

# Chapter 16

## Water Systems in a Circular Economy: Extracting Value Through Integration

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### **ABSTRACT**

*The circular economy is based on three fundamental principles as defined by the Ellen MacArthur Foundation: design out waste and pollution, keep products and materials in use, and regenerate natural systems. This chapter explores the relationship between the circular economy principles and the water management systems to identify the integration points where the water systems can be aligned with the circular economy. The chapter also ascertains the impediments which hinder this transition and identifies the opportunities that will present themselves in this endeavor. This chapter aims to help the readers understand the social, economic, and environmental impacts that will be created when water systems get integrated into the circular economy framework.*

### **INTRODUCTION**

Water is an essential resource of human beings that can neither be replaced nor discarded. It is the very essence of sustaining life on earth. Water is used for several purposes that can be either consumptive or non-consumptive. Around 71% of our planet's surface area is covered with water with oceans holding close to 96.5% of the water on earth (USGS). Water also exists in the atmosphere as water vapor and is also present in rivers, lakes, swamps, and glaciers. A large quantity of water is held by the soil and underground layers of permeable rocks called the aquifers. The water that is extracted from the ground is known as groundwater. Even the bodies of living beings are not devoid of water. 60% of an adult human body is made up of water (School, Water Science).

Water is constantly changing forms and moving from place to the other. This movement of water above and below the surface of the earth is called the 'Water Cycle' or the 'Hydrological Cycle'. The

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consistent natural supply of water on earth is attributed to this Water Cycle. (The Water Cycle for Adults and Advanced Students)

Despite the abundance of water on earth, the shortage of water is felt by the world very often because over 97% of Earth's surface water is saline leaving less than 3% of all water as 'Freshwater' (Earthdata). More than two-thirds of the available freshwater is frozen in the form of snow and ice, and a big chunk of the remaining is groundwater. A mere 0.3% of freshwater on the earth is stored in rivers, lakes, and swamps and is easily accessible to us to fulfill the need of the people around the world (P. H. Gleick, 1996). Low availability, poor accessibility, and uneven distribution of freshwater resources have resulted in an extreme 'Water Stress'. One-quarter of the world's population spread across 17 countries faces an 'Extremely High' level of baseline water stress (Rutger Willem Hofste, 2019).

Unlike oil and other resources, water cannot be substituted with other products. Neither it is economically viable and sustainable to transport water from 'water-rich' to the 'water-stressed' areas. It is projected that in the next three decades the growing population and economy will push the water stress to its limits and freshwater availability may become the world's biggest impediment for growth. Southern California is already experiencing such a situation (Veolia Water).

Water Stress has created a huge water crisis in several developing and developed countries of the world. The highest number of water-stressed countries (12 out of 17) are in the MENA (the Middle East and North Africa) region. The World Bank estimates an economic loss amounting to 6-14% of the GDP because of the acute water crisis (Rutger Willem Hofste, 2019). The water situation in India is no better. In 2018, the apex think tank of India, the National Institution for Transforming India (NITI Aayog) announced that the country is suffering from its worst water crisis with 600 million people facing high to extreme water stress-causing 200,000 deaths every year. It is projected that by 2030 severe water scarcity will result in a ~6% loss in the country's GDP (NITI Aayog, 2018). A subsequent report released the following year declared that if corrective actions are not taken then 70% of the country's thermal power plants will face high water stress by 2030 that will result in higher power cuts to industrial units and which in turn will slow down the economic growth. Besides the economy, the ecology and biodiversity of the country may be compromised because of increased efforts to find new water sources (NITI Aayog, 2019). Even the countries that face low overall water stress may contain territories that experience extreme water stress. The Water Research Institute (WRI) has pointed out that places like New Mexico in the United States face extreme water stress despite the US being ranked 71 on WRI's list of water-stressed countries.

The current water crisis can be attributed to poor water system management. Water management is the activity of planning, sourcing, treating, distributing, and managing water resources under a defined set of regulations. Water management is a sub-set of water cycle management (OMICS International).

In the present system, water, like other materials is managed linearly. A linear system is a step by step plan to collect, create, and dispose off the products as waste. Therefore, the common cliché, Take-Make-Dispose associated with the linear economy can be inferred as Take-Use-Discharge strategy in water-based systems. The key takeaway from a linear system is 'Waste'. More than 80% of wastewater worldwide is drained away without being treated. The release of untreated water in the environment not only limits water re-use but also contaminates the rivers and the oceans and destroys the marine ecosystems. Over 800,000 people died from drinking contaminated water in 2012 (UNESCO World Water Assessment Programme], UNESCO. Director-General, (Bokova, I.G.), 2017).

Wastewater is an untapped resource that offers tremendous potential to benefit the economy and the environment. It is already playing a substantial role in several resource cycles. The reuse of properly

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