

# Love River Restoration, Taiwan

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## 1. Static Analysis – Collective action

Love River Restoration case is part of the comparative urban river analysis developed between 2019 to 2020 by Herlin Chien at United Nations University, Institute for the Advanced Study of Sustainability in Japan. The common pool resource system is the Love River (12 km) located in a metropolitan city of Kaohsiung with 2.7 million inhabitants. This case is identified by the Executive Yuan - central government in Taiwan as one of eleven rivers with more than 50% of mediumly polluted section in 2012. To improve the waterbody environment of Love River, along with ten other identified polluted streams, the Environmental Protection Administration (EPA) implemented a large-scale pollution remediation project undertaking several major river form, process and function improvements between 2012 and 2017.

### 1.1 The commons dilemma

The commons dilemma dominating the Love River is rooted in the urban and industrial expansion, especially industrial process zones and highway/railway complex system developed around upstream area in the post-war era. The catchment of 62km<sup>2</sup> flows through an area inhabited by 1 million urban population with only [58% of sewage connection rate](#) (April 2020 data). Main source of pollution is therefore household wastewater (90% of pollution) discharging directly into the river with around 50 companies listed as catchment monitoring entities, ranging from car wash, hospital, electroplating factory, etc. To manage the restricted catchment area, the environmental protection authority of local government installed six water quality monitoring stations. What distinguishes this urban river from others is how its downstream is connected with Kaohsiung Port where the water flow is obstructed by the tidal change of ocean and contingent on the subtropical weather with long sunlight days (dry season) alternating with frequent typhoons and monsoon rain (wet season). In other words, the carrying capacity of Love River can be greatly impacted, for instance during the dry season where the self-dilution ability is lower with limited water flow. Furthermore, citizen periodically complained about the changing color of river water with fear of unknown pollution source. Yet the authority explained the color shifts as part of [natural sedimentary decomposition](#) process during changing of the seasons and the colored colloid is within the safe regulation causing no harm to the environment.

### 1.2 Biophysical Context (IAD)

**Natural Infrastructure** The natural infrastructure of the system includes not only the Love River and its floodplain, but also five artificial wetlands or eco detention ponds. Among the man-made natural infrastructure, the earliest and the largest is the Benheli Eco Detention Pond established in 2005, occupying an area of 37.5 hectares. Thereafter, Love River Wetland (0.7 hectares) was installed in 2006, followed by

Heart of Love River (3.1 hectares) in 2007, Shetzulibi Wetland (4.2 hectares) in 2009, Junddu Wetland (12.6 hectares) in 2011. Additional new artificial wetlands are in need in the upper stream area to purify the source of Love River. Construction started at the beginning of 2020 and estimated to be completed by 2021.

Despite decades of remediation effort, river pollution index (RPI) of Love River does not reflect and match the human endeavor. The objective evidence shows that the river is still in poor health, occasionally recording a RPI score of over 6 which means severely polluted, based on measurement of dissolved oxygen (DO), biochemical oxygen demand (BOD), suspended solids (SS) and ammonia nitrogen (NH<sub>3</sub>-N). The average RPI between 1999 to 2019 is 5.15 which is medium polluted.

**Hard Infrastructure** In this case, only the public hard infrastructure was coded with no private hard infrastructure present after the 1960s due to the decrease of provisioning service provided by Love River such as farm land irrigation or navigation operated by private fish or tourist boat. Public hard infrastructure, however, was only coded since 2001 from which the open data of public procurement database system can be sorted electronically. A total of approximately 0.17 billion US dollars of tax payers' money was invested in the Love River related restoration and routine maintenance between 2001 to 2019. Nearly half of restoration budget was implemented by Public Work Bureau of Kaohsiung City Government (45%), followed by other projects planned by Water Resources Bureau (17%), Metro Construction Bureau (8%), Central Government (6%), Shipping Company (3%), Public Car Bureau (2%), Environmental Protection Bureau (1%), Tourism Bureau (1%) or other Kaohsiung City Government bureaus.

### 1.3 Attributes of the Community (IAD)

**Social Infrastructure** Social infrastructure in this study was coded based on the scale of social events held by the public and private sectors. Whereas the Kaohsiung City local government hosted Love River Lantern Festival since 1998 for the first time, attracting thousands of tourists annually. Other large events hosted by local government include Love River International Beer Festival, Love River Music Festival, Dragon Boat Festival, Tour de Taiwan circling around Love River (2.2 km per lap), 2009 World Game, Puma Evening Run, etc. Since Love River has become an iconic symbol of Kaohsiung, non-governmental organizations also actively organize events using "Love River" as theme for artistic inspiration such as "Searching Love River Dream" literature event series, community riverbend events by Sanming Riverbend Community Association. Love River is also regarded as an environmental protection advocacy theme and its associated wetlands as major environmental protection educational sites. Numerous environmental education events were organized by Wetland Protection Association or Kaohsiung Wild Bird Association.

**Human Infrastructure** Kaohsiung City local government is the main human infrastructure in charge of managing the Love River through a variety of policy priority, rulemaking and project collaboration with private actor. Other human

infrastructure in place was categorized into three type: primary, active, periphery in terms its themes of concern or events held pertaining to restoration of Love River. Primary human infrastructure includes: Cultural Love River Association, established in 1994 promoting the cultural aspect of Love River; Takao Green Association for Ecology and Humane Studies, established in 1995 with founding members from a variety of professional backgrounds yet devoting to gather the power of grassroot to reconnect the relation between urban dwellers and land; Wetland Protection Association since 1997 focused on advocating the importance of wetlands to the urban ecology and urban planning. Active human infrastructure refers to organizations that actively promoted a healthy environment of Love River watershed yet its emphasis is broader and became more engaged after the watershed began to be restored such as Kaohsiung Wild Bird Association, Long-Hwa Elementary School Love River Patrol Group, Kaohsiung Love River Street Market Association. Lastly, periphery human infrastructures only occasionally participated Love River related advocacy activities , for instance, Hai-San Cultural Studio documenting history and culture in Kaohsiung; Yen-Chen-Pu Cultural Association concerned with historical and cultural linkage between the adjacent neighborhood of Yen-shen district and Love River.

#### **1.4 Rules in Use (IAD) (also Soft Human-Made Infrastructure in CIS framework)**

Due to the degraded status (Meyer et al. 2005) of Love River and decrease of provisioning service provided by river in the post-war era such as irrigation or log transportation function, there is no specific rules passed by Kaohsiung City Government to regulate resource users to use water from Wannian River. There is neither co-operative formed to use the water resource. Rules in use to manage Love River are mostly following regulations passed by central government. There are four types of regulations pertaining to management of river watershed in general: space distribution, wetland conservation, soil and land resource and ecological protection. In addition, there were a few major national projects devoting to river management that included Love River – Taiwan River and Ocean Management Project (2001-2003), River and Ocean Water Quality Improvement Project (2005-2007), River and Ocean Water Quality Improvement Project Phase 2 (2008-2010), Water Environment/Water Quality Improvement and Management Project (2012-2017).

#### **1.5 Summary**

Love River has undergone major biophysical and social transformation in the post-war era. The advent of technology had created an industrialization and urbanization driven economy that eventually degraded the water quality of Love River and reduced the urban ecosystem services that this urban stream can offer to the urban dwellers. Luckily, this unsustainable process of human-nature interaction had been reversed and intervened by local government's policies since the turning of the century. Multiple efforts and strategies have been devised by Kaohsiung City Government in consultation and collaboration with non-governmental actors. Although the water quality of Love River remained mostly medium polluted, at least the river restoration program had been initiated and taken into serious consideration with injection of both financial and human resources. Future efforts remain to be

monitored and evaluated.

## **2. Part II. Dynamic Analysis – Robustness**

### **2.1 Update on the Commons Dilemma**

As Love River restoration in the urban setting transitions away from form or process river restoration toward celebration of recreational function and improvement of cityscape, the robustness of the system becomes increasingly fragile as the provision and regulation service of urban river are not sufficiently problematized in the evaluation. In specific, the documentation analysis of river restoration success, at least in the rhetoric of city government reports to city council, reveals a biased focus on the cultural service (du Bray, Stotts, Beresford, Wutich, & Brewis, 2019) of urban stream that is directly related to the well-being of residents. Overall, Love River riverscape revitalization is also framed with a new hope for city branding that would revitalize the city and attract new economic development from the urban planning and tourism perspective, a human centered rather than nature centered point of view.

Furthermore, this study posits that resource user of urban stream is also voter who can grant or deny support to the Mayor in the next election. We argue that in the context of a democracy, as long as voter can appreciate the new cultural service provided as a result of urban river restoration effort, the successful re-election of mayor would reinforce this focus on cultural service of urban river, strategically neglecting the provision and regulation service that is not directly linked to the human well-being or beyond citizen's monitoring reach. In other words, if citizen remain silent or uncritical about a variety of restoration aspects of the urban river and take for granted the "business as usual" without depending on urban river for critical provision service such as drinking or irrigation, the robustness of urban stream would be systematically compromised in the long term. Urban river would constantly remain mediumly polluted ( $3 > RPI > 6$ ) or even worse without complaint or political motivation to change.

### **2.2 Shocks, Capacities, Vulnerabilities**

The system is periodically subject to the democratic routine of mayoral election – so called political turnover (Wolman, Strate, & Melchior, 1996) as exogenous driver to impose change in the political leadership. Based on the Love River case, there are at least three scenarios that can influence the robustness of the system:

- 1) The elected mayor pays little attention to urban river restoration (Mayors before Mayor Hsieh II 2002-2006)
- 2) The elected mayor pays abundant attention to Wannian River restoration (Mayor Hsieh II 2002-2006, Mayor Chen I 2007-2010, Mayor Chen II 2011-2014, Mayor Chen III 2015-2018)
- 3) The elected mayor was ready to claim the last mile of restoration (Mayor Chen III 2018, Mayor Han I 2019-2020).

### 2.3 Robustness Summary

This study posits that the sustainability of urban river restoration is contingent to a repeated game of mayoral election, reelection of mayor (maximum two terms), the associated campaign promises, policy priority and restoration focus that followed. While Love River has undergone nearly two decades of intensive river restoration effort, how the sustainability of Love River can be guaranteed with the present institutional arrangement is unclear. In particular, the objective data of water quality showed a slightly declining trend in spite of heavy investment in different infrastructures and the celebration of the last mile of restoration claimed by the local government since late 2018.

### 3. Case Contributors

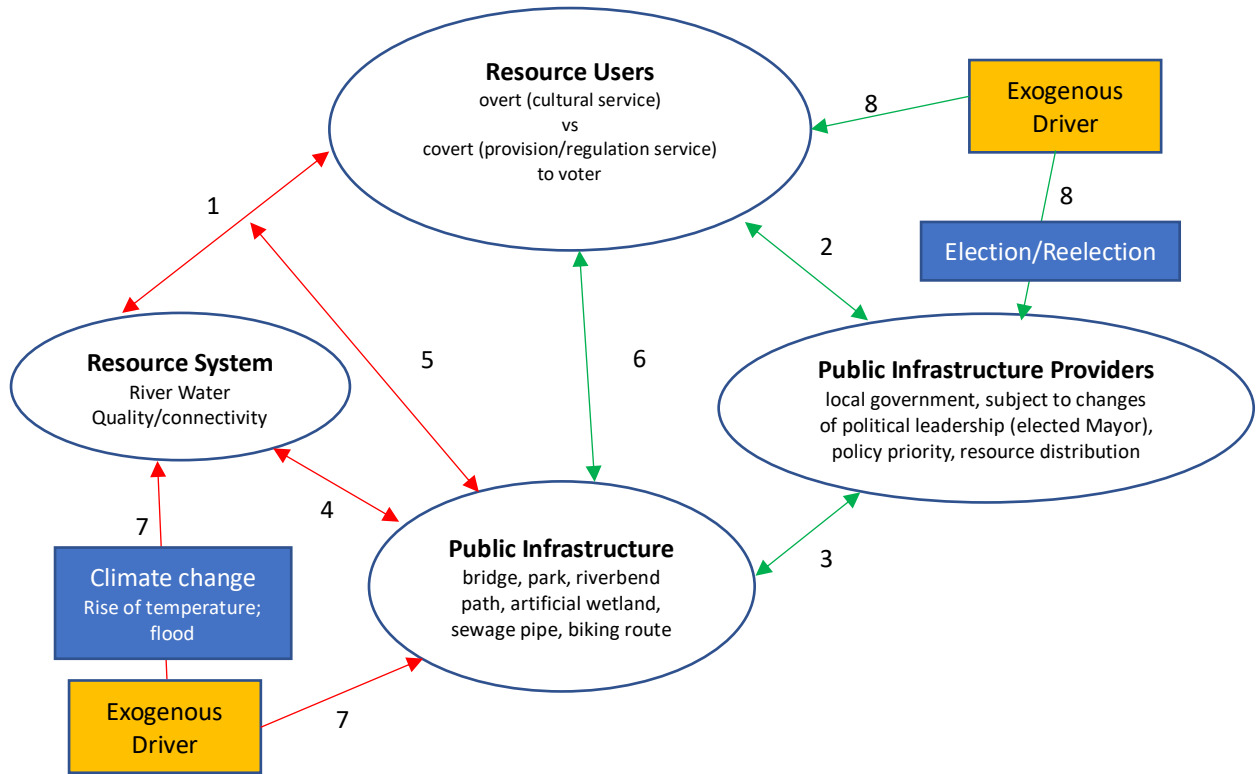
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### 4. Source

- du Bray, M. V., Stotts, R., Beresford, M., Wutich, A., & Brewis, A. (2019). Does ecosystem services valuation reflect local cultural valuations? Comparative analysis of resident perspectives in four major urban river ecosystems. *Economic Anthropology*, 6(1), 21–33. <https://doi.org/10.1002/sea2.12128>
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## System Representation



\*green line represents positive feedback; red line represents negative feedback

\*\*decoupling of cultural service (overt to voter) and provisioning/regulation service of urban river (covert to voter).