

<寄稿>

Multipurpose Rainwater Management in Korea

Mooyoung Han*

Professor, School of Civil, Urban and Geosystems Engineering
Seoul National University

Abstract

A new paradigm for rainwater management is suggested as a means of reducing water problems that arise from urban flooding and drought because of climate change in Korea. The rainwater management system uses many decentralized rainwater tanks for more than one rainwater management purpose. Multipurpose rainwater management is made possible by the use of information and control technology together with the cooperation of citizens. The system has been implemented by regulation in Seoul City.

Key Words : climate change, information technology, Korea, multipurpose, rainwater management

1. Introduction

Korea has always suffered from frequent flooding and drought because it is located in a monsoon area. Flooding and drought have increased in severity, probably because of climate change coupled with increased surface runoff caused by urbanization. This has resulted in many casualties and loss of property, as well as the high cost of securing sewerage and river systems.

A new paradigm is suggested where rainwater is managed on a decentralized basis, is controlled near its source, and involves local activities. The concept of multipurpose rainwater management is suggested for a more efficient management system.

Two examples of multipurpose rainwater management in Korea are discussed. The first example is a design concept for a rainwater tank in a new building in the Star City project. The tank is divided into three compartments: one for flood prevention, another for water conservation, and the third for emergency use.

The second example is a new regulation made by the Seoul Metropolitan Government, which requires installation of rainwater tanks in new large buildings for the purposes of flood prevention and water conservation. The

disaster prevention board of Seoul City can control the multiple rainwater tanks by using information and control technology. When heavy rainfall is expected, the City can order building owners to empty the tanks to prevent sewer flooding. At other times, the stored rainwater can be used for non-drinking purposes as a water conservation measure.

Cities elsewhere that have unexpected water pollution could use the multipurpose rainwater management concept suggested in Korea.

2. Changing rainfall characteristics due to climate change

Seoul City is 600 years old and has a population of 10 million. Comparison of the rainfall averages over the last five and 30 years shows the effect of climate change (**Fig. 1**). Overall precipitation has increased with more rainfall in summer and less in spring. As a result, many casualties and much loss of property occur each year. A very large investment is being planned to prevent flood damage.

The question arises as to whether the capacity of the existing water conveying system, such as sewers and rivers, is sufficient and, if not, how to increase the capacity.

Traditional thinking has been to upsize sewers, widen rivers, or increase pumping capacity when carrying capacity becomes inadequate. The water conveying system could be reaching its limit because of the recent rainfall characteristics. The cost of upgrading is very high and there are space

* Seoul, Korea
TEL: +82-2-880-8915
E-mail: myhan@snu.ac.kr

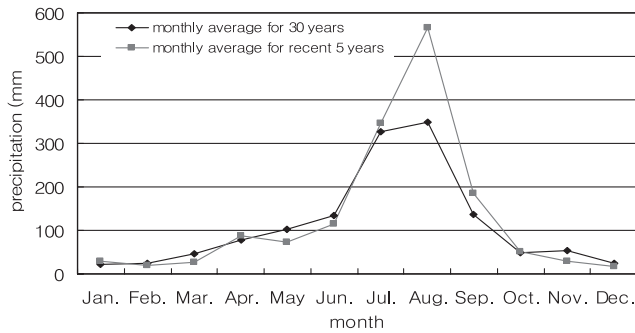


Fig. 1 Change in average monthly rainfall in Seoul

restrictions on constructing new facilities on or under roads in a congested city.

Hydraulic analysis of a circular sewer pipe shows that, when flow is near its peak, flow capacity decreases suddenly after a small addition of water. This causes sudden urban flooding. Therefore, when a sewer pipe is close to its full capacity, a small volume of water diverted to a water tank can reduce the danger of urban flooding at a local level.

3. A new paradigm for rainwater management

The traditional approach to urban flooding is to convey rainfall over a wide area to sewers and rivers.

An alternative concept is to manage rainfall in its watershed; that is, to store and manage the rainwater in the local area. By storing rainwater in a large number of small tanks, peak runoff is reduced and the time to reach peak flow is delayed. Relatively clean water stored in the tanks can be used for non-drinking purposes, resulting in water conservation. However, this approach requires the understanding and cooperation of local people, who must build many tanks and operate them according to rules.

A new paradigm is to develop multi-purpose rainwater management facilities. For example, it would be more efficient to manage both flooding and drought simultaneously.

3.1 Concept of multipurpose rainwater management

There are many water problems in Korea, such as flooding, drought, water pollution, dry rivers, and mountain fires. As briefly discussed below, these problems remain, possibly because each problem has been dealt with separately in the past.

Flood mitigation Large structures, such as dams, and riverbank raising, are considered for flood prevention. However, they cannot prevent flooding in local areas and small-scale sewer inundation occurs. These structures are not used to their full capacity most of the time.

Drought management Groundwater extracted in

spring, when there is no rainfall for an extended period, is being rapidly depleted. Water quality problems arise in rivers because there is insufficient water for dilution.

Dry river restoration Some rivers in the city become dry during the dry season because of the lowered groundwater level caused by slow infiltration of rainwater and by fast runoff during rainfall from covered impermeable surfaces. Measures to pump treated wastewater effluent or downstream river water upstream require large amounts of energy and result in water quality problems.

Mountain fires Mountain fires, which can be controlled by water, occur frequently in spring. However, the firefighting agency has little control of water availability. Unfortunately, mountain fires burnt a 1000-year-old temple and its treasures in March 2005.

Individual ministries with different interests and priorities deal with water problems. Solutions may sometimes be shortsighted and inefficient in national terms. The simple rose diagram shown in Fig. 2 illustrates this approach. Each law is shown conceptually. The river law, drawn in bold, shows that the major interest is flooding, with very little concern for drought. The water supply law deals only with water resource management, with little emphasis on other major fields.

An ideal management model would encompass all major items. However, the current major concerns in Korea are flooding, drought, and fire prevention.

The Seoul Metropolitan Government is now enforcing the first example of multipurpose rainwater management. Seoul has been suffering from repeated damage by flooding because it is urbanized and covered with impervious surfaces.

3.2 Examples of multipurpose rainwater management

1) Design of a multipurpose rainwater tank in a building project

A specific rainwater system was designed for a recently constructed building (Fig. 3) at the Star City Project in Kwangjin-Gu, Seoul. A 3000 m³ rainwater tank was installed in the basement and divided into three sections of 1000 m³ each. The first section collects rainwater from the unpaved surface. It should be kept empty most of the time except when there is heavy rain. The second 1000 m³ section collects rainwater from the roof, which should be used for toilet flushing and landscaping purposes. The third 1000 m³ section should be filled with fresh water and used for supply during emergencies such as firefighting or accidents.

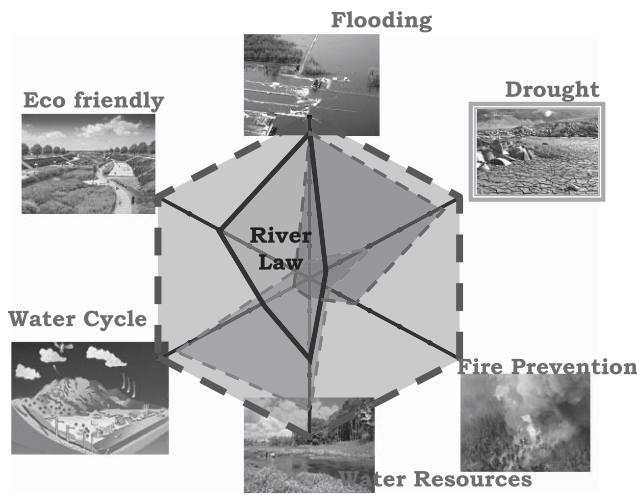


Fig. 2 Concept of multipurpose rainwater management

2) Seoul City rainwater management

Seoul City announced a new regulation to enforce the installation of a rainwater harvesting system in December 2004. The main purpose is to mitigate urban water flooding. The secondary purpose is to conserve water. It expects to ensure the safety of the city and improve the well being of citizens as a result. It asks citizens to voluntarily cooperate by filling and emptying the rainwater tanks according to directions from the disaster prevention agency.

A special feature of the new system is to provide a network for monitoring water levels of all water tanks at the central disaster prevention agency. Depending on the expected rainfall, the central disaster prevention agency may issue an order to building owners to empty their rainwater tanks fully or partially. An incentive program is planned for those who follow the order and some punishment for those who do not. After a storm event, the stored water can be used for firefighting and/or miscellaneous purposes such as toilet flushing and gardening.

The buildings included in the regulation are:

- All public buildings: compulsory for new buildings and recommended to the extent possible for existing buildings.
- New public facilities such as parks, parking lots, and schools: to the extent possible.
- Private buildings: recommended for new buildings subject to building permission (floor area larger than 3000 m²).
- Large development plans such as new town projects: installation of a rainwater management system as a first priority.

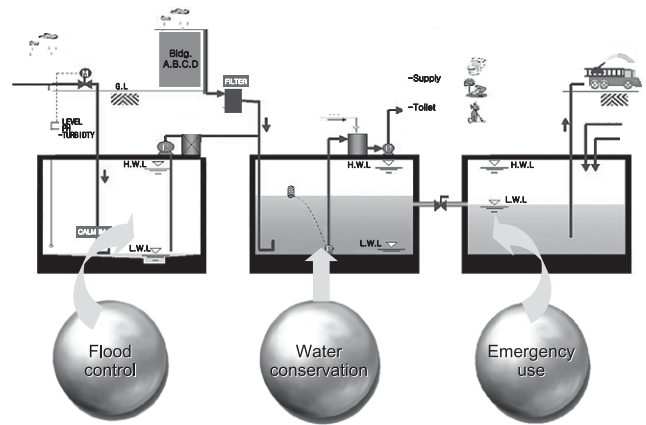


Fig. 3 Example of multipurpose rainwater tank design

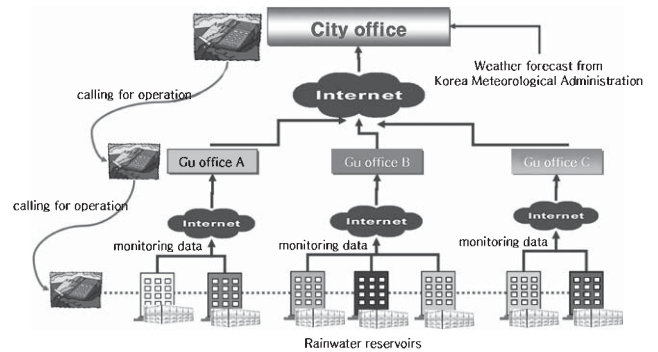


Fig. 4 Diagram showing the monitoring of a multiple tank system for preventing urban flooding and for water conservation

4. Conclusion

Damage by flooding is increasing in Korea because of climate change and urbanization. A new paradigm for rainwater management is suggested to reduce the cost of flood mitigation. The concept is to use many decentralized rainwater tanks as a multipurpose rainwater management system. The examples of multipurpose rainwater management at a building project and by regulation in Seoul City to prevent flooding and improve water conservation are promising. Operation and control of multiple tanks in conjunction with weather information is possible with the development of information and control technology and with the understanding and cooperation of citizens. Other innovative ideas and projects based on the concept of multipurpose rainwater management are in progress.

References

- www.rainwater.snu.ac.kr
- www.seoul.go.kr

韓国における多目的型雨水管理

Mooyoung Han (韓 武榮)

韓国ソウル国立大学 土木・都市・地圏工学部

要 約

キーワード