

Water Governance for Drought/Water-Scarcity in Taiwan
– a Multi-Layer Management System
Jan, Ming-Young¹ and Chang-Chi Cheng²

Taiwan is located in the mid-latitude area of northern hemisphere with annual rainfall reaching 2,300mm. However, rainy season accounts for over 80% of the total annual rainfall while there's only scattered rainfall in dry seasons. The status of agricultural water in Taiwan agrees pretty much with the distribution in wet/dry seasons. In other words, a great amount of water is required in almost every Februaries. At the same time, however, water level is at its lowest, river flow is close to the base-flow, and the possibility of rainfall is slim. Water scarcity occurs frequently due to little precipitation in the previous year, or insufficient storage as a result of flood operation of reservoirs. Overall speaking, the short of water resources in the spring each year has become an important issue for the management agencies in Taiwan. Over the years, a multi-layer management model has gradually formed, and it's worthwhile to share it as well as for discussion.

According to the law of Taiwan, the major water resources uses are domestic, agricultural, industrial, and other secondary purposes. For domestic water (approximately 17%) and industrial water (13%), the water distribution facilities are mostly provided by the public water companies, and only a small portion of the industrial water uses recycled water for production (fig-1). In wet seasons, the water companies intake surface water from rivers, and in dry seasons, the water distribution from reservoirs is relied. In the first half of spring application, nearly two thirds of the agricultural water is provided from reservoirs, and in the second half, irrigation water is sustained by rainfall as well as surface water from rivers. The demand for domestic and industrial water remains generally in a constant volume. However, as the demand for irrigation water is closely related to crop types, there is competition as well as cooperation among every water sectors in the spring (fig-2). And further water shortage requires negotiation in an effective and fair manner.

On the distribution or management of water shortage in Taiwan from the perspective of water management, the roles for the water-use negotiation could be briefly classified as follows.

- 1) the governing units(GU), which mainly are the government agencies, e.g., the Water Resources Agencies of the Ministry of Economic Affairs, and /or the Department of Agricultural Water Resources, Council of Agriculture. These agencies are responsible for the distribution of water rights and the preparation of administrative guidelines, and the activation of the

¹ Associate Professor, Department of Civil and Environmental Engineering, I-Shou University, Kaohsiung, TAIWAN, +886-910-871580, aqua.jan@gmail.com

² Corresponding author, Associate Professor, Department of Property Management, Chien-Hsin University of Science and Technology, Zhong-Li, Taoyuan, TAIWAN, +886-926-634635, fabercc@gmail.com

- negotiation process.
- 2) the distribution units(DU), which operate with a complete organization, e.g., Water Companies, regional Irrigation Associations, or centralized Science Parks. Organizations in this category generally have clear targets for service, a more precise water-use records, and negotiation capabilities.
 - 3) the end users(EU), which are those receiving distributed water in the water-supply system, e.g., households, farm units, or small production businesses. No solid organization, no clear representatives, and possibly no information on the minimum demand are characterized in this category.

When there is potential emergency for water supply, the warning for water conservation would be issued by the government (fig-3). However, no enforcement on the behavior of the water users is applied. When there is water-scarcity crisis, the negotiation mechanism is activated in order to find actions which could solve problems among water users. If negotiation fails, the government intervenes to introduce the administrative regulations, and domestic users have the first priority, followed by industrial, and then agricultural.

Various water management alternatives are gradually applied step by step, from pressure-reduction, flow-reduction, rotational cut-off by regions, fallow, to crop-change, etc. In the negotiation process, the end-users are supporting roles without getting involved for further discussion.

Although the water-shortage problem is solved in the negotiation process, the fact that agricultural water always being put in low priority has become another issue. Due to the control of government units, the Irrigation Associations and farmers could do nothing but to accept the result of water resources re-distribution (fig-4).

Although each year in Taiwan, the water-shortage crisis is always passed through the practices of the water management agencies in Taiwan, yet no systematic control rule has been formed. Based on the experience of water-shortage management as well as the model of strategic levels for management, it is suggested in this article that the strategic management levels for drought /water-scarcity be classified into three, namely, the government level, the regional level, and the end-users' level. There are strategic goals for each level. Whenever these goals are confirmed, the corresponding countermeasures are prepared and examined.

For the national level, policy management or revision of the laws and regulations is the main strategy, and food security, sustainable use of land, and minimal impact on the environment are set as the goals. Thus, in order to reach certain goals, certain regulations must be prepared by the government.

For the regional level, the negotiation for the allocation of limited water resources is the strategy, and to remain continuous operation of the business is the goal. Examples include that the Irrigation Association has to ensure the minimal water demand, Water Company has to satisfy the living requirement, and the Science Parks need to obtain the minimal water requirement for the operation. Under these circumstances, the regional-level water resources managers would find a balance point for negotiation between limited water

resources and flexible water price. And for the end-users' level, although there's no connection to the distribution process, basic principles for the strategy of least water loss must be followed. The purpose for this strategy is to reduce the water use in an attempt to delay the situation of no available water resources, so that the threat for lowered hygiene or sanitary for water-scarcity /drought

There is a lot of experience in the management of water-shortage scenarios. In this article, the hydrological as well as water-use characteristics, past water-shortage situations, and water-shortage cases (2014~2015) would first be introduced, then a multi-layered strategic management framework is stated (fig-5). This framework is basically a negotiation model of water-scarcity management, and has been practiced for years. Once the written format is confirmed, it can be a guideline to be followed for future water-scarcity management.

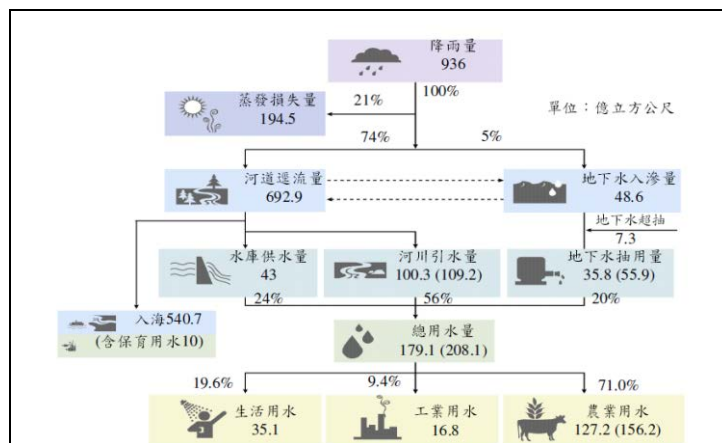


Figure 1 Water uses in Taiwan

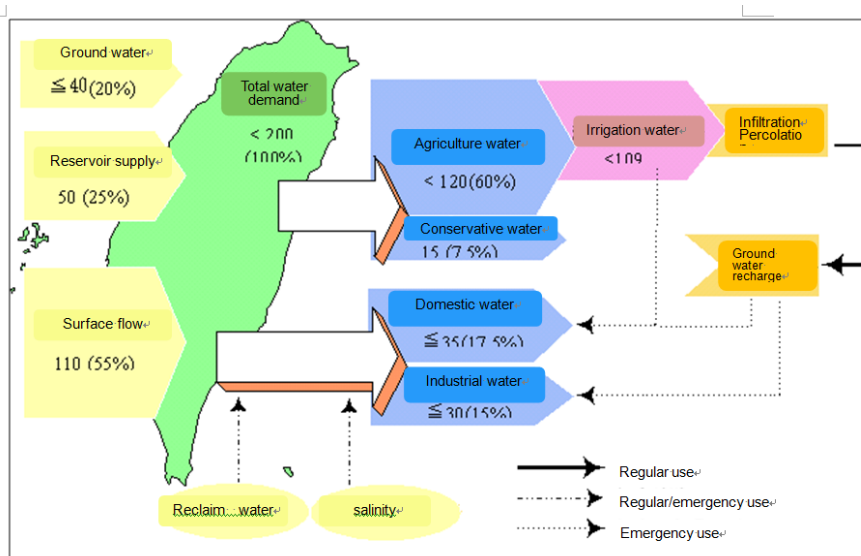


Figure 2 Water resources objectives and their water sources

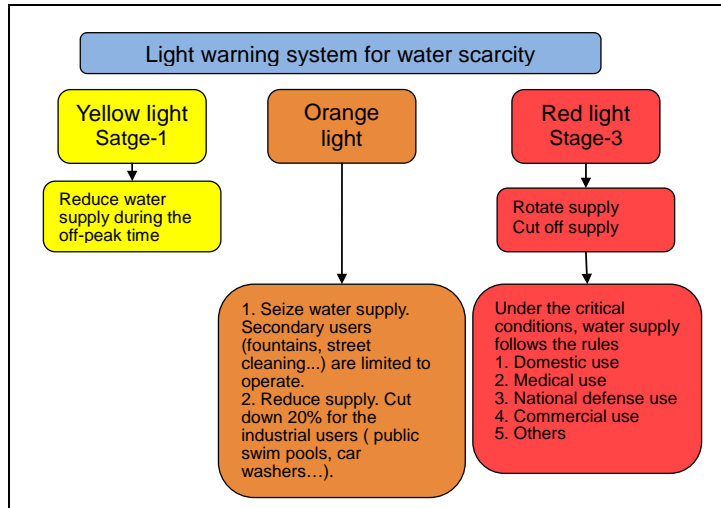


Figure 3 Light warning system for drought management in Taiwan

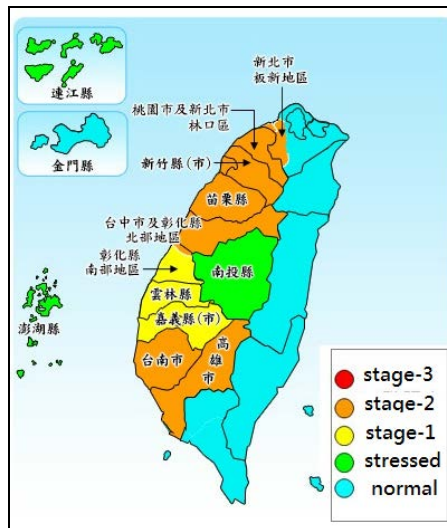


Figure 4 Example of the announced lighting status (2015-03-15)

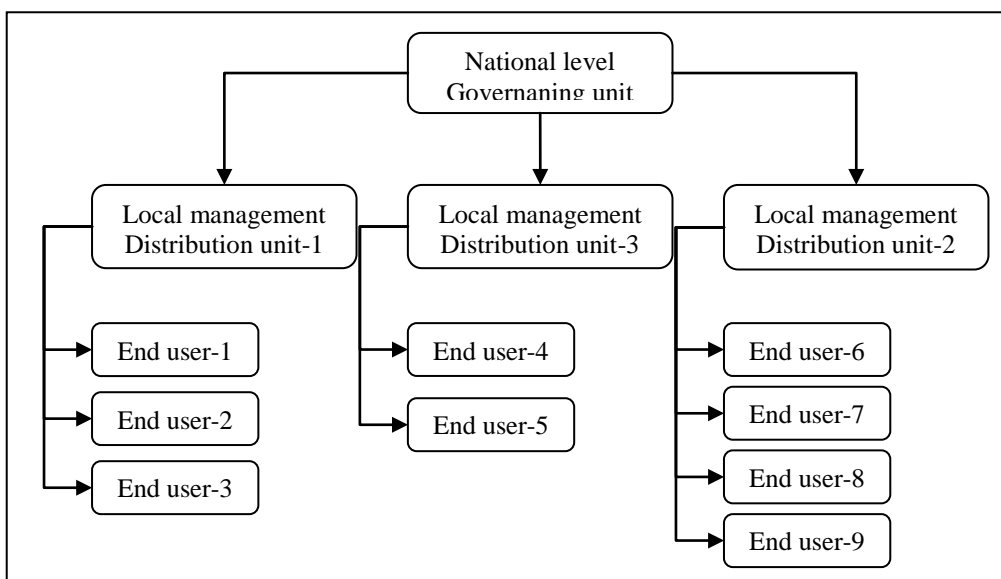


Figure 5 The conceptual framework of layered strategic management for water shortages