Empathy: Essence of Ecological Engineering

同理心
師法自然真價值

郭瓊瑩　公共建設之生態思維
Monica Kuo on Ecological Oriented Green Infrastructure

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1. 「生態」是一種無所不在的觀念與生活方式。每一工程、工法都應有生態思維 / 郭瓊瑩提供
Ecological thinking and living is everywhere in our life,each project and construction method should incorporate ecological thinking./photo provided by Monica Kuo
2. 因應降雨強度，以乾砌石塊作為排水溝，即使乾季時，亦可呈現自然綠意
Drily piled stones function as gutters in accordance with the intensity of rainfall, and may present as green belts during dry seasons.

2009年，九二一震災十周年，老天又給台灣吃了一記重拳。 颱風接續過境，八八水災的重創不必多說，即便是宜蘭享譽已久的生態大縣，在芭瑪颱風龜走牽拖行逕下，數日的雨量亦造成「水淹冬山」景象，部份居民被迫強制撤離。

「生態工程」又再被拿來討論、檢驗，甚至質疑。

「生態工程」，非表面的綠化施工

以往「生態工法」一詞，就是誤導的開始。

生態工法常被人誤以為是一種施工方法、一種技術，以如此狹隘的視角，從看得到的片斷：一段被沖垮的堤防、一座截斷的橋樑，而判定生態工程的效益功過，顯然是對錯焦，搞錯生態多面向的整體考量。

「就像在不該截彎取直的地方，截彎取直，宣稱施以生態工程，然後再因河道受沖蝕，垮了，質疑生態工程，這是很荒謬的！」文化大學環境設計學院院長郭瓊瑩教授，在她主持的環境規劃與生態設計研究室直言台灣普遍存在，斷章取義，從枝節末端看事情的現象。

要知道，任何工法、工程，都需要有生態思維，從國土規劃、都市計畫、交通建設等等，每個位階、程序都需要建立在生態基礎上，這是永遠不變的真理。至於工法，是已經到末端的執行，當前端的問題未解決，而希望從末端看得見的工程做努力，可投入的其實已很有限。

In 2009, the 10th anniversary of the 921 Earthquake, Nature gave Taiwan another lesson as typhoons hit hard. Besides the notorious 8/8 Flood, even Yilan, renowned for its eco-friendliness, was flooded by the downpour brought by Typhoon Parma, and some of its residents were forced to evacuate.

This has had ecological engineering, once again, brought up, discussed, or even criticized.

Ecological Engineering Not Equal to Greening Construction

First, the term “ecological engineering” is misleading.

Ecological engineering is often misunderstood as a construction method or technology. People tend to judge its effect partially from a failed part of it, and miss the focus on the multi-dimensional thinking in ecological engineering.

“For example, some people applied improper techniques and called them ecological engineering, but only to criticize it upon its failure. This is ridiculous!” said Professor Monica Kuo, Dean of the College of Environmental Design, CCU, pointing out public tendency in Taiwan to make judgments through half-truths and draw conclusions from trivia or simply by part of the result.

In fact, ecological thinking is essential in any engineering method and construction project, such as national land planning, city planning, transportation, etc. The techniques, as the final stage of the process, could only exert limited influence when the thinking – the initial stage – has failed or gone wrong.

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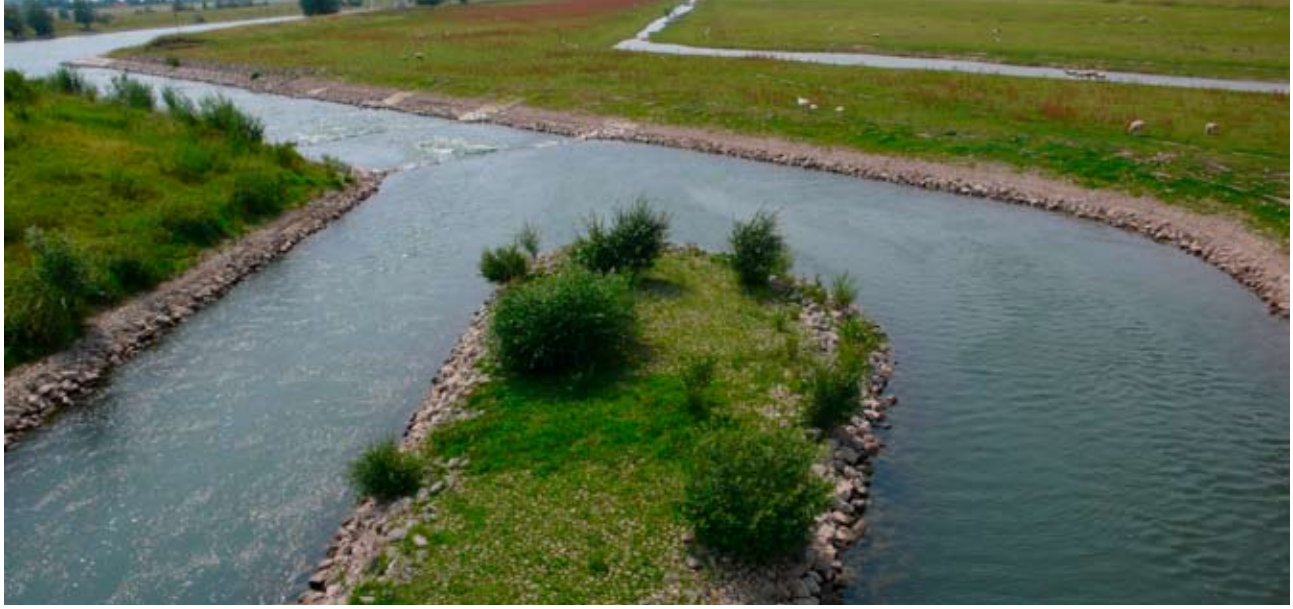


顯然，建構整體性的系統思維，溯源每個程序環節對生態的考量與否，是釐清問題的第一步。

了解土地　因地制宜

國家公園，即是最佳反證。曾任職營建署國家公園組技正的郭院長特別指出，就國土規劃來看，國家公園已遵循生態原則，即依不同的土地資源特性與其敏感度加以等級分類：保護區、緩衝區 (包括特別景觀區、一般管制區)、遊憩區等等，也因此即便是颱風過境，損害也是很有限，甚至有土石崩落也是自然現象，不會造成「災難」。

再則，「什麼叫災難？落石壓死一隻熊、一隻獼猴，叫不叫災難 ?! 」只有依人類的角度看，人使用了那塊土地，跟自然起衝突，有所損失才叫災難。而當了解土地的特性，做適當的規劃規範，不在易崩塌區開發建設，不在環境敏感區從事人為活動，生態保護區就不讓人為活動涉入，災難發生的機率自然降低。

談到國家公園在觀光遊憩與生態保育兩相兼顧的原則，郭院長指出，世界各國國家公園在整體承載量上的可控制下，已從絕對的隔離保護，進入「與人共生」的經營概念，「人」也是生態系統中的一環，也可走進來。當然，民眾教育也是讓此概念可以實踐的重要條件。

順帶一提，生態綠化的美感接受度可能就是最明顯的一環。

「生態景觀是需要時間、長效性的掩替過程，它不同於傳統綠化景觀『蓋好就算完成』的特效藥作法。」生態有其多樣性，複雜性，也因為多樣複雜，自然不同於過去整齊、有秩序，追求「綠覆率」的表面綠化，如「數大就是美」單一種類大面積造園；選擇需要經常澆水、換盆，極耗能的草花；或即使種植多年生的木本植物，

A systematic and holistic thinking in taking ecology into consideration for each stage and every part is the first step to straighten out the problem.

Understand the Land with a Locally-oriented Mindset

National parks are a good counter example. Kuo, long-time Technical Specialist of National Parks Division, CPAMI, pointed out that in national land planning, national parks follow the ecological principle and categorize the land into a protected zone, buffer zone (including special sightseeing zone and general controlled zone), leisure zone, etc. So the damage will be minimal even if a typhoon passes through. Even landslides are not a “disaster” but a natural phenomenon.

Also, “what defines a disaster? Is it a disaster when a bear or a macaque is killed by falling rocks?” It is so only when humans' interest is in conflict with Nature and when humans suffer from losses. When we understand the land, plan proper use of it, and avoid conducting human activities in environmentally sensitive areas, then the probabilities of occurrences of disasters will surely be diminished.

When talking about dual concern of sightseeing and ecological conservation in national parks, Kuo pointed out that in many countries around the world, when the overall capacity is under control, people are no longer excluded and are allowed to enter a national park, being a part of ecology. Educating the public, of course, is an essential requirement that makes this concept applicable.

For instance, the acceptance of the beauty of the ecological plantation is an obvious aspect.

“It is a long process to construct an ecological scene, and is different from traditional methods of planting green plants, which shows immediate effect.” Ecology is diverse and complicated, not just pursuing superficial coverage of greens. This mindset of “numbers build beauty” has resulted in improper choice of plants and large consumption of water

亦未加以考量使用原生種的原則，台灣都市景觀中目前到處可見生態效益極低的外來種小葉欖仁，即是一例。

對著一片蛙鳴鳥叫生機盎然的保育溼地，搖頭直說沒啥東西可看的人，所在多有。從整齊、有秩序、有造景造園的建設才叫有東西可看的習慣性綠美化，跨到欣賞不整齊，甚至雜亂的生態綠化，「如何懂得自然美」也是一項需長期教育的生態美學。

走到現場　正視自然

「台灣需要的是一群真正懂得生態系統運作過程的規劃師，他需要能走出戶外，了解現實環境，而不是只會坐在電腦前寫論文。」一向重視現場教學的郭院長強調。

規劃師的養成，沒有不到現場的道理，對政府官員的要求，亦然。

「每一個決策者都有義務責任認識環境。」對官員們蜻蜓點水式的所謂視察，郭院長非常不以為然，並提及「當年張隆盛署長那一代的官員在這方面的觀念就極強」，他可以為新中橫公路之開闢工程問題請到五位政務委員一起踏勘「讓他們全身泥濘走一趟，新中橫能不能闢建，答案就出來了」。

當年葉署長在籌劃玉山國家公園之初，亦親自欽車踏遍玉山國家公園之重要稜線與溪谷。沒有第一線感覺，節無法有今日創設國家公園屬之大思維。

壞了再修 妥適利用

生態工程是「因地制宜」沒有非此即彼的固定工法。這也是一般誤以材料、單項單價、片段解釋生態工程的地方。

and energy. Even when people plant perennial woody plants, they choose foreign species over native ones, which has low ecological benefits. Terminalia boivinii Tul is a good example.

Many people would lament that there is nothing to see in a piece of well-preserved wetland, where frogs and birds abound. People always think neat and ordered places with obvious gardening as places with something to see. It needs a long time to educate people to appreciate natural beauty – often times something disordered or messy.

Being There for an Up-close Look at Nature

"Taiwan needs a group of planners that really understand the operation of the ecosystem. They need to go outdoors to understand the environment, not just sitting front of the computer writing papers," emphasized Kuo, who prefers on-site teaching.

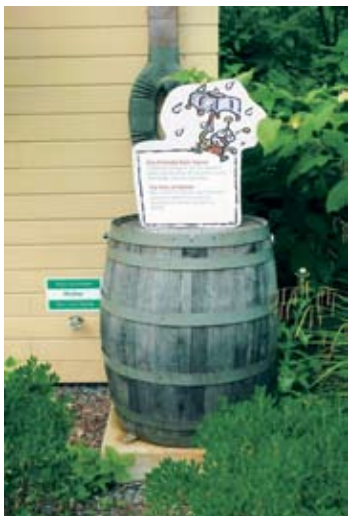
In training planners, it doesn't make sense not making them be there. It is the same for the government officials.

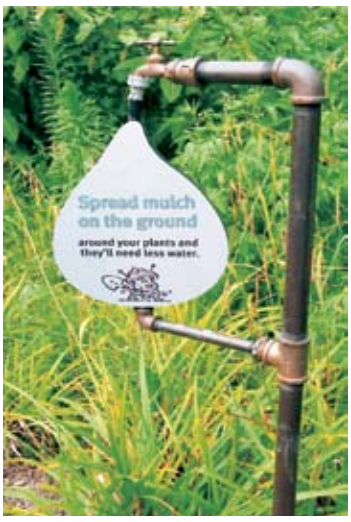
"Every decision maker has a duty to understand the environment." Kuo strongly disagrees with the officials' supervising trips, which are mostly superficial. She mentioned that "former Director-general Lung-sheng Chang and other officials in that era, instead, knew very well how to do it in person and on the scene." For the construction of a new Cross-Island Highway, he would invite 5 ministers without portfolio to examine the site with him together. "They take a muddy trip, and they will know whether it can be built."

In planning the establishment of Yushan National Park years ago, Director-general Yeh had visited all the major ridges and valleys in person. Without his feeling it at the front line, such wisdom of building national parks could not have possibly been cultivated.

Fix it upon Damage Use it with Proper Choice

Ecological engineering has no fixed method of construction, a myth and misunderstanding held by the public.





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1. 洪氾平原之管理應讓河中沙洲保留，並以生態工程進行高灘地之低度利用。
To manage a flood plain, sandbanks in the river should be maintained and high riverbanks should be minimally used through ecological engineering.

2-3. 生態廁所外部截留屋頂降雨回收作為澆灌使用，具有環保及教育功能
Inside the eco-toilets are dry and wet compartments while outside the toilets rain collected from the rooftop is recycled for flushing. They serve the functions of environmental protection and education.

如何從總體計量，即價值工程，達到真正的永續－符合環保、可以回收、讓生態體系功能可以達成，壽命更長，是所有專業人員須具備的基本概念。也因此沒有所謂非天然材料不可使用、水泥是萬惡之源，這些似是而非的片斷思考。

舉例說明，同樣在河上搭一座橋，選擇使用鋼材或木材為材料？以一般對生態工程的認識，木料當然較符合「自然」原則，但鋼板的強度可以製造大跨距，減少對水流的影響，且可以回收再利用，鋼板的選擇就總體價值來看，是較優的選擇；但，放在另一現場，可能又是另一回事。郭院長再舉一例，颱風過後高雄縣桃源鄉山區多處坍崩，勘查人員原規劃造鋼橋，可是地方狹隘無法使用機具搬運鋼料，且造價昂貴，原住民提出他們的想法：就地使用倒地的桂竹，僱用幾個當地人就可搞定，可是耐用問題呢？「壞了就再修啊，幾千塊的事！」。到處都是垂手可得的桂竹，比起以數百萬元計且須從遠地大事工程運來的鋼料，當然環保多了，也是較合乎生態的選擇。

這樣的案例，也提醒我們另一思維：沒有一勞永逸的工程。

比起早已承襲百年的老方法，用石頭竹簍搭建蛇籠，沖壞了破損了，再修再建，或不與洪患相爭，搬遷另覓地的柔性作法，顯然對生態價值工程的整體計算，老祖宗比目前大部分專業人員更高明，更會算。

每次重建，都是生態機會

台灣年年有颱風，風災過後必然面對重建大業。當

Professionals must know how to do the planning from a macro view and employ value engineering to achieve sustainability and environment-friendly, recyclable and long-lasting ecological functions. Therefore, there is no such thing that we must use natural materials only, or cement is an evil material. This is only paradoxical, partial thinking.

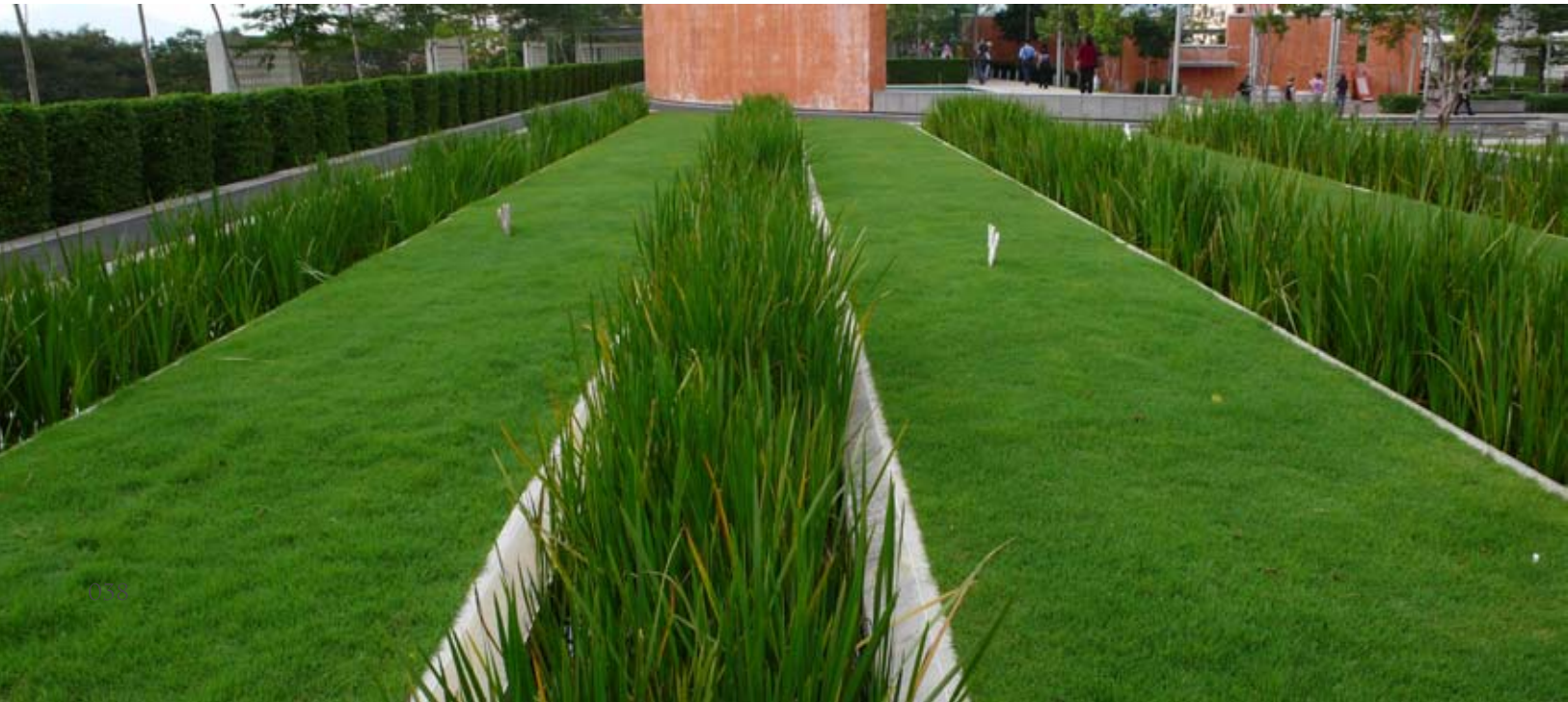
For example, when choosing materials for building a bridge, with common understanding of ecological engineering, wood is a more "natural" choice, but actually steel is a better choice because its strength allows pillars with larger span, minimizing the impact on the flow of the river. But it may be the opposite at another site. The government once needed to build a bridge with steel at a mountain area that just suffered landslides after a typhoon, but the road would be too narrow for transport the steel and the cost would be too expensive. So the aborigines suggested using local Makino bamboo as material, which would be easy and much cheaper to build and fix upon damage. In this case, bamboo is a more eco-friendly choice.

This case also reminds us that there is no such construction project that can be done once and for all.

In the olden days, people filled gabions with stones to stop the flood, and fixed them when they were damaged by floods. Or people would choose not to confront with floods, but shun them by moving away. This traditional type of ecological calculation by ancestors was far wiser than those of today's professionals.

Each Reconstruction is an Opportunity for Sustainable Ecology

As typhoons frequent Taiwan every year, reconstruction become a must in the aftermath of typhoons, and it's



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1. 屋頂綠化除以綠屋頂技術建設外，並可構築帶狀濕地截蓄雨水營造屋頂之 Biotope
In roof greening, besides green roof engineering techniques being applied, strips of wetlands many also be built for rainwater retention to construct rooftop biotopes.
2. 將雨水截留後，利用地形重力導水，以有效續留雨水並能循環利用，且做為庭園地景一部分。
Directed by terrain gravity, the retained rainwater can be recycled and reused. The retention construction may be part of the courtyard landscape.

政府官員肩負重建大任時，生態觀念的具備與否，就影響甚鉅。

會喊出「限幾百天，原地原樣完工」指令的行政首長，就令人淌汗了。要知道，「有一百件重建工程，就有一百次機會」若迫於時間壓力「先答應再說」，不求更好更環保甚至更美的改進，台灣是平白流失建構生態、安全的永續環境的機會，那真的是讓自己再次陷入履建履災的重建夢魘。

「從很多地方看，台灣仍是把政治放在優先考慮，生態還排不上」官員們可以排出時間努力學客家話或台語，卻不會想到請位老師上一堂生態學。

決策者或許不必鉅細靡遺的熟悉專業知識，但須具備有夠寬的知識概念，幕僚單位必須有宏觀的人才庫包括對生態深入研究的學者專家作為核心人員，並大膽提出問題所在，確實走到現場，讓每一位階的問題得到系統性的解答，鼓勵使用更新更好更具創意的生態工程，創造更優質的環境。

在這樣的整體系統思維，與行政首長的重視下，台灣重建工程或還有機會在永續生態上更進一步，至少可望不會再出現千篇一律，標準答案式的「工程」。

important that government officials be equipped with ecological thinking.

It is somewhat frustrating to see some executive chiefs give orders like: "restore the original look at the same place in a few hundred days." Every reconstruction project means an opportunity for a safe and sustainable ecology. But this opportunity would simply be missed if we hurry to make promises without pursuing better, more beautiful and more eco-friendly improvement.

"Too often, in Taiwan, politics still comes first while ecology is not on the list." Government officials can squeeze time for Hakka lessons but they have never thought of getting some on ecology.

Perhaps decision makers are not necessary to understand professional knowledge thoroughly. But they need sound knowledge in many things. And their think tank should have people with macro views, including scholars with profound studies of the ecology as core people. They should encourage newer, better, and more creative ecological engineering to build a better environment.

With systematic thinking and the emphasis made by chief administrators, reconstruction projects in Taiwan may have a chance to step forward or at least there'd not be just "construction" as the only answer.

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Profile of Professor Monica C. Kuo

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A person with administrative experience in the government, with teaching experience in the academy, and professional experience in the business. Setting out from the perspective of ecology with concerns for humanity, she dedicates herself to rebuilding Taiwan's environment.