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Patterns, structures and regulations of domestic water cycle systems in China

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Domestic water cycle systems serving as one critical component of artificial water cycle at the catchment's scale, is so closely related to public healthy, human rights and social-economic development, and has gained the highest priority in strategic water resource and municipal infrastructure planning.

In this paper, three basic patterns of domestic water cycle systems are identified and analyzed, including rural domestic water system (i.e. primary level), urban domestic water system (i.e. intermediate level) and metropolitan domestic water system (i.e. senior level), with different "abstract-transport-consume-discharge" mechanisms and micro-components of water consumption (such as drinking, cooking, toilet flushing, showering or cleaning). The rural domestic water system is general simple with three basic "abstract-consume-discharge" mechanisms and micro-components of basic water consumption such as drinking, cooking, washing and sanitation. The urban domestic water system has relative complex mechanisms of "abstract-supply-consume-treatment-discharge" and more micro-components of water consumption such as bath, dishwashing or car washing. The metropolitan domestic water system (i.e. senior level) has the most complex mechanisms by considering internal water reuse, external wastewater reclamation, and nutrient recycling processes. The detailed structures for different water cycle pattern are presented from the aspects of water quantity, wastewater quality and nutrients flow.

With the speed up of urbanization and development of social-economy in China, those three basic patterns are interacting, transforming and upgrading. According to the past experiences and current situations, urban domestic water system (i.e. intermediate level) is the dominant pattern based on indicator of system number or system scale. The metropolitan domestic water system (i.e. senior level) is the idealized model for the future development and management.

Current domestic water system management efforts typically fail in China, because the approach is generally narrowly-focused and fragmented. This paper put forward a total-process control framework following the water and pollutants (or nutrients) flows along the dualistic domestic water cycle process. Five key objectives of domestic water cycle system regulation are identified including water use safety, water use equity, water saving, wastewater reduction and nutrient recycling. Comprehensive regulatory framework regarding administrative, economic, technical and social measures is recommended to promote sustainable domestic water usage and demand management. Considering the relatively low affordability in rural area, economic measures should be mainly applied in urban domestic water systems and metropolitan domestic water systems. Engineering or technological measures which are suitable to the three domestic water cycle systems are discussed respectively.