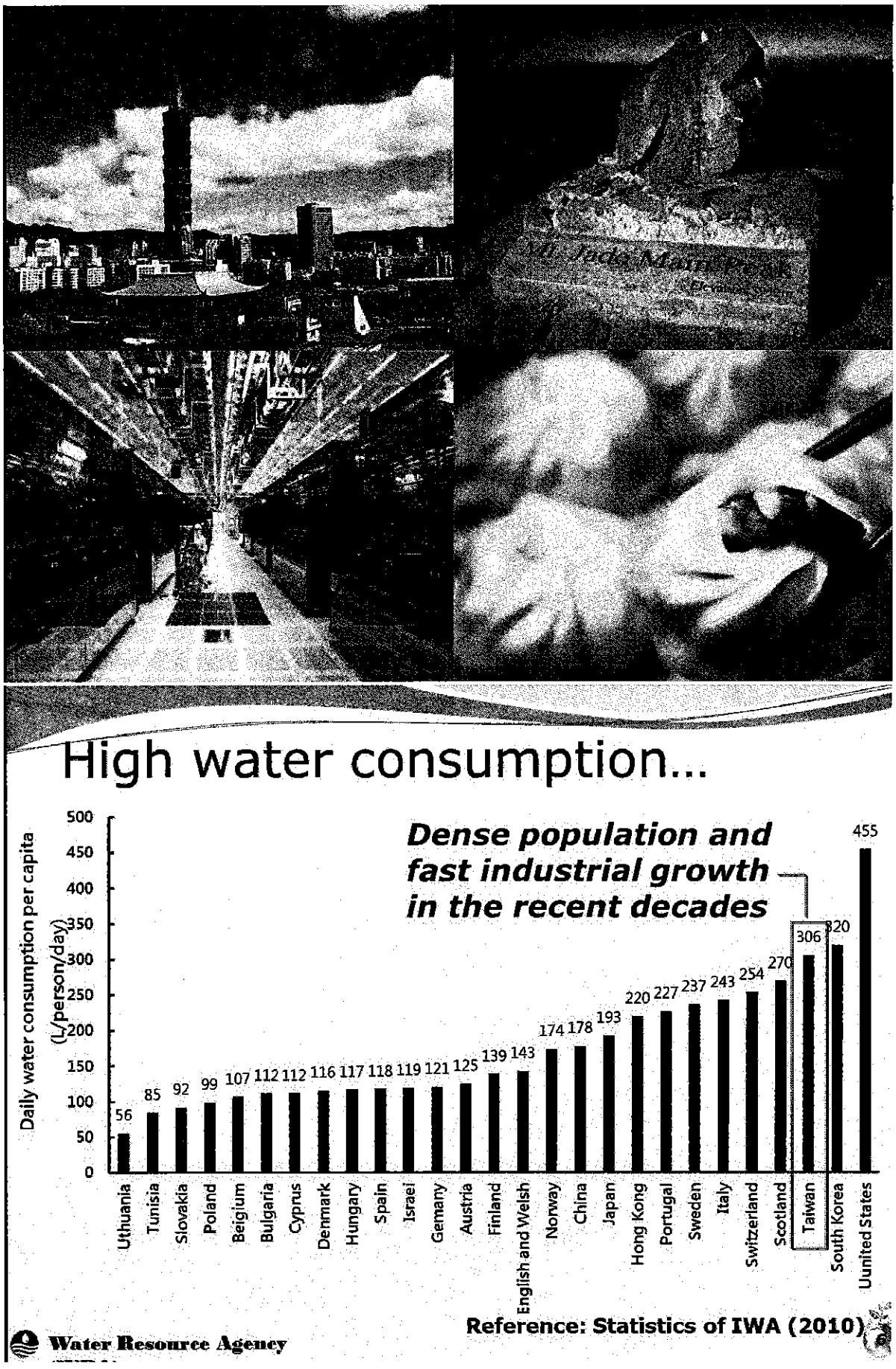
- Water Crisis in Taiwan
- The Policy Target of WRA
- Promoting the Effluent Reclamation of Wastewater Treatment Plants (WWTP)
- Summary

Water Crisis in Taiwan

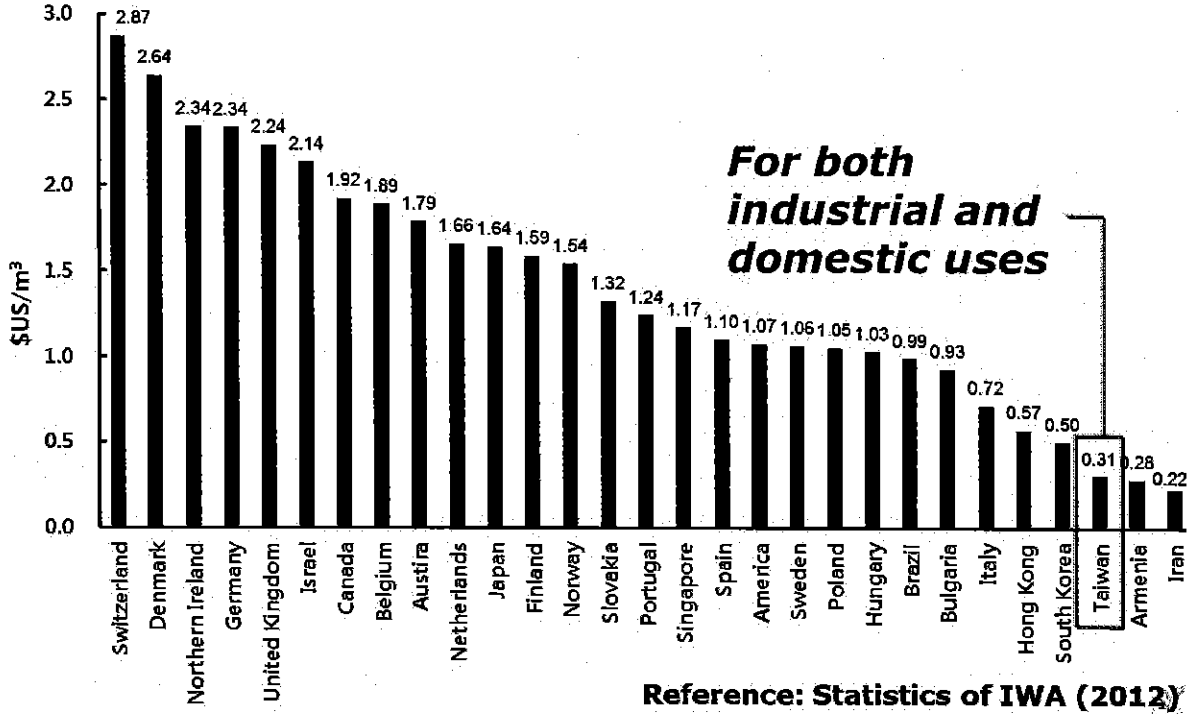
Taiwan: a rainy island in East Asia



Water Resource Agency


High water consumption...
Dense population and fast industrial growth in the recent decades
Daily water consumption per capita (L/person/day)
500
450
400
350
300
250
200
150
100
50
0
56
85
92
99
107
112
112
116
117
118
119
121
125
139
143
174
178
193
220
227
237
243
254
270
306
320
455
Uthuania
Tunisia
Slovakia
Poland
Beigium
Bulgaria
Cyprus
Denmark
Hungary
Spain
Israel
Gemany
Austria
Finland
English and Welsh
Norway
China
Japan
Hong Kong
Portugal
Sweden
Italy
Switzerland
Scotland
Taiwan
South Korea
Uunited States
Reference: Statistics of IWA (2010)
Water Resource Agency

But with relatively low water price!

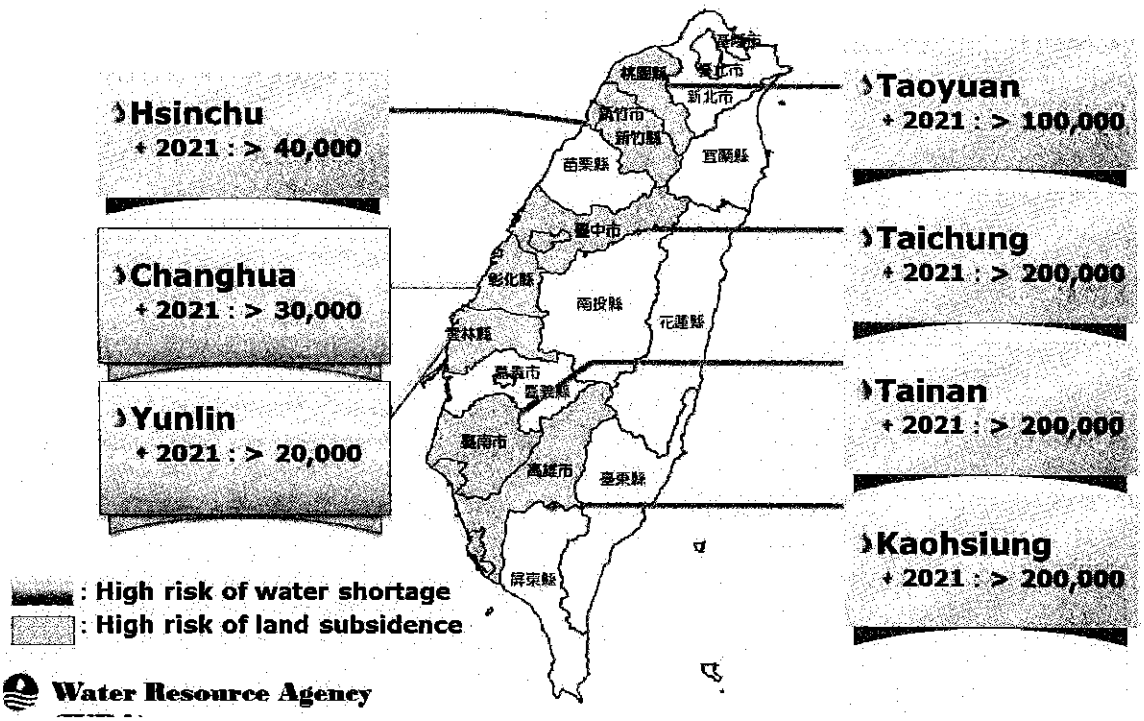


Reference: Statistics of IWA (2012)

Water Resource Agency

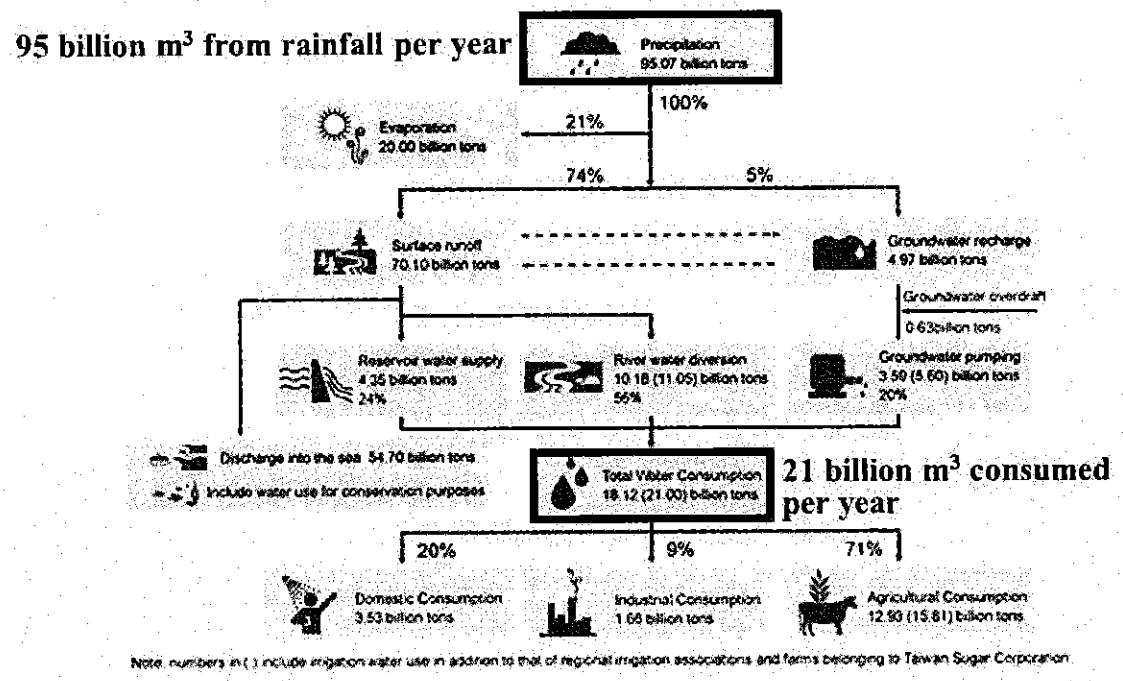
7 regions facing water shortage

Maximum Deficiency (CMD) = Demand - Supply



Water Resource Agency

Less than 22% of the rainfall can be utilized...

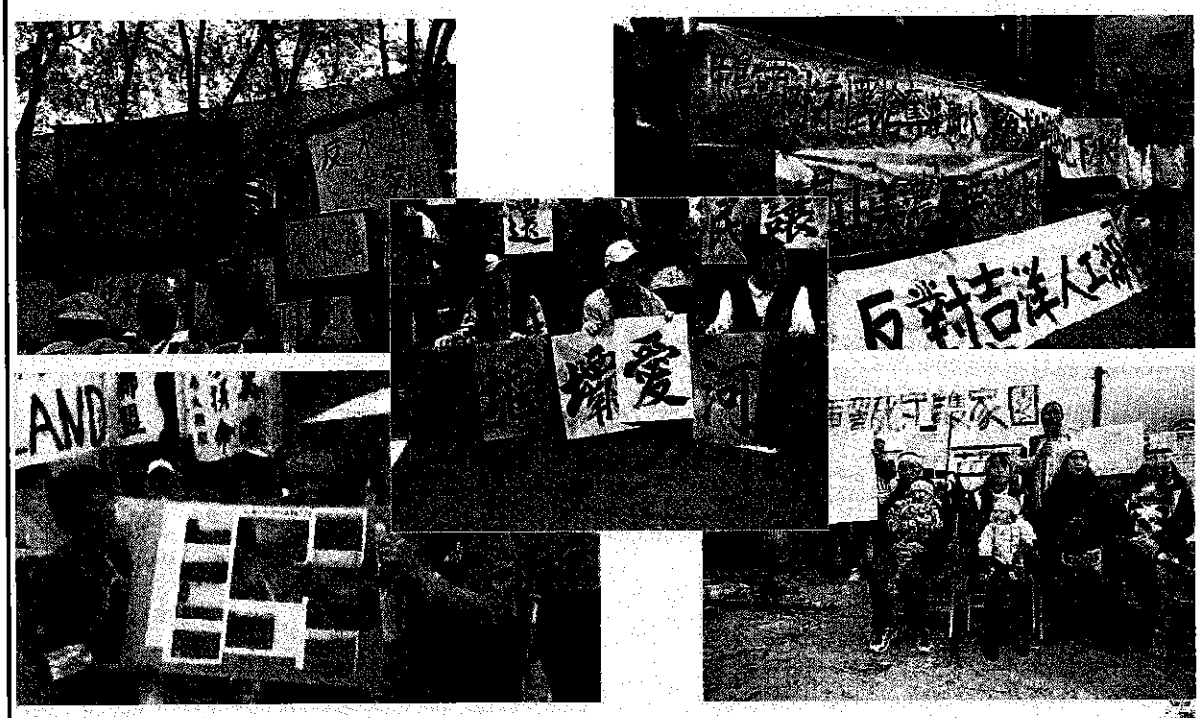


Utilization of Water Resources in Taiwan (Average Water Resources Utilization from 2000 to 2009)

Water Resource Agency

9

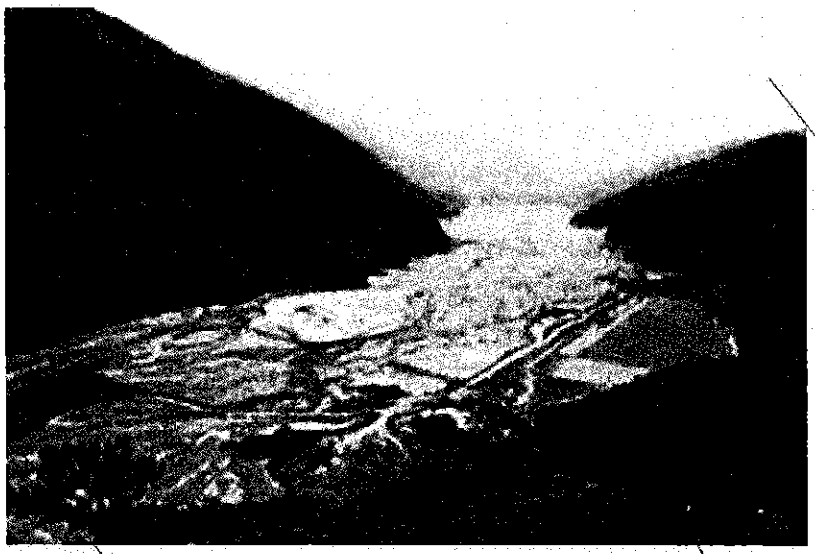
Building new reservoirs is difficult...



Water Resource Agency

10

Reservoir dredging is difficult too...

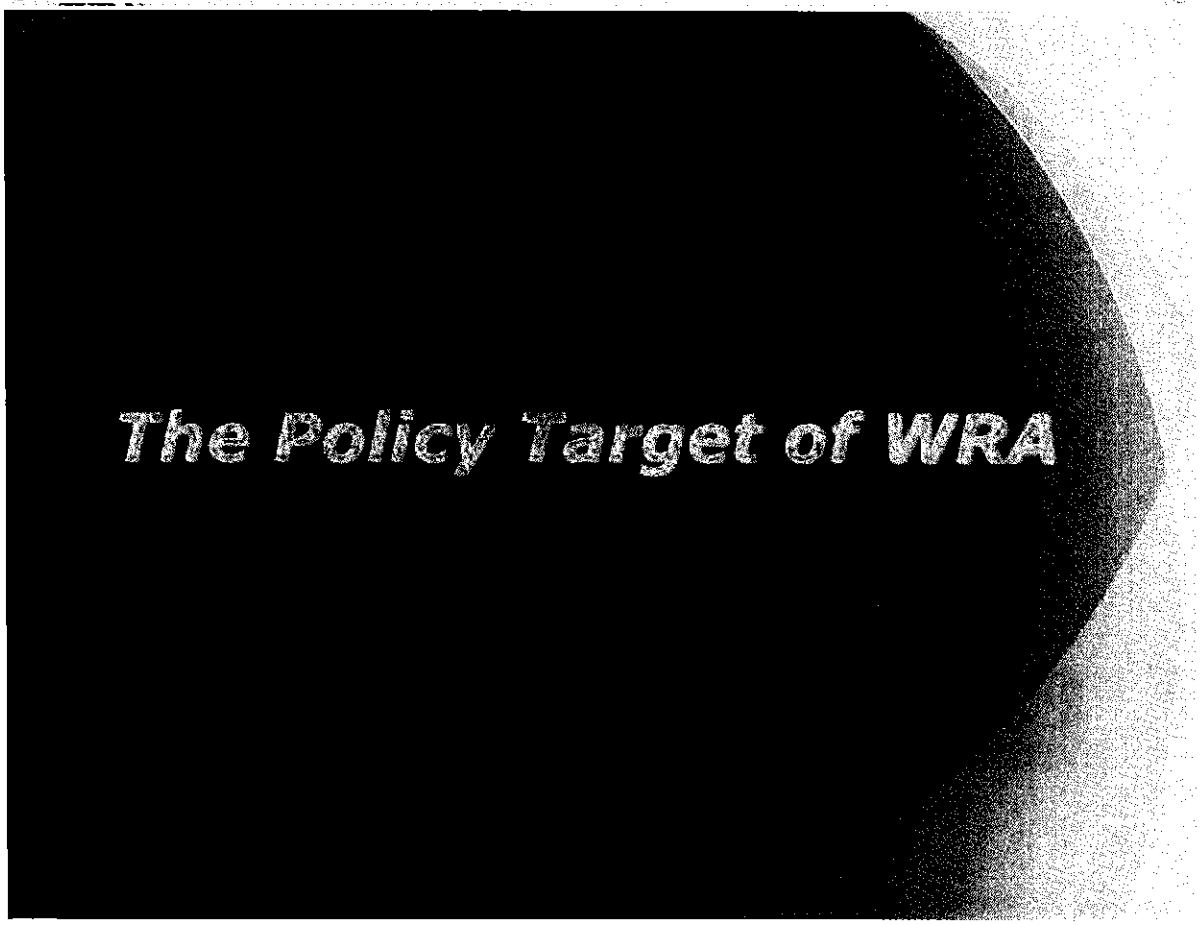


The volume of sediment brought by typhoon is tremendous and largely reduce the effective capacity of reservoirs (more than 10,000,000 m^3 in some extreme case).

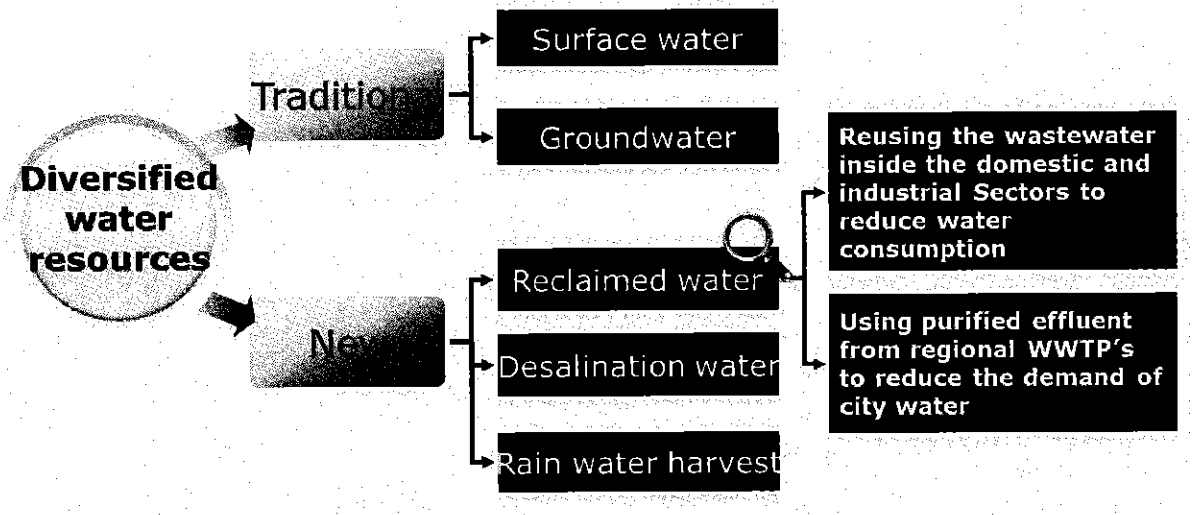
Most of the mechanically dredged clay has nowhere to go.

There is no hydraulic discharge / dredging design for those old reservoirs (before 1980s).

Water Resource Agency

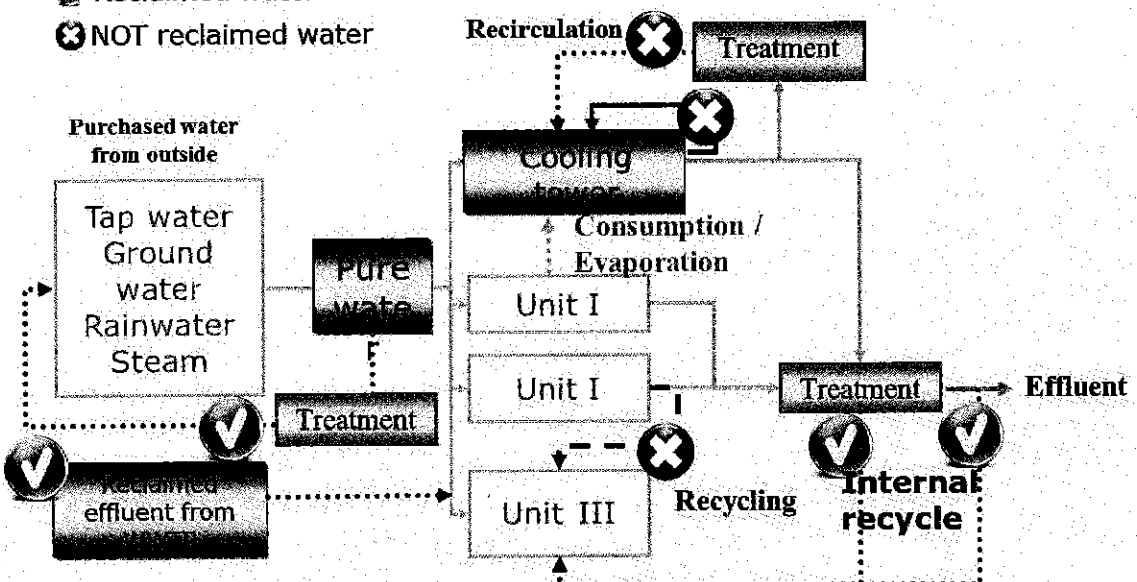


Water diversity



Definition of "Reclaimed Water"

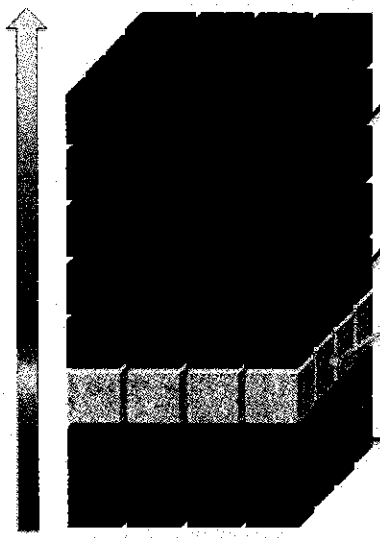
- Reclaimed water
- NOT reclaimed water



Goal of reclaimed water usage in Taiwan

Reclaimed water

1.2 million CMD at year 2031



700,000 CMD from reclaimed effluent of municipal wastewater treatment plants

100,000 CMD from reclaimed effluent of wastewater treatment plant of industrial parks

150,000 CMD from reclaimed wastewater of domestic users

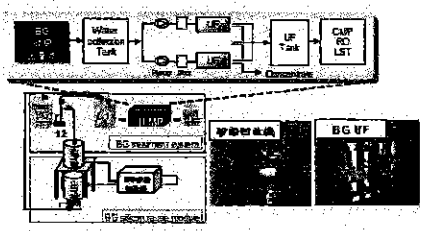
250,000 CMD from reclaimed wastewater of industries

- **Mainly to satisfy the demand of the industrial sector**
- **Roughly 10% of the city water supply in Taiwan**

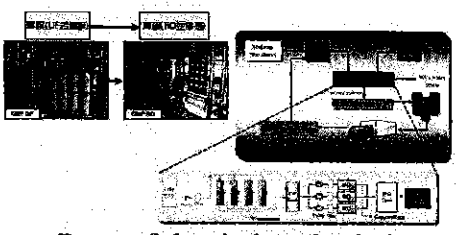
Water Resource Agency

Industrial water reuse

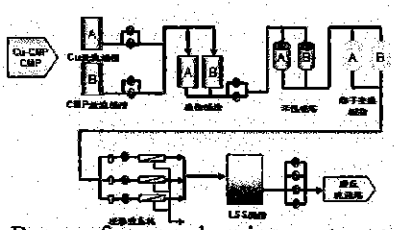
- Since the middle 1990s, due to the stringent request of water reuse efficiency by laws, at least 70% of the factories in Taiwan have installed a variety of wastewater recycling facilities.



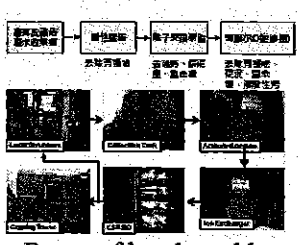
Reuse of silicon wafer backside grinding (BG) wastewater



Reuse of chemical mechanical polishing (CMP) wastewater



Reuse of copper-bearing wastewater



Reuse of local scrubber blowdown wastewater

Water Resource Agency

Industrial water reuse (Cont.)

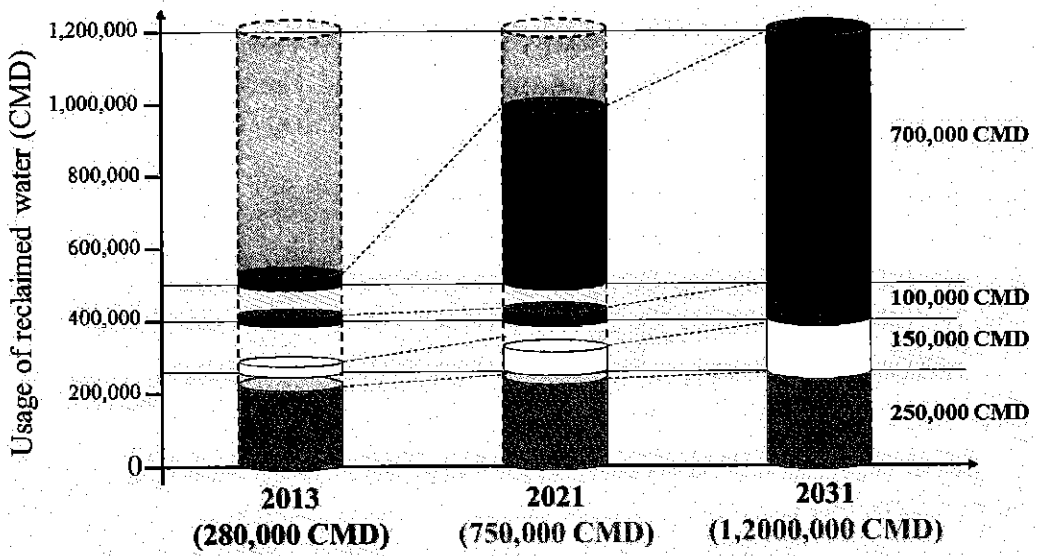
- Hsinchu Science Park

Foundation time of the factories	The reuse efficiency of the main manufacturing process	The reuse efficiency of the entire factory	The percentage of effluent discharge
Before 1994	> 50%	> 30%	< 80%
1994 ~ 1998	> 70%	> 50%	< 80%
After 1999	> 85%	> 70%	< 70%

Note: The requirement of every science park is different due to their promise in the environmental impact assessment (EIA).

Water Resource Agency

Distance between current status and the target



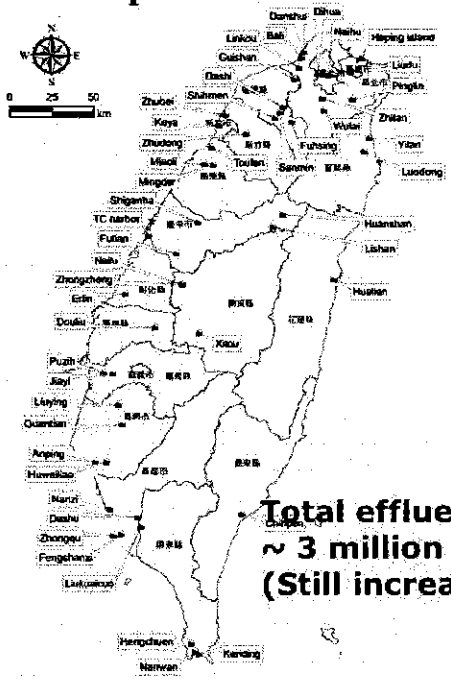
- Effluent reclamation from municipal WWTP: 23,772 CMD
- Effluent reclamation from WWTP of industrial parks: 7,071 CMD
- Wastewater reuse in domestic sector: 5,301 CMD
- Wastewater reuse in industrial sector: 245,351 CMD

Water Resource Agency

Promoting the Effluent Reclamation of Wastewater Treatment Plants (WWTP)

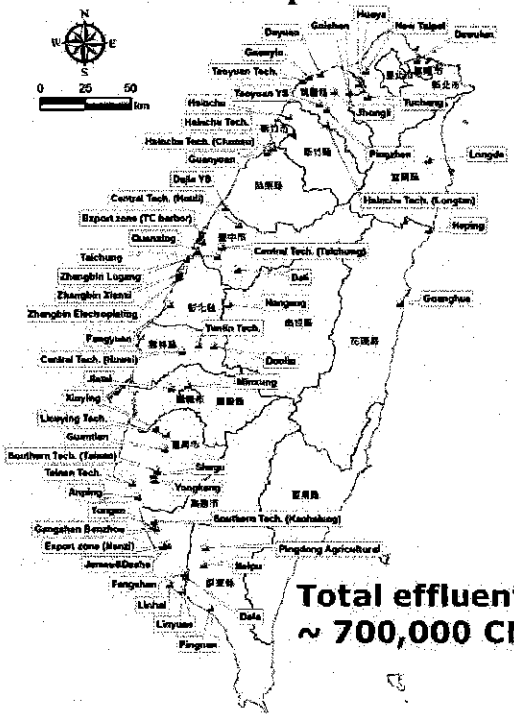
WWTPs currently in service at 2013

Municipal WWTP



Total effluent:
~ 3 million CMD
(Still increasing)

WWTP of industrial parks



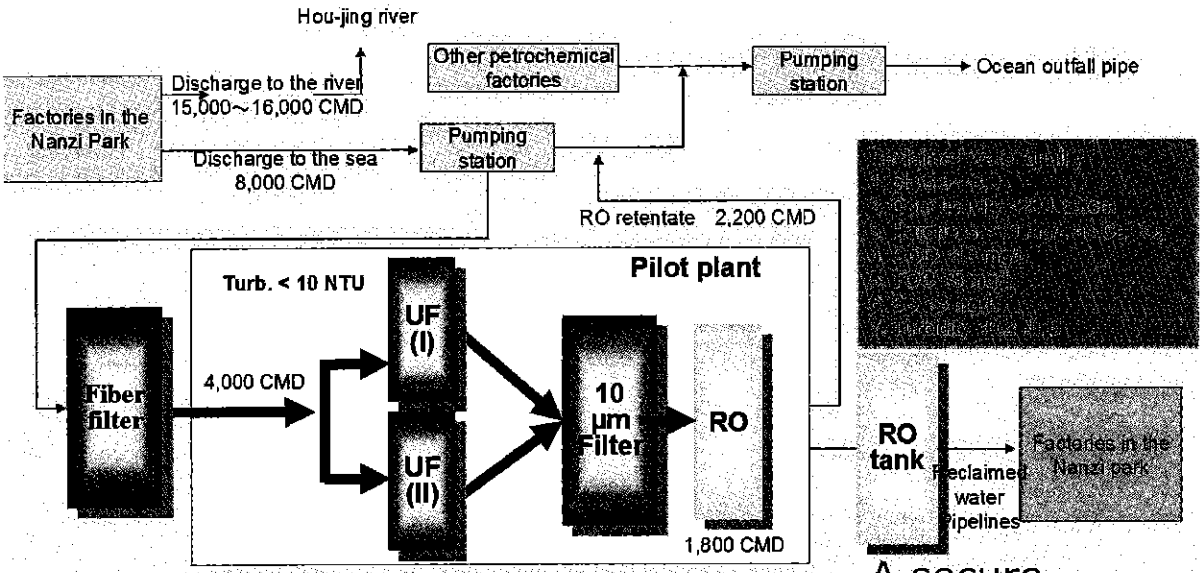
Total effluent:
~ 700,000 CMD

Water Resource Agency

The price is always a problem...

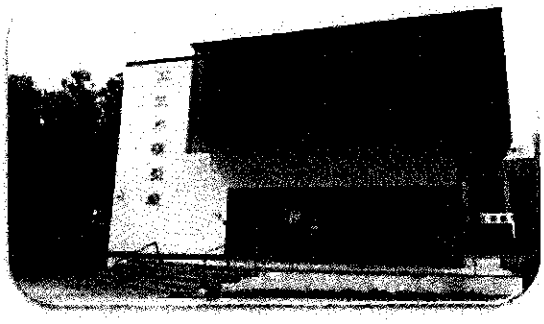
- The price of reclaimed water from WWTP effluent (using dual membrane technology) is roughly ***60~95 US cents*** per m^3, depending on the pipeline distance. It is apparently higher than the current tap water price (***30 US cents*** per m^3).
- The industries also concern about the stability of water quality, especially when using in manufacturing.
- To gradually increase the acceptance on using reclaimed water in the industrial sector, a series of ***demonstration projects*** have been launched by WRA.

The effluent reclamation plant in Nanzi park (since 2011)



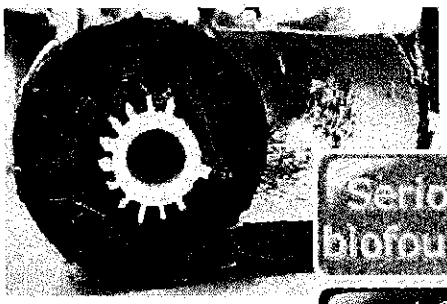
A secure insurance for water usage!

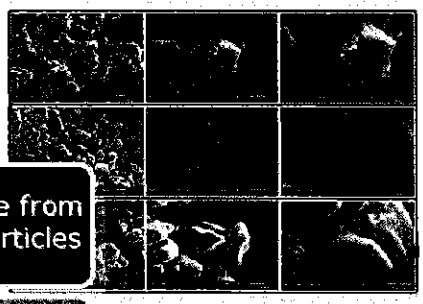
The effluent reclamation plant in Nanzi park (Cont.)



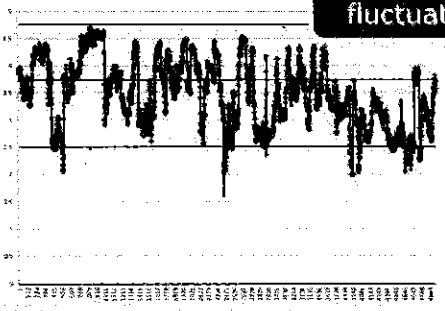

Water Resource Agency

The effluent reclamation plant in Nanzi park (Cont.)

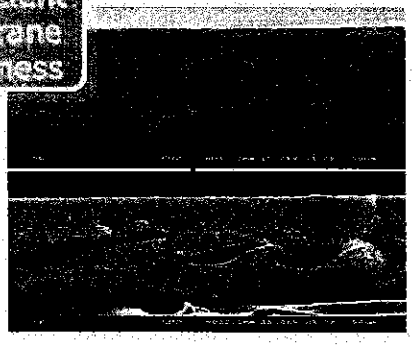

Serious biofouling


Damage from nanoparticles

Large influent quality fluctuation

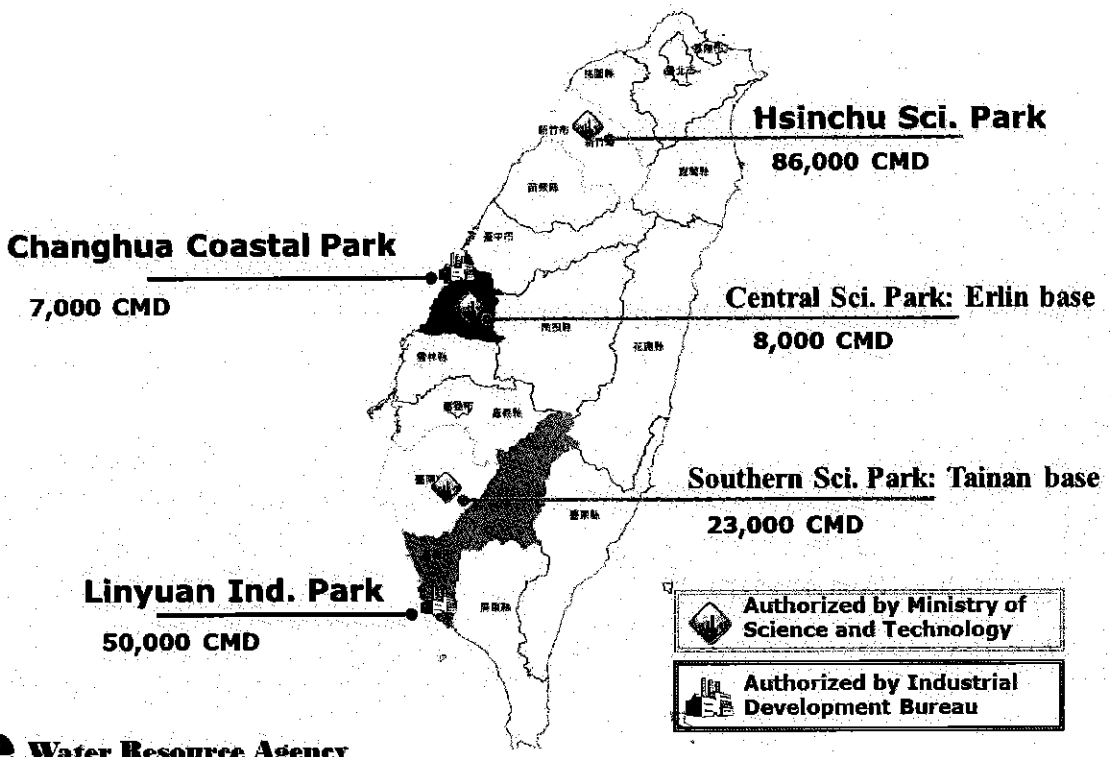


Insufficient membrane robustness



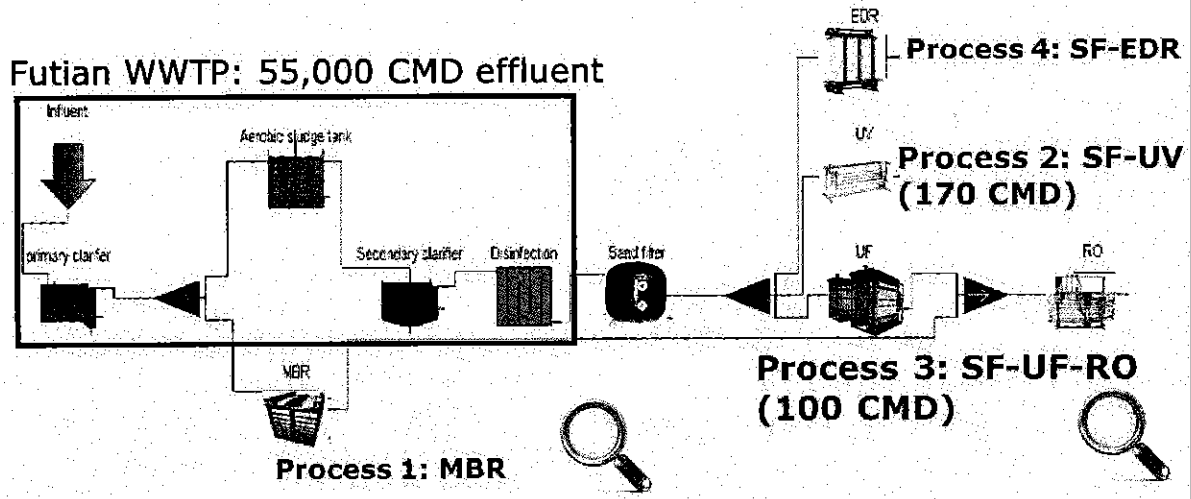
Water Resource Agency

More schemes of industrial park effluent reclamation



Water Resource Agency

The effluent reclamation plant in Futian municipal WWTP (since 2008)



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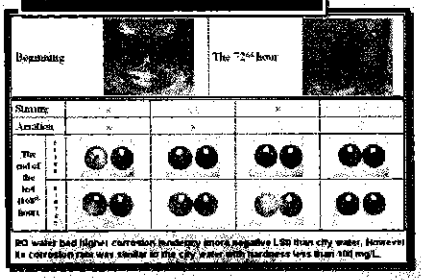
A five-year safety evaluation of reclaimed water

Corrosion evaluation



RO water had higher corrosion tendency since negative LSI than city water, however its corrosion rate was similar to the city water with hardness less than 100 mg/L.

Water quality evaluation

Category	Item number	Detailed items
Organic indices	6	TOC, BOD, COD, SCOD, Oil and grease, Anionic surfactant
Colloidal substances	3	Turbidity, Suspended solids, SDI, particle size
Eutrophication species	5	NO_3-N, NO_2-N, NH_3-N, TKN, PO_4^{3-}, TP, TN
Scaling substances	12	Ca, Mg, Sr, Ba, Al, Fe, Mn, SO_4^{2-}, CO_3^{2-}, HCO_3^-, SiO_2, General Parameters
Salinity	6	pH, TDS, Na, K, Cl, F^-, alkalinity, conductivity
Microorganism	7	Total bacteria counts, *E. Coli*, *Legionella*, *Giardia Cryptosporidium*, *Enterovirus*, *Nematode*, *Egg*
Toxic heavy metals	12	Ag, As, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Zn
Volatile organics	65	65 species according to NIEA W703.31B
Semivolatile organics	70	70 species according to NIEA W801.51B
Phthalate esters	17	17 species according to NIEA W801.51B
Nonyl phenols	10	NP, NP_1EO, NP_2EO and NP_3EO-$NP_{17}EO$

More than 200 species performed 6 or 8 times per year since Nov. 2008

Safety of Reclaimed Water

Gene toxicity

Ames test (*Salmonella typhimurium*, five strains: TA 97, TA 98, TA 100, TA 102 and TA 1353)	Based on OECD 471 method
In vitro mammalian chromosome aberration test (Chinese hamster ovary cells)	Based on OECD 473 method Normal cell / Chromosome / Sample
Mammalian erythrocyte micronucleus test (mice strain BALB/c)	Based on OECD 474 method

Chronic toxicity

Medaka fish (*Oryzias latipes*)	OECD 204 method
Mice (B6C3F1 strain)	Based on OECD 452 method

Human Health Risk Assessment

Carcinogenic (R)

$$R = \sum_k \sum_i CDI_i \times SF_i$$

Non-carcinogenic (HI)

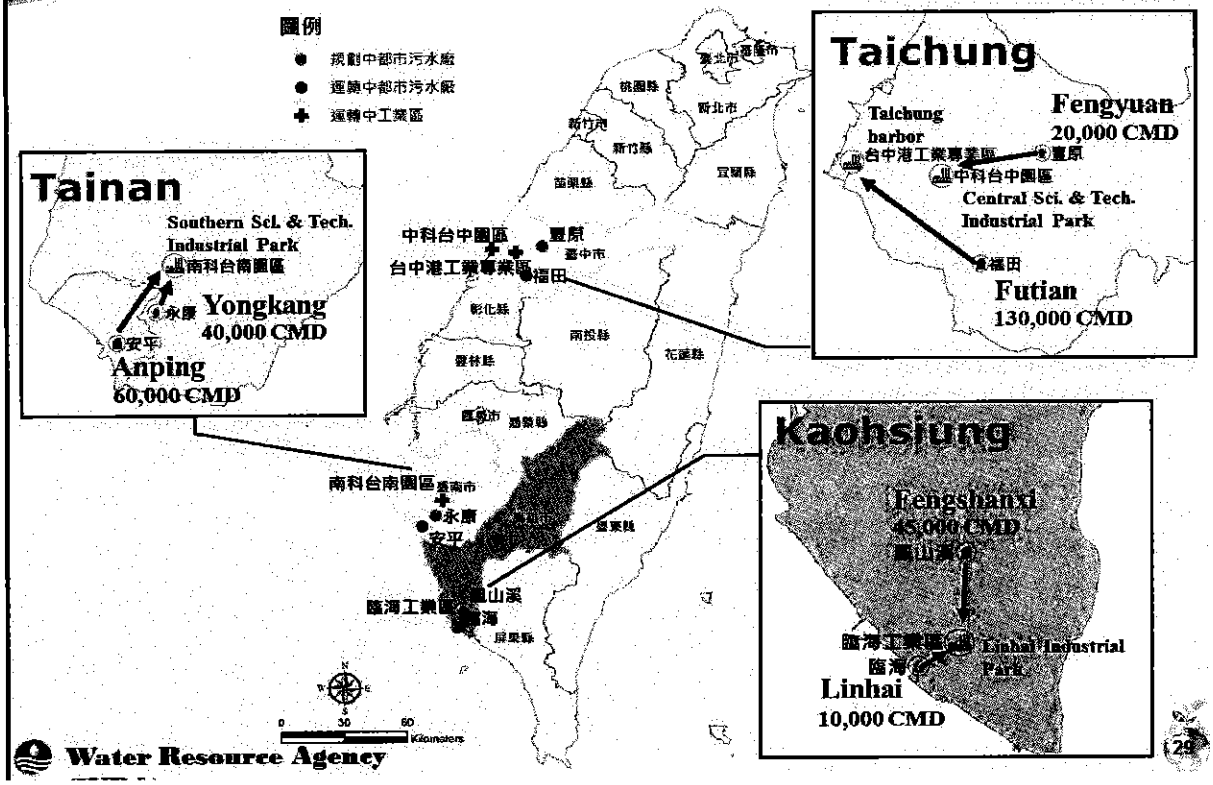
$$HI = \sum_k \sum_i \frac{CDI_i}{RfD_i}$$

Infectious P_{inf}

$$P_{inf} = 1 - (1 + \frac{D}{\beta})^{-\alpha}$$

Water Resource Agency

More schemes of municipal WWTP effluent reclamation



Summary

- Using reclaimed water has been considered as a feasible solution to solve the water crisis in Taiwan. It becomes a secure **insurance** for water supply stability.

- The policy target of reclaimed water usage in Taiwan is **1.2 million CMD at 2031**, roughly 10% of the current city water supply.

Water Resource Agency

Summary (Cont.)

- Promoting the reclaimed water from WWTPs is more difficult than the wastewater reuse in the factories themselves. The **price** and **stability** are still the main concerns.

- A series of demonstration projects in the next five years have been launched to produce at least **200,000 CMD reclaimed water** from WWTPs. The purpose is to establish the confidence of the industrial sector, and gradually increase the acceptance of reclaimed water as one part of water supply.

Water Resource Agency

附錄三、張貼論文：

Study on the Strategy for Promotion of Water Reuse in Taiwan

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[2] Department of Bioenvironmental Environmental Engineering, Chung Yuan Christian University, 200, Chung Pei Rd, Chung Li, Taiwan 32023, R.O.C (E-mail: yvonne_221@cycu.org.tw; sjyou@cycu.edu.tw)

The average annual rainfall in Taiwan is 2,500 mm, however the per capita water allocation is only 15% of the world average due to Taiwan's small land area and high population density. The application of new water resources such as reclaimed water, rains, desalinated water, emerge consequentially as solutions for tackling water shortage. Among them, the reclaimed water from wastewater treatment plants has advantages that include better stability and cost effectiveness, which makes it an important solution to the issue of water shortage in Taiwan. A development scheme for water reuse policy is proposed based on the results from water reuse projects conducted in the past decade and the concern for climate change. The development scheme consists of promotion &guidance, legislation & administrative support, promotion focus on water shortage areas and key technology & business incubation. The goal of water reuse policy aims for the supply of the reclaimed water meeting 10% of the public water consumption by 2031, reaching 1,200,000 tons per day. To reach the goal, the sources and uses of the reclaimed water is suggested as follows: the effluents from sewage treatment plants be used for industrial purposes, effluents from industrial park wastewater treatment plants be used for industrial purposes, industrial sectors consuming large amount of water build their own water reclamation plants, and non-industrial sectors consuming a large amount of water be kept checked to assure the promises they agreed on in the environmental risk evaluation report. The erection of the reclaimed water development act is now under way by the Water Resources Agency, Ministry of Economic Affairs for facilitating the development and public awareness of water reuse. According to the statistics, the use of reclaimed water in 2012 was about 250,000 CMD. The Water Resources Agency, Ministry of Economic Affairs will continue the surveys and research projects on water reuse and the completion of the reclaimed water development act to resolve the water scarcity and manage water resources for sustainable development.

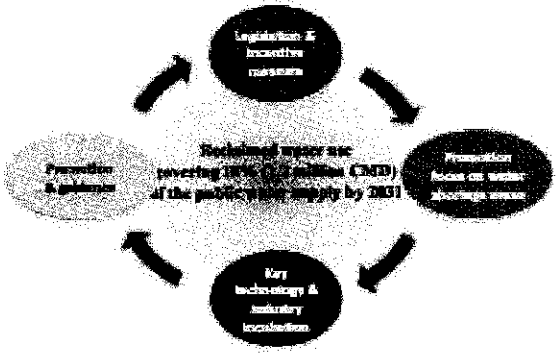


Fig1. A blueprint for development strategy for water reuse

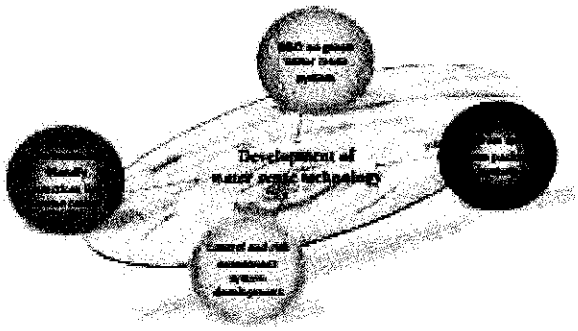


Fig2. A blueprint for development of water reuse technology

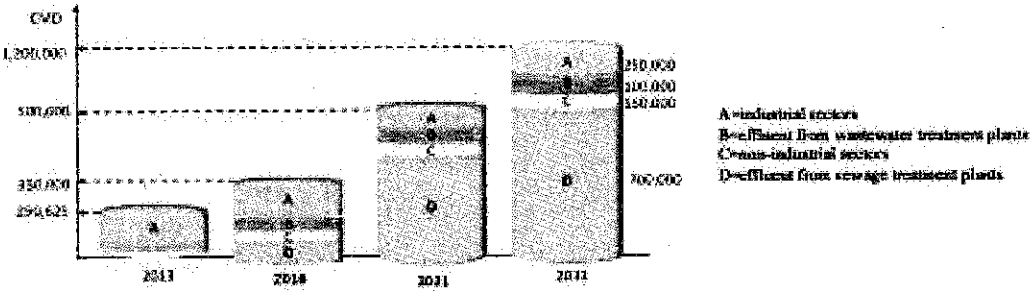


Fig3. Objectives for the sources of the reclaimed water

附錄四、新加坡公共事業局(PUB)希望我國抗旱應變、工業用水輔導作為分享資料

第一篇：水利署抗旱應變作為：

一、臺灣水資源概況

(一)臺灣由於降雨量在時間及空間上的分佈極不均勻，豐水季與枯水季之降雨量比分別為北部地區 7：3，中部地區 8：2，南部地區 9：1（表 1），因此南部地區進入枯水期後，需評估約半年於正常水文狀況下之水庫蓄水量，是否可正常供水，北部地區則估計未來 3 個月，正常水文狀況下之水庫蓄水量可正常供水。

表 1　台灣主要水庫累積降雨量表

	時間	冬雨 11-1	春雨 2-4	梅雨 5-6	颱風及陣雨 7-10
翡翠水庫	歷年平均	847	571	689	1,813
	佔全年%	21.6	14.6	17.6	46.3
石門水庫	歷年平均	296	358	503	1,480
	佔全年%	11.2	13.6	19.1	56.1
鯉魚潭水庫	歷年平均	121	376	824	1,184
	佔全年%	4.8	15.0	32.9	47.3
曾文水庫	歷年平均	98	273	895	1,634
	佔全年%	3.4	9.4	30.9	56.3

(二)由於農業用水佔整體用水量約 72%之水量（圖 1），且其耐旱程度較高，因此，短期間降雨不足時，藉由管控調度農業用水供應民生使用，可以減少民生缺水頻率，並降低災損之發生。因此，供水區燈號實施除水文、蓄水狀況外，另需考量水資源調度能力而定，需經演算評估及用水單位協商後決定。

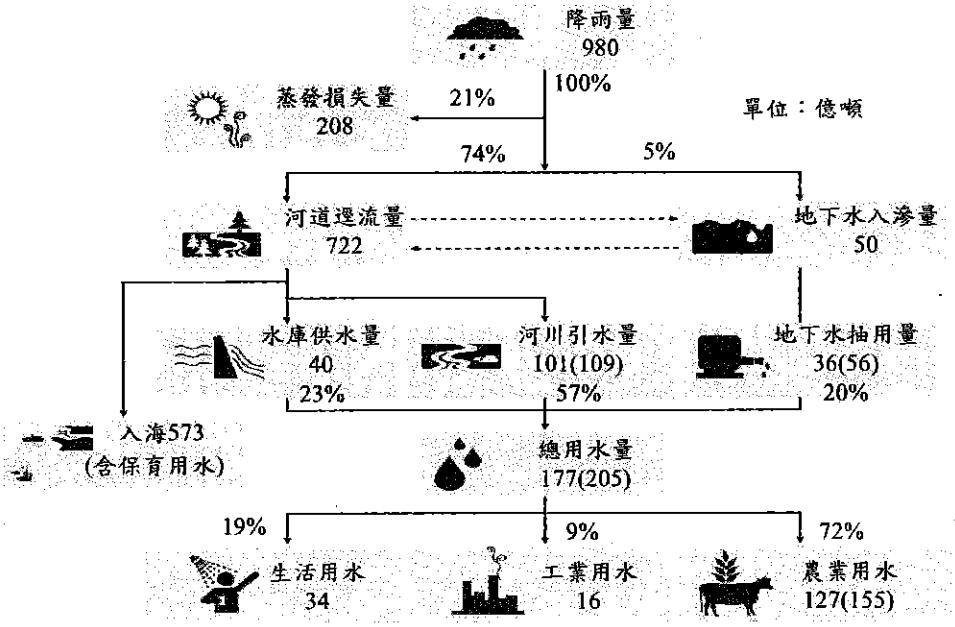


圖 1 水資源利用概況(2003~2012 年平均值)

二、旱災災害防救依據：

(一)**相關法規**：依據水利法、災害防救法、經濟部災害緊急應變小組作業要點、經濟部旱災災害支援協助處理項目及程序要點、經濟部水利署災害緊急應變小組作業要點及經濟部水利署人造雨工作小組作業設置要點辦理。

(二)**執行機制**：依據區域水資源調度機制、各水庫運用要點、農業用水調度使用協調作業要點、自來水停止及限制供水執行要點及旱災經濟部災害防救業務計畫，按水情條件及各標的用水之供、需水量等狀況實施，視水情條件持續滾動式召開會議研商並檢討適當因應措施，適時調度調整供水。

三、抗旱操作機制：

(一)**水資源分區及原則**：本島有 15 個調度區及離島有 3 個調度區，共為 18 個調度區，由本署北、中、南 3 個水資源局統籌調配及調度管理。調度原則為：

1、由內而外：同用水標的優先調度，不足則協調由其他標的調度。

2、由近而遠：同調度區（農業用水）優先調度，不足再由其他調度區支援。

(二)**水情監控預警**：由下而上，由本署各水資源局掌控水情，於每年枯水期開始前（約 10 月中旬）水利署及各區水資源局及掌握各水庫蓄水狀況及確認各標的用水次年度之計畫用水量，並規劃配水管控事宜，後續依據未來天氣展望、累積降雨量、河川川流量、水庫進水量、水庫蓄水率等，預判未來 3 個月供水情勢，並適時召開會議（圖 2），採取節限水及水源調度措施，並由本署發布水情燈號，分別為供水正常（藍燈）、水情稍緊(綠燈)、第 1 階段限水(夜間減壓供水，黃燈)、第 2 階段限水(大用戶減供及非必要用水停水，橙燈）及第 3、4 階段限水(分區輪流供水及定點定時供水，紅燈)，如需限水(自來水限水措施，詳圖 3）於實施限水前於 1 週前公告周知。

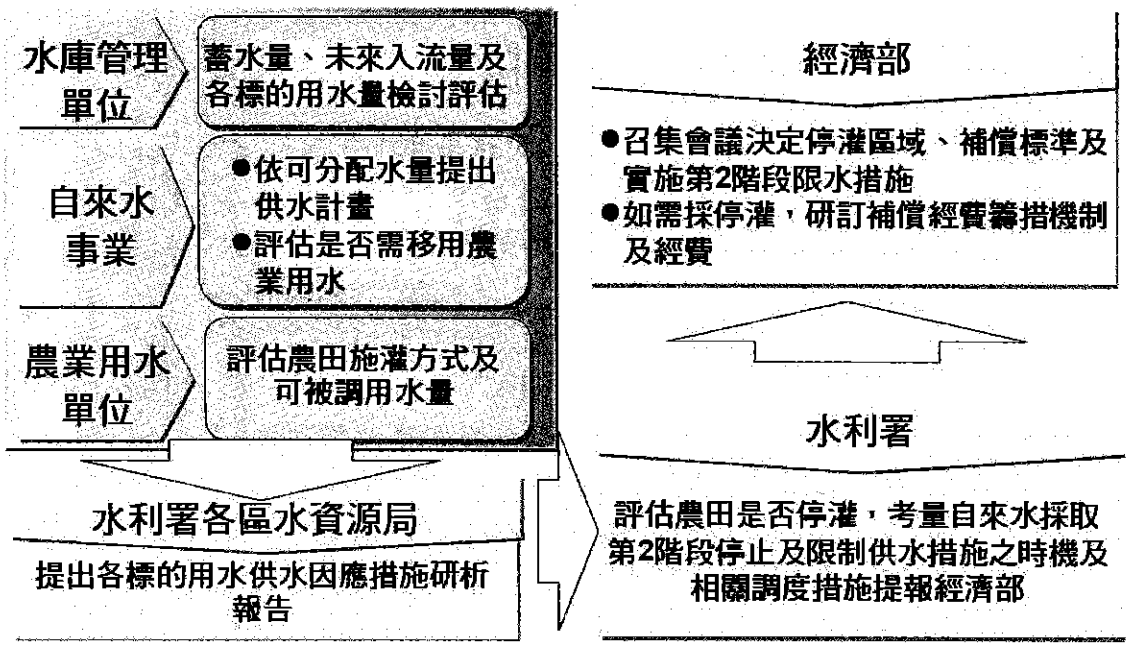


圖 2　抗旱決策作業流程圖

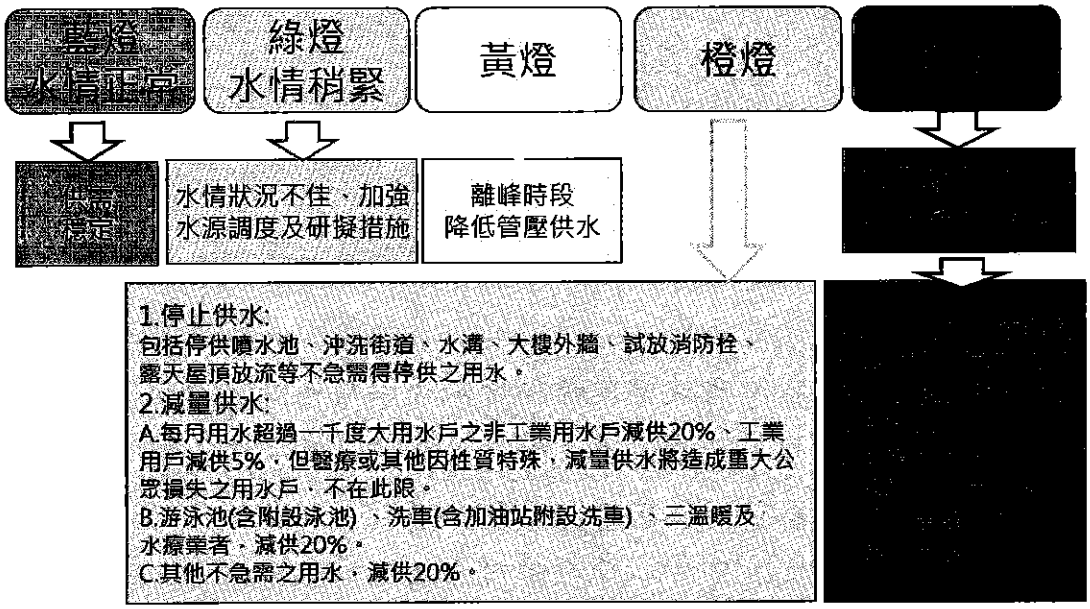


圖 3　自來水停止及限制供水與水情燈號對照圖

(三)**採取因應程序**：依據前項預警依輕重狀況「超前部署、主動救災」，由輕而重，由下而上防災原則，分由本署水資源局、本署、經濟部至最嚴重由**中央災害應變中心**召集會議邀集各部會、供水機關(構)研議對策（表 2）。

表 2　旱災災害狀況、應變層級、成立條件及缺水率表

旱災狀況	應變層級	成立條件	缺水率	
			家用及公共用水	農業用水
一級狀況	旱災中央災害應變中心	二供水區橙燈或一供水區紅燈	>10%	>50%
	旱災經濟部災害緊急應變小組	二供水區黃燈且涉水源調度或一供水區橙燈，並經水利署研判水情恐持續惡化	5~10%	40~50%
二級狀況	旱災經濟部水利署災害緊急應變小組	一供水區黃燈且涉水源調度，並經水利署研判水情恐持續惡化	2~5%	30~40%
三級狀況	水利署水資源局、水庫管理單位、地方政府、自來水事業、農田水利會、工業區及科學園區管理單位等應變小組	一供水區黃燈或一供水區綠燈且涉水源調度，並經研判水情恐持續惡化	1~2%	20~30%

(四)**抗旱因應措施**：因應降雨及水庫蓄水量不足問題，除啟動抗旱機制成立應變小組召開會議協調放水量總量管制、用水打折供應、跨區水源調度、增加地下水出水能力、實施人工增雨作業、加強節約用水、加強灌溉管理、延後灌溉、採取自來水限水措施、公告停灌稻作等各項節限水及水源調度措施實施時機。

四、**調度補償原則**：依據「受益者付費、受限者得償」原則由調用水量者負擔補償金給調用水量者，因農業用水缺水忍受度較高，目前向農業用水調用水量以加強灌溉管理節餘水量、公告停灌辦理坪割或休耕為原則。

第二篇：工業用水輔導作為

摘要

台灣目前各部門之用水，以工業用水成長最為快速。政府各部門均積極透過各項廠商輔導措施，以提高工業用水效率，以及媒合使用再生水，降低區域自來水供應壓力。本署為水資源主管機關，目前相關措施包括成立「水再生利用技術服務團」，配合系統性之全國性問卷調查、現勘盤查與深入輔導，以提升工業水回收率，解決工業用水問題。其他工業區目的事業主管機關，包括經濟部工業局、加工出口區管理處，以及三處科學園區管理局均推動類似措施，其中又以竹科管理局針對區內高科技產業進行系統性輔導最具規模與系統，而許多廠商均已達到85%以上之高度回收效率。

一、水利署「水再生利用技術服務團」成立背景

為配合經濟部水再生利用小組之相關行政支援作業以及再生水推動之統計工作，本署已於101年以專案計畫方式成立「水再生利用技術服務團」(目前委託財團法人中興工程顧問社執行)。該服務團工作除協助推動再生水使用媒合外，亦針對工業用水大戶與生活用水大戶進行用水狀況盤查以及進行必要之輔導。除統計各類用水量與用水來源外，如價格、技術等相關

資訊亦加以整合，作為推動水利產業之用。其盤查與輔導作業概述如下。

二、工業用水大戶用水現況盤查

為促進調查單位持續推動廢污水再生，提升水資源利用率，本署發放用水現況問卷普查，並依據相關結果，每年遴選出 10 處具使用再生水潛勢單位，進行再生水使用情形現地訪查。現地訪查作業流程如**圖 1** 所示，各階段工作重點說明如下。

1. 現場盤查前置作業

依據前述遴選原則，篩選具再生水使用潛勢單位，聯繫盤查單位確認問卷填寫資料正確性，並要求盤查單位提供用水平衡圖以及水電報表，以掌握盤查單位之用水基線資料、用水需求以及水處理設備能源耗用現況；視盤查單位之需求及意願，安排現場訪查行程。

2. 現場訪查作業

現場勘查以初步瞭解廠商執行節水或用水回收再利用現況，協助診斷盤查單位之水處理設施運作狀態以及處理效能，比對用水指標合理性以及水處理設操作穩定性，確認廠內用水需求，並與盤查單位人員協調改善措施，確立改善方向。

3. 資料彙整

導入「水再生利用技術服務團」之輔導能量，評析水處理成效以及能源運用效率，就廠內規模及用水特性進行水再生利用可行性評估，提供廠商作為執行水再生利用方案參考。同時，持續進行後續追蹤輔導，彙整廠商接受度與改善成效。

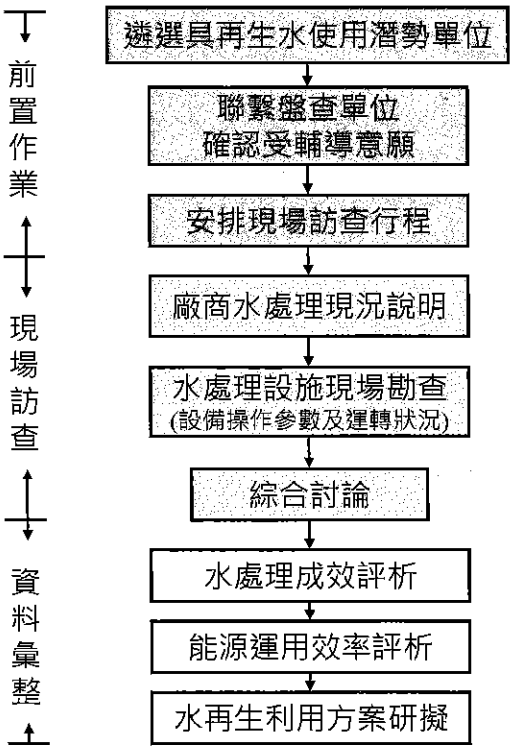


圖 1 具再生水使用潛勢單位盤查作業流程圖

三、深入輔導工業用水大戶進行再生水使用與節水評估試驗

為確認針對具再生水使用潛勢單位所提出之水再生方案具有技術及財務可行性，本署每年遴選或指定至少 2 處用水量大於 100 CMD 且具再生水使用意願之單位，配合盤查單位之需求，導入現場模廠測試或駐廠輔導之深入輔導工作，進行改善方案執行完整評估，並提出先期規劃報告。

本項工作乃在於協助用水量及污水量大之工業用戶及生活污水戶，從技術面與管理面，導入水再生利用技術，提升水資源使用效率。深入輔導作業流程如**圖 2** 所示，各階段工作重點說明如下。

1. 深入輔導前置作業

自現場盤查單位中，依據盤查單位配合意願與再生水使用潛勢評估，初步遴選工業用水戶以及生活污水戶列深入輔導之儲備名單，後續將與各有意願接受輔導單位討論再生回收利用方案之可行性，遴選工業用水戶與生活污水戶各 1 處，提送本署核備，並安排現場訪視行程。

2. 模廠測試或駐廠輔導

深入輔導作業首先針對廠商之用水現況、基線資料以及用水需求進行了解，同時協助建置用水平衡圖以確認廠內用水資訊。透過現場訪查紀錄，評析水處理成效以及能源運用效率，依據受輔導單位之用水需求，歸納輔導重點並共同研議廢污水再生利用方案規劃方向，如建置水再生利用模廠，驗證再生處理程序可行性；或持續協助受輔導單位人員，改善廢污水及再生處理效能，提升水再生利用之可行性。

3. 資料彙整與評析

彙整現場模廠測試或駐廠輔導之水質檢測數據與設備操作紀錄，針對改善方案執行完整評估，提出先期規劃報告，內容包括受輔導單位基本資料、單位用水基線資料、模廠測試與駐廠輔導規劃、財務可行性評析與再生利用可行性評析。

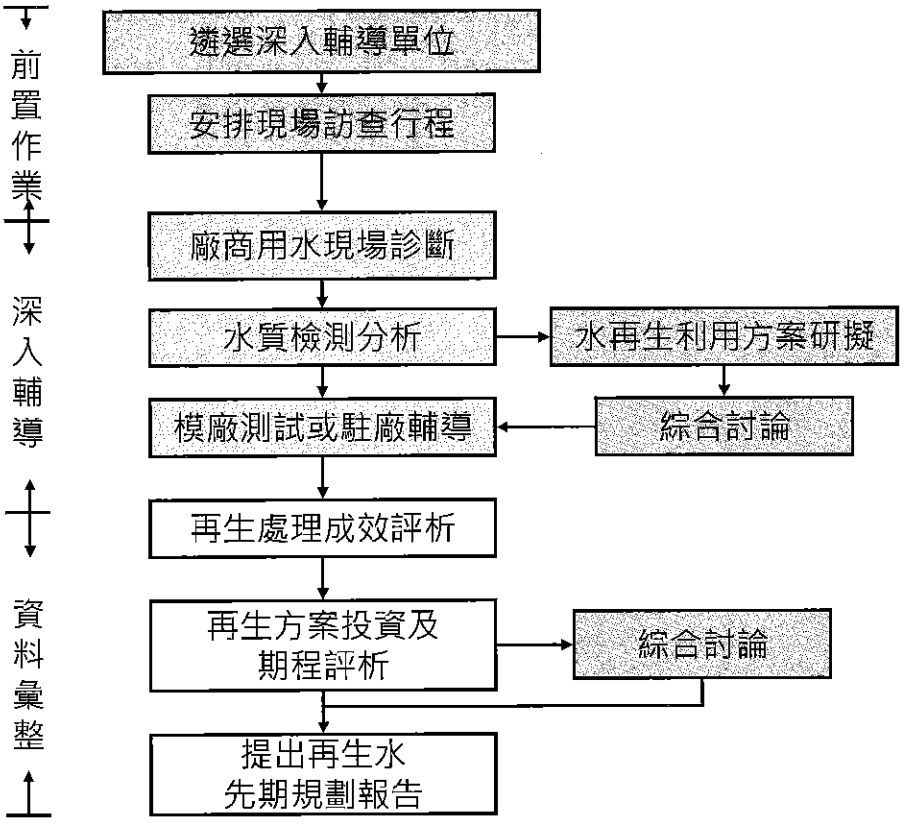


圖 2 具再生水使用意願單位深入輔導作業流程圖

四、其他部會節水輔導作為概述 – 以科學園區管理局為例

目前工業局、加工出口區管理處、三處科學園區管理局、農委會等均有針對轄下事業進行用水輔導，以下即以科管局為例進行說明。

科管局為協助園區內事業，從技術面與管理面，導入節約用水技術，提升水資源使用效率。主要節水內容包括：用水基線資料調查、建置用水平衡資料、純水系統排水回收、製程排水回收、雨水及空調冷凝水貯留利用、冷卻排水以及洗滌廢水循環再利用，以及廢水處理回收可行性評估，提出製程用水減量評估與診斷，建議節水改善方案與評估經濟效益，以協助受節水輔導單位有效運用水資源，提升節水及回收再利用技術，並展現具體之節水與經濟效益。

配合節水輔導工作計畫所成立節水技術小組，成員包括科學工業園區管理局、學者專家、園區同業公會及計畫執行單位成員共同組成，主要工作內容包括篩選並擬訂節水輔導對象，出席現場節水技術輔導及科學工業園區管理局召開之各項工作會議。

完成受輔導廠商遴選後，將辦理一場節水輔導期初說明會，說明本年度節水輔導規劃以及廠商配合事項，輔導內容依需求計畫書要求，至少包括：

(1) 基本資料收集及分析：包括工廠用水現勘，工廠供水資料、用水資料、回用資料、排水資料、相關水質資料及正確用水平衡圖之建立、修正。
(2) 節水潛力分析：包括工廠用水資料清查、水平衡圖分析、已回用水量、可回用水量、原廠取水量、建議改善後取水量、原回收率、改善後製程回收潛力及全廠回收潛力。視廠商用排水情形，本團隊可提供水質檢測分析服務，協助廠商釐清各項用排水之回收再利用潛力以及水質提升處理需求。
(3) 節水方案建議：包括廠內具有節水潛力之用水減量，製程回收、純水系統、空調系統及廢污水管末回收等具體可行節水方案評估。
(4) 回收水量統計：包含工廠已回用水量、年度內可回收水量及未來可回收水量等各廠商過去年度及未來年度 (原則為三年內) 之節水達成/預估績效，並將作為本計畫本年度節水績優廠商選拔之評分參考。
(5) 經濟效益分析：建議方案之回收單位處理成本計算及回收年限評估。

附錄五、參加韓國水協會舉辦之第七屆世界水論壇高峰圓桌會議(WWF7-1st Asian Water High Level Round Table)楊署長中英文對照談參資料：

壹、台灣水利界參與第 7 屆水論壇（WWF7）狀況：

一、People who are interested in the water issues in Taiwan including governmental organization, professional association, industry, NGO, and academic institute are very pleased to participate in the 7th World Water Forum held in South Korea, our Asian neighbor. This global water summit will allow us to exchange with fellow specialists from around the world, and we will be happy to share Taiwanese technology and know-how. Our agency, the Water Resources Agency, would be the coordinator to organize the related sectors working together to jointly participate in this event.

（適逢本屆水論壇在韓國舉行，同處亞洲地區，台灣水利界非常高興能有此機會參與此世界水高峰會議，與各國專家互相交流學習，也非常樂意分享台灣的水利技術。本年初水利署即組織相關政府單位、民間團體、產業界、NGO 團體等打算一起共同參與此盛會。）

二、Last February, Water Resources Agency dispatched representatives to the second stakeholders consultation meeting (2nd SCM), and submitted proposals to host some sessions. （在今年 2 月底召開的第 2 次籌備會議中，水利署亦派員參加會議，並在會中提交申請主辦 session 申請書：）

(1) Water Resources Agency submitted a proposal entitled "Thematic process-theme1.3. Adapting to Change: Managing Risk and Uncertainty for Resilience and Disaster Preparedness—The application of Multi-hazard mitigation and prevention technology" to share Taiwan's disaster preparedness technology and a Water Show Case—Demonstrate hazard prevention and mitigation technology.（水利署提交：「Thematic process-theme1.3.Adapting to Change : Managing Risk and Uncertainty

for Resilience and Disaster Preparedness－The application of Multi-hazard mitigation and prevention technology」以分享台灣的水利防災科技及 Water Show Case－Demonstrate hazard prevention and mitigation technology 申請書。）

(2) PAWEES-Taiwan submitted a proposal entitled: "Thematic process-theme2.1. Water for Food － Sustainable water resources management for food security"

（PAWEES-台灣提交:「Thematic process-theme2.1. Water for Food － Sustainable water resources management for food security」申請書。）

(3) Environmental Quality Protection Foundation (EQPF) submitted a proposal entitled "Thematic process -theme2.3. Water and Cities－Water as climate change adaptation".

（環境品質文教基金會提交「Thematic process -theme2.3. Water and Cities－Water as climate change adaptation」申請書。）

(4) On behalf of National Taiwan University, Prof. You Jene submitted two proposals entitled: "Thematic process- theme1.4. Infrastructure for Sustainable Water Resource Management and Services － Sustainable Reservoirs Management and Sediment monitoring", and "Science and Technology Process - focus area1-Water Efficiency －Groundwater Management and land subsidence control".

(5) 「Thematic process- theme1.4. Infrastructure for Sustainable Water Resource Management and Services－Sustainable Reservoirs Management and Sediment monitoring」及「Science and Technology Process - focus area1-Water Efficiency－Groundwater Management and land subsidence control」等 2 主題申請書。）

三、Besides hosting sessions, we also hope to participate in the panel discussions, to engage in exchange and to share the Taiwan experiences, such as:

（除了主辦 session 外，另外台灣相關單位也希望能參加各 session

討論，以學習各國經驗及分享台灣經驗，例如：）

-theme1.4.Infrastructure for Sustainable Water Resource Management and Services

-theme2.1.Water for Food

-theme2.3.Water and Cities

-theme3.1.Green Growth, Water Stewardship and Industry

-theme3.4.SMART Implementation of IWRM

-theme4.5.Enhancing Education and Capacity Building

貳、Sanitation－自來水供應、水質、下水道設備、再生水(Water supply, Sewers, Reclaimed Water)

一、Current situation(現況) (台灣地區自來水供應現況、台灣自來水水質要求、污水下水道現況、再生水發展現況)

(一)In Taiwan, Water supply enterprises are public utilities. It should be operated by a public entity, and could only be operated by private entities under the approval of authority. The water supply in Taiwan has been privatized and is the responsibility of Taipei Water Department and Taiwan Water Corporation, Lienchiang County Water Supply Plant and Kinmen County Waterworks, supplying 21.62 million people throughout Taiwan, reaching 92% of population.

在台灣，自來水事業為公用事業，以公營為原則，並得准許民營。自來水供應目前為民營化，分由臺北自來水事業處、台灣自來水公司負責、連江縣自來水廠及金門縣自來水廠等 4 大自來水事業負責，全台供水人口約 21.62 百萬人，供水普及率約 92.%。

(二)The quality of water supply is required to meet water quality standards laid down in these statutes, including strict provisions for maximum permissible amount of water bacteria, turbidity, chromaticity, chemicals etc. In order to protect the source of water supply, we designate and announce water quality and quantity protection areas. In

the areas activities that would harm the water quality or quantity are banned or restricted. The total protection area is about 25% of Taiwan area. Drawing surface water or ground water in protection areas shall pay water resources conservation and compensation fees, unless the water is supplied in a non-profit manner for domestic use or public use in the protection area. If the water is supplied for industrial use or public use by a public utility, said public utility may add a 5% to 15% surcharge to its water bills after obtaining approval from the central authority-in-charge. The fees used exclusively on water resources conservation and environmental conservation infrastructure projects, public welfare of residents in protection areas, and compensation for landowners whose land use is restricted.

自來水水質須符合自來水水質標準及飲用水水質標準，針對自來水水質細菌最大容許量、濁度、色度、化學性物質等訂定嚴格標準。此外，為保護自來水水源，劃設保護區，面積約占全台面積 25%。在保護區內取用地面水或地下水者，除區內非營利之家用及公共給水外，並應繳交水源保育與回饋費，其為工業用水或公共給水之公用事業，附徵百分之五以上百分之十五以下之費額，所得費用專供水質水量保護區內辦理水資源保育與環境生態保育基礎設施、居民公共福利回饋及受限土地補償之用。

(三)In terms of sewers, sewage created by homes is processed with specialized airtight sewers lines. Which collect waste and transport it to sewage treatment plants where it is biologically or chemically treated and then discharged or reused. This greatly reduces the pollution, thereby enhancing the living environment. Since 2010, the Ministry of the Interior has had a target of increasing the number of users connected to the system by 3% annually. It rapidly expanded the spread of sewers, while facilitating and maintaining the quality of home life and water resources. As of the end of March 2014, the

sewage treatment rate is 35.63% in Taiwan.

有關污水下水道處理部分，家庭產生之生活污水以專用密閉的污水下水道管線，收集輸送至污水處理廠，以生物或物理方式處理後再予排放或回收再利用，以大幅減輕生活污水對水源水域之污染，提升生活環境品質。內政部自 99 年度起即以每年提升 3%用戶接管普及率為目標，快速提升污水下水道普及率，以建設並維護住家及水源水域之品質。台灣地區污水下水道用戶接管普及率，截至 103 年 3 月底止，全國用戶接管普及率已達 35.63%。

(四)In addition, administrative measures were formerly used to require industry to reuse wastewater at their own plants with impressive results. In the current period, government policy continues to demand that industry strengthens water recycling and reuse, but in order to develop new water resources there are now projects to provide industry with effluent from public wastewater treatment plants. It is estimated that by 2031 1,200,000 CMD (ton/day) of reclaimed water will be available for industry use. However, because of the low water supply price the central government is currently investing construction, and local government is building and operating demonstration facilities in an effort to encourage useage.(此外，過去透過行政措施要求產業進行自廠廢水再生利用，成效顯著；現階段政策除仍持續要求工業加強水回收與再生利用外，為開發新興水源，亦著手進行公共污水廠放流水之再生供應產業使用計畫，預計至 2031 前將開發 120 萬 CMD（噸/日）再生水供工業使用，惟因自來水水價偏低之故，為建立使用端使用意願，目前推動由中央政府投資建設費用、地方政府興建及營運方式之示範案，以建構中央與地方合力開發都市水源之模式。)

二、Future Development 未來發展方向(自來水供應未來發展、再生水未來發展)：

(一)Water Supply－自來水供應部分：

1. Replace and upgrade waterworks equipment: draft projects for the upgrade and improvement of waterworks equipment, evaluate current water quality, and add high-grade water purification processing facilities.(進行淨水場設備汰換更新及增設高級處理設施：研提淨水場設備更新改善計畫、評估水質現況，增設高級淨水處理設施)
2. Examine drinking water quality standards and add new inspection items: discuss the addition of new inspection items and standards (new pollutants, dioxin, toxic algae), inspection program to check water source background and enhance quality of running water.
   檢討飲用水水質標準及新增檢測項目：檢討新增檢測項目及標準（新興污染物、戴奧辛、藻毒等）、自來水品質加強追蹤水質背景檢驗工作計畫
3. Improve water quality management information systems: water quality information management program, water quality inspection information management system, water quality warning system.
   強化現代化水質管理資訊系統之應用：水質資訊管理計畫、水質檢驗資訊管理系統、水質預警系統

(二) Future Developments in reclaimed Water-再生水部分

1.Draft regulations on development of reclaimed water sources, provide clear rules on the use and management of waste water and effluent, governments in areas with water shortages should develop reclaimed water sources, deregulate private sector user rights, integrate points of use, create an environment that supports water reclamation and reuse and promote related industry development.

研擬再生水資源發展條例草案，明定廢污水及放流水使用權管理、缺水地區政府開發再生水義務、開放民間取得使用權、用水端整合，建構水再生利用友善環境並促進相關產業發展。

2. Human activities pollute and impose burdens on the environment. The pollution is not only bad for the water also has an impact from terrestrial to aquatic water environments and ecosystems. Therefore, it is proposed

that an international water protection treaty be drafted, so that countries can work together to devise water protection standards and establish a cooperative platform incorporating water processing technology, water and sewage reuse circulation technology.

人類活動將造成環境的污染與負荷，陸地水質的污染除不利水的利用外，亦將影響陸地水域至海域水域的水環境與生態體系，因此，建議訂定國際水質保護公約，共同勠力達成水質保護基準，並就水處理技術、水及污泥再生利用循環技術建立合作平台。

參、Climate Change-氣候變遷：

一、Current Situation(現況)：

1.In June 2012, in response to the impacts of climate change challenges, Taiwan announced the "Adaptation Strategy to Climate Change in Taiwan". This presented a national adaptation prospects, principles and strategies in eight major sectors: disasters, infrastructure, water resources, land use, coastal zones, energy supply and industry, agricultural production and biodiversity, health, with governing ministries proposing action plans.

為因應未來氣候變遷之衝擊與調適，臺灣已於 2012 年 6 月函頒「國家氣候變遷調適政策綱領」，就災害、維生基礎設施、水資源、土地使用、海岸、能源供給及產業、農業生產及生物多樣性、健康等八大領域，提出國家調適願景、原則與策略，並由各部門提出行動計畫以為因應。

2.Water Resources Agency has adopted the IPCC AR4 General Circulation Model (GCMs) to complete a simulation of climate scenarios for the near future (2020-2039) in Taiwan. On this basis, the agency has completed its analysis of vulnerability in the water environment (including use of water resources, prevention of flooding and coastal defenses), risk mapping and related countermeasure strategies.

水利署並採 IPCC AR4 之大氣環流模式（GCMs）完成臺灣近未來（2020~2039 年）之氣候情境模擬，並據以完成水環境（包含水資源利用、洪水防護、海岸防護）之脆弱度分析、風險地圖繪製及相關因應策略研擬。

二、Future Developments(未來發展)：

1.As countries around the world continue to research climate chang**(10/15)** data are constantly updated and refined. Taiwan will also continue to improve its research into climate simulation techniques, including Asia-Pacific monsoons and the development of global and regional climate models. In addition, whether climate change research or adaptation strategies and actions, both require more collaboration and therefore the promotion of multidisciplinary research, which will be a focal point of future developments.

鑒於世界各國對於氣候變遷相關研究仍持續進行中，相關資訊不斷更新且精進，臺灣亦將持續加強氣候模擬技術研究，包括東亞季風研究探討、全球氣候模式及區域氣候模式的發展等；另外，不論是氣候變遷的研究或調適策略與行動，均需要各領域之間的合作，故推動跨領域研究與合作，亦將為未來發展重點。

三、Exchange and Cooperation(交流合作)：

(一)As climate simulation is considerable uncertain, in terms of adaptation approaches Taiwan currently adopts a risk management strategy that is focused on prevention, risk reduction and risk avoidance. In addition, adaptation strategy is based on dispersed small systems supporting the larger system, which enhances the flexibility of the system and its ability to respond to change. For example, flood prevention no longer implies strengthening the ability of water channels to discharge flood water but rather focuses on the whole river basin, strengthening the sponge function of land and building structures, improving rain seepage and storage, retention and use, as a basis for storm water and flood management. Further efforts

are also being made with the promotion of green growth and cross-boundary governance (for example water – energy – food).

鑑於氣候模擬仍存在極大的不確定性，目前台灣在因應調適方面採用風險管理的策略，以預防性、降險性與避險性方向思考，並以分散式小系統支援大系統，增加系統彈性應變能力的原則研擬調適策略，(11/15)護，不再一味強化水道的排洪能力，而係以全流域觀點，從強[illegible]建物的海綿功能，增加雨水滲透及在地貯留、滯、蓄、利用等來進行雨洪管理；另一方面也致力於推動綠色成長及跨域治理（如水－能源－糧食）。

(二)Furthermore, certain adjustments are also made to water control strategies and as such, the accumulation and exchange of executive experience and innovation are extremely important. It is proposed that after this roundtable more proactive efforts should be made to establish a knowledge exchange platform, a cooperative mechanism that will enable us to face the severe challenges of climate change together.

在治水思維與策略方面，正在進行調整改革中，因此，執行經驗與創意的累積與交流甚為重要，建議本圓桌後續能更積極建立一個知識交流平台，透過相互交流合作機制，共同因應氣候變遷嚴峻的挑戰。

(三)In addition, as a member of the international community, Taiwan loves to share information on its current approach to dealing with the impact of climate change on the water environment and how to adapt to such changes. This includes the use of water resources, flood prevention, analysis of coastal defense vulnerability, risk mapping, the drafting of related countermeasures/strategies and techniques, as a way of collectively resolving the water security issues in the Asia-Pacific.

此外，身為國際社會一員，台灣非常樂意分享已完成之氣候變遷對水環境之衝擊及調適作法，包含水資源利用、洪水防護、海岸防護之脆弱度分析、風險地圖繪製及相關因應策略研擬方法及技術等，以共同解決亞太地區水安全問題。

四、Water Disaster-水災

一、Current Situation 現況(台灣水災情況、防災準備及防災科技發展狀況)

With Taiwan's special geographical environment of short rapidly flowing rivers and fragile geological conditions, summer typhoons and torrential rain often cause landslides into rivers, which not only results in the severe sedimentation of rivers and reservoirs but also causes severe flooding. In recent years, the impact of extreme climate in Taiwan has significantly increased. Indeed, data for the past 60 years shows that the intensity and frequency of rainfall has increased significantly, and the intervals between floods and droughts have declined dramatically. The difference between wet and dry year reaches 2,000mm yearly.

台灣因特殊的地理環境特性，河短流急及脆弱的地質條件，每年夏季時颱風及豪雨常引發山崩或土石滑落至河川問題，除使河川及水庫嚴重淤積，也常造成重大水患災害。近年來，極端氣候的影響在台灣亦逐漸顯著，依據過去 60 年水文資料顯示，降雨強度逐漸增強且延時趨短，洪旱交替頻率亦呈現密集現象，豐枯水年差 2,000mm。

In the wake of Typhoon Morakot in 2009 and the increasing frequency of natural disasters, Taiwan established a disaster prevention goal of "zero fatalities and minimal losses." This has involved working more closely with the private sectors and the timely provision of a disaster prevention information service, which effectively reduces losses. We continued proactive development of water resources disaster prevention technology, such as

台灣經歷 2009 年莫拉克風災後，面對天然災害發生頻繁，以「零傷亡、少災損」為災害防救目標，除與民間單位結合，加強提供民眾即時防災資訊服務，以有效減少災害損失外，並持續積極發展水利防災科技，例如:

(一)Flood monitoring image identification system. It utilizes city CCTV coverage to automatically monitor flooding and provides an early warning, thereby enabling a timely response.

淹水監視影像辨識系統，利用都市 CCTV 影像進行自動化淹水監控，可達早期預警以利即時應變的功效。

(二)Automatic flood scope assessment system. This uses data on gauges' elevation and water depth in flooded areas to determine the actual elevation of flood, comparing flood elevation and Digital Elevation Model (DEM) to estimate the flood area. It can also be used in conjunction with the address system to estimate the number of households affected by flooding.

自動化淹水範圍評估系統，利用通報災點的高程搭配淹水深度以獲知實際淹水高程，並將淹水高程與 DEM 進行比對以估算淹水面積；此外，尚可套疊內政部門牌系統以推估淹水受災戶數。

(三)Q-water, an emergency water filtration supply system: The lack of drinking water during Typhoon Morakot in 2009 gave rise to innovative new ideas on water filtration equipment. This system has three key characteristics: (1) Quick: Two people with no expert background or tools can install this system in 20 minutes. (2) Quality: it can treat highly turbid water source (>500 ~ 3000 NTU) and produce drinkable water. (3) Quantity: it can be placed in a 1.2-meter square space, produce 15 CMD of water and can be used in parallel to increase water output, providing drinking water for up to 6,000 people per day (2.5 liters of water per person per day).

Q-water 緊急淨水系統:因應 2009 年莫拉克颱風救災時民生供水問題，因而引發淨水設備創新的想法。本系統具備 3 大特點，包含(1)Quick 快組:可由 2 個非專業背景的民眾，於 20 分鐘內不用工具即徒手組裝完成；(2)Quality 優質:可處理高濁度(>500 ~ 3000 NTU)原水，出水亦符合飲用水標準；(3)Quantity 豐沛:可於 1.2 平方米的小空間下，產水 15 CMD，並可並聯以增加產水量，每天可供應 6,000 人飲用水(以每人每日 2.5 公升計)。

二、Future Developments(未來發展方向)

(一)Enhanced timely monitoring and analysis ability of flooding disasters: Monitoring precision improved from a river basin scale (km) to an urban scale (10m) and forecasting ability from long time duration (24-12hr) to short time duration (12-6hr).

精進水情災情即時監測分析能力：監測精度從流域尺度(km)至都會尺度(10m)，預報能力從長延時(24-12hr)至短延時(12-6hr)。

(二)Enhanced flood defenses durability and capability: Establishment and operation of flooding information centers in various departments, flood prevention education promotion, disaster risk evaluation capability.

提升災防韌性與防災能力：各機關水情中心建置及運作、防災教育推廣、災害風險評估能力。

(三) Research into integrated flooding prevention technology: integrated disaster database, sharing of flooding data and disaster monitoring results, disaster data management and value added applications.

研發巨量防災資訊整合應用科技：災害資料庫整合、水情及災情監測分析成果分享、災害資訊管理與加值應用。

三、How to Assist Other Asia-Pacific Countries 可如何協助亞太地區其他國家(水利防災科技中那些可協助其他國家?如何協助?)

(一) In the aftermath of a disaster, how to provide victims with clean and safe drinking water, how to prevent people from falling ill or dying as a result of the problematic water is one of the most important issues during post disaster rehabilitation.

災難發生後，如何在災後提供給民眾潔淨安全的用水，避免民眾因水環境問題而導致生病或死亡，為災後復建階段最重要的課題之一。

(二)A new type of emergency water filtration supply system– village emergency water filtration system. The Q-water system is not only applied in Taiwan for the emergency provision of water in isolated areas, it has already been used in several other countries by non-governmental organization. Such as the

Buddhist Compassion Relief Tzu Chi Foundation and the Red Cross Society of the Republic of China (Taiwan) engaged in relief work in such places as (1) Qiantangxuan in Shandong, China (2) Philippines (3) Cambodia (4) Poland (5) Southern India (6) Myanmar. As a member of the international community, Taiwan is more than happy to share this technology and help the people of the Asia Pacific.

目前已開發完成之新型態套裝式緊急淨水系統-村落型緊急淨水系統Qwater系統除應用於國內颱風災害發生時，偏遠山區緊急供水外，並已透過台灣民間組織，如佛教慈濟慈善事業基金會、中華民國紅十字會總會等單位，推廣應用至國際社會，包括(1)大陸山東乾唐軒(2)菲律賓(3)柬埔寨(4)波蘭(5)南印度(6)緬甸等地。身為國際社會一員，台灣非常樂意分享此科技技術，幫助亞太地區民眾。

附錄六、參加 SIWW 重要人士照片資料：

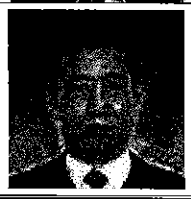
單位	姓名	照片	備註
駐新加坡台北代表處 大使	謝發達		駐星
中國大陸 水利部部長	陳雷		大會 (Speaker)
中國大陸 松遼水利委員會主任	黨連文 (Dang, Lianwen)		大會 (Speaker)
韓國 k-water CEO	Choi, Gye-Woon		
韓國 第 7 屆水論壇國際委員會主席	Lee, Jung-Moo		
新加坡 PUB chairman	Tan Gee Paw (陳義輔)		
新加坡 PUB 助理總裁	陳玉仁		

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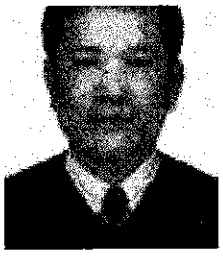
Photo	Nationality	Organization	Position	Name
	Korea	K-water (Korea Water Resources Corporation)	CEO	Mr. Choi, Gyewoon
	Philippines	Asian Development Bank (ADB)	Vice-President	Mr. Bindu Lohani
	Indonesia	UNESCO Indonesia	Director	Mr. Hubert Gijzen
	Hong Kong	Water Supplies Department	Director	Mr. Enoch, Tim Sin Lam
	Taiwan	Ministry of Economic Affairs, Water Resources Agency (WRA. MOEA)	Director General	Mr. Yang, Wei Fuu

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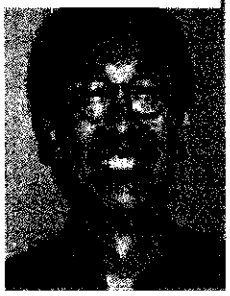
	Indonesia	Perum Jasa Tirta II(PJT2)	CEO	Mr. Herman Idrus
	Japan	Asia Pacific Water Forum	Chairman	Mr. Ravi Narayanan
	Singapore	Tropical Marine Science Institute (TMSI)	Deputy Director	Mr. Liong, Shie-Yui
	Singapore	Singapore National Water Agency (PUB)	Deputy Chief Executive	Mr. Chua Soon Guan
	Uzbekistan	Ministry of Agriculture and Water Resources (MAWR)	Deputy Minister	Mr. Shavkat Khamraev

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	LAO PDR	Ministry of Energy and Mines (MEM)	Deputy Minister	Mr. Khammany INTHIRATH
	Korea	Emissary of UN Executive Secretary	Envoy for Disaster Risk Reduction and Water	Mr. Han, Seoung-soo
No Image	Korea	Korea Institute of Construction Technology (KICT)	Chief Researcher	Mr. Hong, Il-Pyo