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第二屆國際集水區研討會專輯（下）

本期目錄

專論

新書介紹

稿約

集水區之經營管理
—以臺北水源特定區為例

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摘要

在水源集水區中最常造成水質惡化與水量流失之因素主要是來自變更土地使用目的的開發行為，水源水質水量保護區雖係以保護水質水量為最高目標，惟對於區內之土地利用只要符合其公告之管制事項要求，仍可進行相關之土地開發，致使水資源保育成效大打折扣。臺北水源特定區係臺灣第一個經由都市計畫程序規劃之水源、水質、水量保護區，其管制規範係以土地使用管制為主，故無論在法令配合、人力、經費編列及業務執行運作上均係國內首創，因此特為本文，希望有助於一般社會大眾深入了解臺北水源特定區劃設之宗旨、原則及經營管理現狀；同時也藉由現行經營、管理、法令制度等之探討，以祈有助於提供未來國內水源保育及永續利用政策制定之參考。

臺北水源特定區位於臺灣省東北部，臺北盆地東南方，範圍自青潭堰溯新店溪上游涵蓋南、北勢溪兩大支流流域，行政區域隸屬臺北縣，包括新店市、石碇鄉、雙溪鄉之一部份及坪林、烏來鄉之全部，面積共計717平方公里。

此區屬水源水質水量保護區，設立目標是以水源保護為主，惟因區內之主管機關關係錯縱複雜，加以為求地方之發展，以致於常有以經濟發展優於水源保護之考量而做出不同之行政決策。事實上，本水源特定區面積廣達717平方公里，希望完全禁止使用並不可能，執行上必招致當地居民之反抗，因而在特定區計劃之土地使用分區上，乃以不影響水源保護之原則下，依據各地區不同程度之發展需求，而給予適當之住宅區、商業區及農業之劃設；其餘之土地則依據不同之目的及生態需求而劃為「水庫保護區」、「生態保護區」及「保安保護區」。

有關各使用分區，概述如下：

一、住宅區：面積280公頃，佔計畫面積之0.41%。
二、商業區：面積2公頃，佔計畫面積之0.003%。
三、農業區：面積96公頃，佔計畫面積之0.14%。
四、水庫保護區：面積956公頃，佔計畫面積之1.38%。
五、生態保護區：面積9114公頃，佔計畫面積之13.194%。
六、保安保護區：面積56021公頃，佔計畫面積之81.10%。
七、其他：面積2606公頃，佔計畫面積之3.77%。

臺北水源特定區之劃設，雖使水源保護工作有專責機關負責，且使管制具嚴制性，惟在歷經十餘年之經營管理，仍有許多困難亟待解決：

一、管理委員會組織架構不建全

水源區業務複雜萬端，且事務繁多；雖然委員成員來自中央、省府、市府、縣府等且全為機官首長，惟因均屬兼任，難予親身全顧，且首長之下無任何主任秘書及秘書編制之幕僚人員，又需列席省、市議會及參與地方協調，實分身乏術。管理委員會所執行之違規查處係極為專業之工作，惟因巡邏警察係屬借調之保警，在人員流動上極為頻繁且缺乏專業素養，更因欠缺司法裁決權，致常造成業務執行之困擾，另依現有警力分析，每位員警轄幅近五十平方公里，警力明顯不足。同時，轄區廣達717平方公里，而管理人力僅60人，人力明顯不足。

二、經費不足且爭取不易

管理委員會經費來源有中央、省、市三種不同來源，故預算之取得常有互相觀望及步調不一之情況發生，再加上省、市基於預算額度不宜澎漲之考量，以致經費常感不足，影響業務推動。

三、管理委員會有責無權

委員會因職掌業務範圍多係地方機關之職掌；雖然大部分之行政事務已經由協調而獲致地方機關之授權，惟有關法之裁決權，仍需由地方之縣政府處理，因此造成委員會有「責」無「權」，而降低即時處理之效果。

四、欠缺專責法規

綜觀現行國內法令，有關水源保護之部份計有「飲用水管理條例」、「自來水法」、「山坡地保育利用條例」、「森林法」・・・等數十種，法令種類繁多，禁止行為及處罰規定又多所差異，民眾不易釐清瞭解。

五、權益失衡

集水區土地屬臺灣省，供水營運由臺北市負責，常造成省、市對於管制與開發立場之不同。而雖有都市計畫通盤檢討以修訂更符實需之管制要點，惟因仍無法滿足民眾需求，致特定區民眾自組壓力團體，陳情抗議，以維自身權益。

綜上所述可知，水源區之經營管理可說是集法令、工程技術、學術研究、行政制度於一身的龐雜工作，其中若有一、二項因子不完善，即可能造成水源保護工作成效之不彰，因此對於未來水源區之經營管理展望，謹提出下列事項作為未來有關政策擬定之參考：

一、建全管理制度

(一)明定水源保護政策及目標

政府應依法行政，惟若政策不周延，常易造成執行成效不彰；故水資源保育管理工作應獲一致共識，並由中央明訂頒佈政策，俾予貫徹執行。至於水源保護之目標，由於各區天然及地理條件均不相同，故在功能目標之釐定上，應以全臺灣整體水資源應用為前題，並分區釐定其目標位階，方不致造成執行困擾。

(二)成立事權統一之專責機構

1. 有專責機構之設立，方可解決多頭馬車互相推諉之情事發生。
2. 賦予「事」「權」方不致於因無權而影響事之執行成效。
3. 層次提升為中央，可有效解決人力與組織問題。

(三)成立流域水管理行政體系

由於臺灣各區河川流域、水文、生態、地質環境頗多差異，加以都市發展之程度及性質亦不同；另鑑於河川上、中、下游有一貫之因果互動關係；故有必要以

河川流域為整體考量，成立流域管理體系，除可避免不同縣、市地方機關不同之開發立場及水源保育工作執行標準不一之現象外，同時亦可改善目前各水源保育機關難於橫向協調之現象。

二、制定專責法令並明定水源保護經費使執法明確並解決經費爭取不易之問題。

三、修訂「警政署組織條例」第五條增設集水區得成立保育專責警察隊條文，並賦予司法裁決權，使警力之行使專業化。

四、水源區應整體治理規劃並優先考慮回饋地方建設方案。

五、加強宣導教育

水是生命之泉源，有潔淨的水源方能蘊孕健康的人生與進步發展的社會，因此水資源的保護工作乃至為重要；有鑑於目前水源保育管理工作正面臨臺灣水資源環境日益惡化之時，特以臺北水源特定區十餘年來之管理、治理經驗提出一些看法，希望能有助於水源保育之永續經營。

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Restoring Streams in Cities by *Ann L. Riley*

新書介紹

本書由Island Press於1998年出版，作者為加州河川復育研究所執行秘書，累積多年參與河川復育之經驗，針對不同使用者的需求，將河川管理策略，作一有系統的整理。此書特別強調整個流域中不同群體的角色扮演與分工合作，這些不同群體包括規劃者、科學家、一般居民、公益團體，以及利害關係者等等。

書中針對上述各社群分設專章討論，例如，假設你是一個關心自己居住地區河川健康的一般民眾時，你該怎麼做？如何獲得必要的專業協助？如何引發周圍鄰居的共同關懷？甚至如何自行設計監測活動等等。內容具有相當的實踐性，是關心河川健康者極佳的工具書。

Technical Report Abstract

本土化土壤沖蝕指標模式之建立

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台灣山坡地集水區之地形陡峻，且降雨多集中於夏季之颱風雨，因此土壤沖蝕型態與美國大陸乾燥平坦之地型大不相同，故若採用USLE等公式，會發生沖蝕量高估之情況。

為使指標模式之建立能真正符合本土之需要，因此對於指標模式之建立，則以台灣本土試區沖蝕之實際量測所得資料為模式建立之主要依據。在模式建立之同時，為使之能夠適用於全島各種地區之土壤沖蝕預估；因而，對於試區之採用乃以北部、中部及南部等多個試區為模式建立之主體；同時，並參照真實集水區內進行開發及利用所造成之土壤沖蝕實測資料，來提高模式之準確性並建立模式之真正適用性及普遍性。本研究選用地形、土壤、覆蓋、降雨及土地利用等五項因子，配合實測資料分析驗證，建立本土化土壤沖蝕指標模式。

本研究之沖蝕指標模式是由數組分佈於北、中、南三地之野外沖蝕試驗所推求獲得，其中為了降低遞移率對沖蝕量觀測值的影響程度，所以試區面積均不宜太大，例如屏東科技大學試區最大面積為88m^2，坡長有22.13m，使得坡度、覆蓋及土地利用等因子在試區上是均勻且單一的情況，但在指標法實際應用於集水區時，常無法滿足此情況，所以指標法之適用範圍勢必受到限制。因為估算之地區面積越小、因子越均勻，沖蝕指標模式才越正確。為了克服此一限制，指標法在使用時將依估算地區之情況做適度之修正。以指標法估算沖蝕量時，僅需將各指標因子之條件，由各個指標值表格中找出適當之對應值，再據此求出所有指標值之總合，代入指標公式，即可估算土壤沖蝕量，此法簡易且可靠性亦高，可供水土保持計畫審議開發行為所使用。

然須注意的是，土壤沖蝕指標模式是針對地表沖蝕所發展的模式，本模式所估算的沖蝕量指的是由地表逕流所帶動的土壤；並不包括由土壓力所引起的崩坍量，或是由土石流帶動的土砂等非由逕流剪應力所帶動的泥砂量。指標法的應用可分為二方面：一是天然小集水區沖蝕量估算，另一是水庫集水區沖蝕量估算。二者在其條件上均有不同之處，所以需克服的限制也就各自不同。

天然小集水區由於其面積不大，各因子在集水區中的分佈情形均可得到詳細的答案，尤其坡度及土地利用因子其受均化影響程度可減至最低。在天然小集水區時依現場之狀況做適當的區分即可得到合理的沖蝕量。水庫集水區與前者比較，其最大的差別在於集水區面積之大小，水庫集水區動輒數十平方公里，甚至數百平方公里不等，雖然同樣可以仿造前者之做法，但先前需要將集水區利用網格加以細分，這需要利用地理資訊系統之技術，增加了使用上的複雜性，所以沖蝕指標法在大集水區時之估算方式即做了一些修正，本研究利用土地利用分類區分法對水庫集水區加以調整，來消除土地利用因子受到均化之後的誤差，如此即可得到適當的土壤沖蝕量。

The Water Right in Taiwan

Kuo, ling-hwei

I. INTRODUCTION

With the rapid economic development and population expansion, water is now becoming a indispensable factor in our daily lives. The growth of population and economics are unlimited, however, the water resources are limited. Thus, the reasonable distribution, the effective utilization and good management of water resources are the key to secure the endless supply of water.

Early in Taiwan, we can see wells and pumping equipment everywhere. This phenomenon reveals that many of the Taiwanese had a wrong concept, that is, water is attached to the land, so they can dig well on their land and make use of the water as they wish. In the time that full of water, this concept may not result in any problem, however, in the time that water is running short, along with the increasing demand of water, it may cause many disputes in using water. In order to solve this problem, the Water law of the Republic of China(hereinafter W.L.) has set up an well-organized registration system of water rights.

II. The Registration System of Water Rights

Water resources are owned by the State

The Constitution of the Republic of China, Article 143(2), provides that mineral deposits, which are embedded in the land and natural power which may, for economic purposes, be utilized for the public benefit shall belong to the State. Regardless of the fact that private individual may have acquired ownership over such land. According to this article, the W.L., Article 2 provided as follow: Being regarded as natural resources, water shall belong to the State, regardless of the land ownership held by the people. In other words, when people have the ownership of the lands, it doesn't mean that they have the rights to using water on their lands. At first, they must according the rule set by the W. L. Article 15 and Article 27 to apply for registration of water rights, then they can legalize the utilization of water on their lands. The purpose of the registration is not only for the sake of the State's administration of water but also for the clarification of the rights and duties between the people who have the water rights. Briefly speaking, the registration system of water rights can make the reasonable distribution of water possible.

Water Rights

According to the W.L., Article 15: The term "water rights" as used in this law shall mean the rights acquired under law for utilization or collection of fruits from surface or ground water.

How to acquire the water rights?

The duty of registration

The W.L., Article 27, it provided that acquisition, if water right shall be null and void unless duly registered in accordance with this law. When a citizen obey the rule that set in the Water Law, applying the registration of water rights, the authority-in-charge shall check out the application form, effect screening, and post the approval on the bulletin board. And after announcement of the approval of registration for water right, no exception has been taken or exception has failed. Then the authority-in-charge shall register the approved water right and issue a water right certificate. Through this procedure, we can realize that when a citizen apply for the registration of a water rights, it does not means that he will get the water right certificate without question.

The authority-in-charge

According to the W.L., Article 28, an application for registration of a water right shall be made to the hsien (municipal) authority-in-charge. The application for registration of a water right shall be made to the provincial (municipal) authority-in-charge in case the water source runs through two or more than two hsiens (municipalities), and to the central authority-in-charge in case the water source runs through two or more than two provinces (municipalities).

The effect of registration

After finishing the register procedure, then accept the water right certificate, the person who has the water right can utilize water from water source. According to the Article 24, in case where a water right is not used for continuous two years, upon investigation and promulgation of the fact by the authority-in-charge, the water right shall lapse; provided that this does not apply if approval has been granted for preservation thereof by the authority-in-charge.

Temporary right for utilization of water

According to the W.L., Article 21, if study of hydrologic measurements leads to the judgement of the authority-in-charge that water in a certain water source within the area under its jurisdiction is more than enough to meet the demand of valid water rights for a certain period of time, the authority-in-charge may authorize temporary rights for utilization of water during the same period, and may suspend such temporary rights when it feels that water in the water source runs short.

Compensation

The compensation system in the W.L. can be divided into two categories:

The compensation for public water supply

a. Article 19：

In case where water in a water source is not enough for domestic use and public water supply, if there is not other water source available, the authority-in-charge may suspend or cancel the water rights. Where holders of water rights sustain serious damage as a result of the suspension or cancellation of water rights or limitation on utilization of water as referred to in the preceding paragraph, the authority-in-charge may give them compensation as it sees fit.

b. Article 26：

The authority-in-charge may change or cancel the water right already registered by private individuals in order to meet the demands of a public utility; provided that adequate compensation shall be paid to the holder of the cancelled water right.

The compensation for the water right acquired first in time

a. Article 20:

Where a dispute arises among holders of the registered water rights as result of deficiency of water in water source, priority shall be given to the water rights acquired first in time. Where water rights are acquired at the same time, water shall be either distributed in proportion to the quantities of water as stipulated in the respective water right certificates or utilized by turns, and measures therefore shall be stipulated by the authority-in-charge.

b. Article 21

If study of hydrologic measurements leads to the judgement of the authority-in-charge that water in a certain water source within the area under its jurisdiction is more than enough to meet the demand of valid water rights for a certain period of time, the authority-in-charge may authorize temporary rights for utilization of water during the same period, and may suspend such temporary rights when it feels that water in the water source runs short.

Penal provision

Article 93：

Any Person who draws, uses of drains water, or obstructs the drawing, using or draining of water, in contradiction to this Law or ordinances in connection with control of water conservancy works issued by the authority-in-charge shall be punished with a fine of more than 4000 and not more than 20000 dollars. If rights and interests of other persons are endangered as a result thereof, he shall be punished with imprisonment of not more than three years, detention or a fine of more than 4000 and not more than 20000 dollars.

The authority-in-charge may seize tools and machines used for drawing, using or draining water, or for obstructing the drawing, using or draining of water as referred to in the preceding paragraph.

III. Controversial Issues in Current System and Resolution

Water expenditure for institutions' necessay

Though W.L. article 17 provides that the water expenditure should be limited to the institution's necessary. There is no obvious limitation to define if the "necessary" is appropriate or not. Without others' objection, the authority will approve the application for the use of water. This will not only make waste of water but also disobey the spirit of W.L.

The approval of temporary right for utilization of water

Article 21 of The W.L. and Article 65 of The Enforcement Rule of The W.L. provide that approval of temporary right for utilization of water is limited in a certain water source within the area under its jurisdiction is more than enough to meet the demand of valid water rights for utilization of water during the same period. Because of the easiness to get the approval of temporary right for utilization of water, there are more and more applications for temporary right for utilization of water. As a result, the authority has no time to issue these applications by legal procedure. This has become a serious problem, especially in some restricted water source area.

The analysis of potential water quantity

Because the authority does not analysis the potential water quantity and calculate the application data in system, in most situations they have no idea about the potential for water ex

penditure. This not only makes troubles issuing the applications for water but also makes difficulties forming the national standard.

Non-registration for driving a well in private land

Article 42 paragraph 1 (c) of W.L. provides that driving a well in private land is not necessary to register the authority. This has become an unfair treatment for others that need to make the registration of water right.

The appropriate depth for the wells of ground water

Article 43 of W.L. provides that the authority should make different standard for the appropriate depth of the wells in different situations, it depends on the data and quantity of water in different places. Because of not observing Article 43, the authority has no exact standard accepting the application of water right. Therefor raise a problem driving too many wells in the same area at the same time and damage other's right of using water.

The resolution

The modifications of the distribution of water right in W.L.(Article 27 of W.L.)

a. Delete the rule of "creation of water right"(Article 27 of The W.L.).

b. To change the registration system of water right into the permission system of using water.

c. Undertake over-all review and modifications of the W.L. and the relevant regulations of the temporary right for utilization of water.

d. Management of water resource should be reunion by central authority-in-charge.

e. Establish the pre-review system of the program of large quantity utilization of water.

The management policy of water resource.

a. Issuing temporary license for utilization of water needs to be serious that water is more than enough to meet the demand of valid water rights.

b. Reasonable distribution of water right.

c. Water distribution should not be judged only by economic concept.

d. Equipment for deriving and expending water should be treated as equal to the management of water resource.

Policy-planning principles and strategies

A. Principles of water resources policy planning

a.The development and the conservation of water resources must receive equal emphasis.

b.The development of water resources must assure the preservation of ecological system.

c.Users of water must be required to pay fees and those receive inadequate amount of water should be compensated for the loss, to promote the rational utilization of water resources.

B. Strategies for water resources management

a.Strengthen the organizational structures and functions of water resources administration and management.

b.Modify the laws and regulations governing water resources.

c.Reevaluate the water rights and allocation practices.

d.Implement water conservation measures.

e.Expand the water resources exploration and the efficiency of water use.

f.Initiate the research of water resources science and technology.

g.Intensify the manpower training and public education on water conservation.

h.Make total planning for the control and management of rivers and streams.

i.Mitigate floods and droughts hazards.

j.Strengthen the conservation and management of groundwater.

k.Reinforce the watershed control, protection and management.

Technical Report Abstract

Polluted Natural Water Treatment by Overland Flow Systems in Taiwan

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Abstract

One kind of free water systems of constructed wetland, overland flow system(OLFS), was used to treat a polluted natural waterway water in Tainan. In this study, under the hydraulic loading(HL) of 11.8cm/d, BOD and COD removal rates are approximately 80% and 70%. If HLs are increased from 20cm/d to 40cm/d, removal rates are slitely decreased. Therefore the ecnomic HLs are between 30~40cm/d. OLFS could also have satisfied removal about ammonium nitrogen and have increased dissolved oxygen in the treated water. According to the results of field studies, the size of 5mx50m per cell of OLFS was suggested.

Experimental Methods

The pilot plant of OLFS is located at the intersection of Ta Chou Drainage and Yen Sui River in Tainan, and shown in Figure 1(a), more detail is shown in Figure 1(b). The size of test field is 10.6 meters wide and 50 meters long. Its slope is approximate 1 %. Wastewater was pump from Ta Chou drainage, and distributed into the test field by inlet pipes. Wastewater flowed over land with 1~2 cm depth, and collected in a channel along the end of the Overland. A triangle weir was installed in the end of the channel for measuring flow rate. The temperature of OLFS was from 17,4°C to 30°C during experimental period. Experimental procedures are list in the follow:

1. To pump wastewater into OLFS with a flow rate and to meet a design hydraulic loading.
2. To sample and analyze influent and effluent during a week for a test run, and calculate removal rates of pollutants, such as BOD, COD, ammonium nitrogen, and suspended solids, etc..
3. To change flow rate with varied hydraulic loading, and repeat from procedure 1 to procedure 2.
4. Hydraulic loads used this study were 11.8, 17.2, 24.9, 29.8, 40.1,and 53.7 cm/day. Wastewater was continuously applied into the system.

Results and Discussion

1. Water Quality of Influent

Influent quality of OLFS which was from polluted drainage water fluctuated very much from time to time, mean values of biological oxygen demand (BOD), chemical oxygen demand (COD), ammonium nitrogen and suspended solids (SS) are 76mg/L, 186mg/L, 9.5mg/L, and 25.5mg/L respectively.

2. The Dissolved Oxygen (DO) in the Wastewater of OLFS

Because DO concentration of influent was zero, the wastewater on the third upstream of OLFS was anaerobic, and then oxygen transfers into the wastewater from the water surface, the System changed into aerobic condition, DO concentration in the effluent increased to 3~4mg/L.

3. The Relationship of Removal Rate and Hydraulic Loading

Hydraulic loading is defined that the wastewater flow over the system per unit area per day, expressd as cmd/ha, or cm/day. To treated a large volume of wastewater, the system was supplied with high hydraulic loading. We can find that the hydraulic loading (HL) of 11.8cm/d, BOD and COD removal rates are approximately 80% and 70% respectively. If the HLs are increased from 20cm/d to 40cm/d, removal rates are less decreased. Therefore the economic HLs are between 30~40cm/d. Ammonium nitrogen in OLFS was also have satisfied removal, some ammonium was nitrified into nitrate and some was uptaken by weeds. We also try to study the relationships between organic loading and removal rate of pollutants, but could not find a good relationship.

4. The Model of OLFS

During wastewater flowing through the system, BOD from the distance of inlet can be expressed by the following equation:

$$L/L_0=ae^{-bx/q^c}$$

L,Lo are BOD concentration(in mg/L)at inlet and x from inlet, respectively; q is hydraulic loading of the system in cm/day; a, b, and c are constants; x is distance from the inlet of system. All field test data were fitted to equation, and got a is 1.01(standard error is 0.14), b is 0.11(0.296), c is 0.085(0.296).

5. Soil Characteristics of Test Field

Because test field is on the flood plain of river, the particle size of soil is large, and wastewater may penetrate into under ground. Five samples of 5 cm top soil were taken from the overland flow test field and analyzed , volatile solid contains 6.3%, mean diameter is 0.63mm, effective diameter is 0.07mm, uniform coefficient is 13, it is belong to sand silt.

In order to study the heavy metals accumulation in soil, heavy metals were analyzed at begin and end of experiments. The result shows that heavy metals were accumulated in top soil.

6. The Quality of Infiltrate

In order to understanding the infiltrate quality, one well was dug away 1 meter from the inlet of test field. Some wastewater filtrated from OLFS, and was sampled and analyzed. Comparing qualities of influent and infiltrate, we can find infiltrate quality is litter better than influent quality it is because infiltrate samples were taken near the inlet site of the system.

稿 約

稿件內容

以集水區為主題，包括水保、水文、生態、環工、社經等各領域。凡符合此主題之技術報告、理念介紹、文獻回顧等論述，皆歡迎來稿。

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謝 誌

本刊物承蒙經濟部水資源局之經費補助，並由推動民眾參與水庫集水區管理實施計畫的工作小組編輯，特此致謝。本期接續第二期，主要內容皆為第二屆國際集水區管理研討會中相關論文報告之摘錄，以享國內讀者，於此一併向所有與會學者致謝。