Water conservation in beverage production: examining corporate water stewardship programs

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Abstract. This paper evaluates the effectiveness of the current water conservation methods of beverage companies and provides suggestions for beverage companies on bet water stewardship strategies. In this paper, I answer two research questions: what are beverage companies’ water conservation strategies? What are the results, and how are the results measured? Four case studies on leading beverage companies are presented. The strategies are categorized by their contributions to different phases of production: the pre-production process, the production process, and the post-production process. Methods in the pre-production process concentrate on sustainable agriculture because agriculture consumes the most amounts of water resources. Strategies in the production process are operation management and plant redesign because they can effectively reduce water consumption in manufacture. The most popular approach in the post-production process is partnering with an environmental organization because it can influence the most amount of people. The four companies’ empirical experiences provide other beverage companies with lessons on sustainable water consumption and reveal practical directions for future academic researches.

1. Introduction

Freshwater is one of the most threatened natural resources. The leading conservation organization World Wildlife Fund indicates that more than one billion people lacked access to water in 2019 [1]. People urgently need more water with cleaner quality. Because the beverage industry is one of the industries that consume the most amount of water annually, tackling beverage companies’ water utilization can bring many environmental benefits to corporations and the affected populations. In addition to environmental issues, corporations that successfully control their water consumption can subsequently decrease their costs of production. Moreover, because environmental topics are receiving an increasing amount of attention, establishing an environmentally friendly image is critical for the reputation of corporations. Because of the environmental, economic, and social benefits, beverage companies have been investing heavily in water stewardship programs.

The current literature on the beverage corporations’ water stewardship programs offers extensive technological and sociological solutions. For example, Baker and colleagues [2] advise people to reduce absolute water consumption through increasing landscape hydrologic storage in agriculture, and Cassano and colleagues [3] discuss the wastewater treatment method Membrane Filtration’s application in beverage factories. On the one hand, researchers and scientists [4] have scrutinized the specific production steps of beverage corporations and redesign the manufacturing process through technological innovation. On the other hand, social scientists [5] have examined the reasons behind the high withdrawal of water of beverage corporations, and these researchers have promoted conservation through social and policy strategies.
Although the current literature demonstrates many solutions for corporations to conserve water, it does not analyze the effectiveness of different methods in different situations. Because the beverage industry is composed of countless suppliers, manufacturers, and customers, each company needs to identify the best strategies and create their own plans to achieve maximized water conservation outcomes. This study summarizes existing water conservation solutions and analyzes the outcomes of different companies’ strategies through four case studies. By comparing these water conservation strategies at different periods, I will specify the most effective water stewardship method for different companies based on the four prototypes. My research has shown that analyzing the water footprint and decreasing water consumption in the highest-consuming step of production can help corporations achieve sustainability.

The analysis that follows is based on the water stewardship programs of four leading beverage companies. Their strategies are compared and contrasted for three phases of production. The comparative analysis shows what some of the best practices are and how the practices are measured. The results will highlight water conservation suggestions for different companies under diverse conditions.

2. Methods

This paper studies four cases in the beverage industry to answer two research questions: What are the strategies of beverage companies for sustainable water consumption in the pre-production process, the production process, and the post-production process? What are the results of these strategies, and how are these results measured? The four cases cover three non-alcoholic beverage companies (Coca-Cola, PepsiCo, and Nestlé) and the biggest alcoholic beverage company, Anheuser-Busch InBev (AB InBev). These four companies are selected because of their global influences. The four companies all have invested in water stewardship for more than ten years. Their sustainability strategies have evolved from their past experiences, and other companies can learn valuable lessons from their strategies at different times.

This paper analyzes the four cases using a 4x3x2 design. The strategies of the four companies are compared and contrasted for three phases of production: the pre-production process, the production process, and the post-production process. Within each of the three processes, the two research questions are answered. Sustainability strategies in the pre-production process involve the company’s supply chains, such as farmers and communities that offer the companies resources for production. Strategies in the production process require operational management in factories. Sustainability efforts in the post-production process are concentrated on partnerships with environmental organizations to provide global communities with access to clean water and to reduce the impacts of beverage companies on the environment.

The four cases are presented in the order of PepsiCo, Coca-Cola, AB InBev, and Nestlé. The cases are ranked by the effectiveness of company strategies. PepsiCo has more than one decade of water stewardship experiences, and its efforts are evenly distributed in three production phases. Coca-Cola has two decades of sustainable water consumption experience and participates in a wide range of environmental projects to help communities in need. Its environmental efforts concentrate on the production process because it focuses on operation management. In addition to the previous two companies, AB InBev has invested in sustainability strategies for a long time, and it provides valuable experiences for brewing companies. Nestlé started its sustainability transformation in the 2010s, and its strategies are examples of food and beverage companies that plan to initiate sustainable production. The data for the cases is mainly from the companies’ reports, whereas some analyses are provided by third-party institutions. The four companies all publish detailed reports about their sustainability efforts and introduce their strategies on their websites. Moreover, their environmental organization partners in the post-production process provide further information about communities that they impact. Other data come from third-party institutions, such as research organizations. This data indicates how scholars and environmental professionals evaluate the strategies of these four companies. The third-party reports, as well as official data from the four companies’ websites, provide a holistic overview of their sustainability efforts. The effects of their strategies are assessed by the number of water resources they save and the number of people they influence.
3. Results and discussion
This discussion will compare the four companies across the three production processes, with the discussion divided into the first research question (strategies) and the second research question (results). Because the information is complicated, there is a separate summary table for each research question.

3.1 Strategies
With respect to the first research question, the four companies employ diverse sustainability strategies in the pre-production process, production process, and post-production process.

| Corporations | Coca-Cola | PepsiCo. | Anheuser-Busch InBev (AB-InBev) | Nestlé |
|--------------|-----------|----------|---------------------------------|-------|
| 1 Pre-production process | Sustainable Agriculture Guiding Principles: requires suppliers to control wastewater discharge and agrochemical runoff [6]. | Sustainable Farming Project: works with farmers to improve their environmental performances. Set up standards for water conservation and train suppliers for on-field agronomy [7]. | SmartBarley: an online platform that publishes AB-InBev’s research discovery about water conservation methods in agriculture. Analyzes farmers’ field data and provides distinct advice [8]. | Caring for Water Initiative: Hold field studies for suppliers. Creates drought-resistant plantlets. Provides general training and specific advice on irrigation practices [9]. |
| 2 Production process | Reduce the manufacturer’s absolute water consumption by launching a system-wide water resource sustainability requirement. Train workers through a web-based, self-guided tool. Set up stringent standards for wastewater treatment. | Resource Conservation program (ReCon): explores and shares the most efficient operation practices in factories. Implements leading technology, such as the Membrane bioreactor strategy, in factories in multiple locations. | Voyager Plant Optimization management system (VPO): analyzes the data of production plants and factories and minimizes wastewater generation. Encourage plant renewal in factories. Educate employees on water conservation. | Conducts 26 Water Resource Reviews in selected factories. Set the Alliance for Water Stewardship Standard. Certifies four of its factories to meet the standard. |
| 3 Post-production process | Recycles wastewater produced in the production process and releases treated water back to the environment - organizations and governments to improve water conservation. | Partners with The Nature Conservancy and World Wildlife Fund (WWF) to start water funds and provide communities | Reduces water consumption in retail and distribution processes. Engages in the 2030 |

1 The data analyzed in this paper comes from company reports cited in this paper’s References section.
The four companies have different strategies because they focus on different phases. In the pre-production process, the companies focus on agriculture because it consumes the most amount of water. Popular methods to reduce water consumption in agriculture include analyzing farmers’ field data and providing agronomic advice for suppliers. AB InBev’s Research and Development Department provides a model strategy because it establishes technology innovation to help farmers. Its advanced analysis of farmers’ field data allows it to provide precise suggestions for its suppliers. PepsiCo’s and Nestlé’s strategies share similar patterns because they both provide farmers with specific suggestions. Coca-Cola grants outperforming suppliers certifications for their sustainability efforts but does not offer specific suggestions for individual suppliers.

The production process allows the four companies to save water in diverse ways. Common strategies are setting water conservation standards and managing their operations. To minimize water consumption in the production process, the four companies all create general operational management systems, such as PepsiCo’s ReCon program and AB InBev’s VPO system. Providing training on sustainable water consumption for employees is another strategy adopted by Coca-Cola and AB InBev. In addition to the prevalent methods, PepsiCo invests in particular technology innovation, the Membrane bioreactor, to further reduce its production’s water usage.

In the post-production process, the four companies all partner with non-profit organizations to implement environmental projects. The four companies establish co-operations with the WWF to conduct water conservation projects, and most of the projects focus on increasing people’s access to clean water. Coca-Cola takes an advanced step to recycle 100% of its wastewater generated in the production process back to the environment, marking an outstanding water stewardship performance in the post-production process.

With respect to the first research question “What are beverage companies’ water conservation strategies,” Table 1 analyzes the strategies of four global beverage conglomerates and indicates that their methods address different production phases specifically. Coca-Cola invests less in the pre-production process but has focused instead on the production and post-production processes. AB InBev incorporates more technology innovation in its strategies than other companies do because of its strong Research and Development Department. PepsiCo has a balanced investment in the three processes. Nestlé started its water conservation efforts in the early 2010s, which is later than the other three companies. Consequently, Nestlé’s achievements are more focused on setting up water stewardship standards. The company has not yet accomplished significant water consumption reduction in the pre-production process.

3.2 Results

Table 2 answers the second research question “what are the effects of beverage companies’ water conservation methods, and how are the results measured?” The efforts of the four companies can be measured in terms of the water they save and the number of people they impact. Their investments in the pre-production process and the production process save water directly. Coca-Cola and PepsiCo

| Corporations             | Coca-Cola            | PepsiCo.                | Anheuser-Busch InBev (AB-InBev) | Nestlé               |
|--------------------------|----------------------|-------------------------|---------------------------------|----------------------|
| environment.             |                       |                         |                                 |                      |
| Launches                 |                       |                         |                                 |                      |
| environmental            |                       |                         |                                 |                      |
| projects to increase     |                       |                         |                                 |                      |
| water access and         |                       |                         |                                 |                      |
| watershed restoration    |                       |                         |                                 |                      |
| in communities in need.  |                       |                         |                                 |                      |
| with access to clean     |                       |                         |                                 |                      |
| water.                   |                       |                         |                                 |                      |
| Performs water risk      |                       |                         |                                 |                      |
| assessments in South     |                       |                         |                                 |                      |
| Africa.                  |                       |                         |                                 |                      |
| Motivates private        |                       |                         |                                 |                      |
| sector investments to    |                       |                         |                                 |                      |
| increase water access.   |                       |                         |                                 |                      |
| Water Resources          |                       |                         |                                 |                      |
| Group to help            |                       |                         |                                 |                      |
| people living in dry     |                       |                         |                                 |                      |
| areas access clean water. |                      |                         |                                 |                      |

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both use less water to produce one unit of product compared to their previous operation, and AB InBev’s and Nestlé’s overall water consumption both decrease from their preceding records. In addition to their absolute water consumption, the four companies all influence two other populations: their suppliers and the people in need of water. On the one hand, by setting standards and providing suggestions for their suppliers, the companies motivate tens of thousands of farmers to engage in sustainable water consumption practices. On the other hand, through partnering with environmental organizations and participating in sustainable projects, the companies help millions of people in areas with high water risk access to clean water.

Table 2. Results Achieved by the Four Companies across the Production Processes²

| Corporations                  | Coca-Cola                                      | PepsiCo.                                      | Anheuser-Busch InBev (AB-InBev) | Nestlé                              |
|-------------------------------|------------------------------------------------|-----------------------------------------------|----------------------------------|-------------------------------------|
| 1 Pre-production process      | Grants certification for outstanding suppliers [10]. | Establishes more than 100 demonstration farms. Saved 466 million liters of water in 2017 [11]. | 7,000 farmers have participated in the SmartBarley platform and received individual reviews from more than 100 agronomists. 8% reduction in AB InBev’s total water usage in 2019 [12]. | Built ten projects in water-stressed areas. 100/100 score in the Water-Related Risks section of the 2018 Dow Jones Sustainability Index. Established farm assessment tools in five countries [9]. |
| 2 Production Processes        | Reduced the amount of water required to produce one liter of the product by 16.4% from 2010 to 2018. Total water consumption remained the same at 300 million kiloliters from 2010 to 2018 while the revenue increased by 16%. | Reduced total water consumption in 2018 to 86,700-megaliters. | 95% of facilities met the VPO goals by 2012. From 2009 to 2012, AB InBev’s factories reduced water consumption by 17.5% in the United States, 17% in Canada, and 38% in China. | Water consumption reduced 56% in its powdered and liquid beverage factories and 29.6% across all of its factories from 2010 to 2018. |
| 3 Post-Production Processes   | Released 179 billion liters of treated wastewater to the environment in 2009. Helped 0.8 million people access to water in 2018. | Helped 0.75 million people to get access to clean water in 2019. | 100% of its communities in highly-stressed areas had improved water availability and quality. Awarded by the German Ministry. | Helped diverse communities in need. For example, supported EcoLink to provide over 150,000 people in South Africa with access to clean drinking water |

² The data analyzed in this paper comes from company reports cited in this paper’s References section.
Other beverage companies can learn from these four companies’ strategies in various ways. Beverage companies can evaluate farmers’ data to provide specific suggestions to reduce their suppliers’ water consumption. If collecting and analyzing different farms’ data is not feasible, companies can provide training on water stewardship for farmers. In the production process, operational management is proven to be the most effective method. Beverage companies can follow water conservation requirements set by industry leaders and revamp their factories. Wastewater recycling and absolute water consumption reduction are two popular means in operational management. In addition to this approach, employee education is a cheap and convenient way to improve sustainable water usage in the production process. The most common water stewardship method in the post-production process is to partner with environmental organizations. WWF is a leading figure in this area. This partnership allows beverage companies to participate in existing projects and improve many people’s access to clean water.

4. Conclusion
My paper compares the water stewardship programs of four leading beverage companies. This study indicates that different sustainability strategies can bring diverse water conservation outcomes in different production phases. Companies should use different strategies in different phases of production to achieve maximized effect. In the pre-production phase, the ideal strategy is to hire agronomists to evaluate the environments of different farms and to provide specific advice and publish water-conservation advice that targets general climate types on online platforms. Meanwhile, setting water stewardship goals also motivates suppliers to use water efficiently. In the production phase, operation management is critical for water conservation. Technology innovations, such as the membrane filtration method, help companies recycle wastewater and subsequently reduce their absolute water consumption. Moreover, employee education encourages workers to apply more sustainable operations. Other companies can learn from leading companies’ operating systems and adopt advanced technology to conserve water. In the post-production process, beverage corporations should strive to reduce the impact of their business on the environment. By partnering with environmental organizations, companies can expand their influences and enable large numbers of people to get water access. Implementing these water stewardship strategies can help companies conserve water and build positive images in front of consumers.

5. References
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