

A Pub-lication of Beer



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Keywords

- Microbrewery
- Brewing
- Fermentation
- Deep Ecology
- Social Ecology
- Shallow Ecology
- Eutrophication
- Acidification
- Green Certification
- Market Response Model

Chapter Menu

Introduction	p. 2
A Short History of Beer	p. 4
Ethics, Justice, and Equity	p. 6
Social Construction of Beer	p. 9
Markets and Commodities	p. 11
Conclusion	p. 13

The Brew-tle Truth of Beer

Imagine walking into your local **microbrewery**. Your eyes scan the room while the smell of beer fills your nose. Stacks of napkins were in arms reach, ready for the unfortunate glass that tips too far. Clean glasses and mugs lined the long counter waiting to be filled and refilled as consumers slowly sip from it. Sliding onto a barstool the bartender haphazardly asks ‘what’ll it be?’ while cleaning the countertop. Sensing uncertainty the bartender starts to list off a plethora of beers specific to the brewery while describing their attributes. Stout? Lager? Ale? Settling on the house favorite your mind begins to ponder over the extensive lists of beers and the words often associated. What does it really mean for a beer to be brewed locally? Besides how the beer is produced, is there anything different?

Microbrewery: A small scale brewery that often brews a limited supply of beer each year and sells it locally.

Brewing: The process of making beer. The final product from the brewing process is often called a brew.

The process of making beer, or **brewing**, is complex (see figure 1). Each step can be altered resulting in different kinds of beers. The brewing process starts with malting, or when the desired grain (depending on what type of beer you want) is dried and sent through a grist mill to crack open. From there water is added to the malt and heated in order to produce a reaction, otherwise known as mashing. Next, you separate the malt from the water and boil the product. At this point the notably important step of hopping occurs- adding hops to the boil, giving the beer its bitter taste and aroma. After the boiling is complete, and hop solids are removed the fermentation process begins. The fermentation process which adds yeast to the substance, through a chemical reaction, gives the beer its carbon dioxide and alcohol content.

Depending on the method of fermentation used, beers can be split into two main styles. The main two styles of beer are the ale, which is usually more aromatic and maltier, and lagers which are usually lighter and crisper. Breaking your train of thought, the bartender asked if you want a refill which you respond with a slight nod. The brewery was small and the atmosphere light. It was different from bars with the typical craft beers. Rather than producing beers in mass quantities like the large breweries, microbreweries produce a limited number of quality beers each year. That being the case, it was a quaint yet active place, the perfect spot to kick back and enjoy a brew.

Before the Pint of No Return

The different kinds of beer make it possible for more people to enjoy it due to the range of flavors. It’s bottles and cans make beer convenient and portable. Plus, the drinks versatility makes it consumable at any (reasonable) occasion. A reunion filled with laughter and old stories pairs well with Bell's Two Hearted. It's a Saturday afternoon and your tailgating with the boys, perfect time to pop open the cooler and grab an ice-cold Coors Light. Dinner, concerts, hangouts, sporting events, parties, holidays, vacations, celebrations and many more all call for a beer in hand. Despite being the most consumed beverage, seldom do people know the implications beer has on our environment (De Gaetano, 2016). From the first step to its last, the production and consumption of beer are detrimental to our environment. In fact, from cradle to grave the average liter of beer produces 1.5 kg of carbon dioxide emissions (Saxe, 2010). Now before you swear off beer for good it's important to know the ways in which beer is harmful to our environment to hopefully

enact change. We will do this by exploring beer through the topics of history, ethics, markets, and social constructs. We hope that this will open people’s eyes to see how even the most common items can pose serious threats to our environment. Additionally, we hope that you will use this as a way to change habits or potentially lead you to consider common things in your life that may be causing a lot of harm.

Un-beerable Impacts to the Environment



Figure 1. “Density Design Research Lab” by Piero Barbieri licensed by (CC-BY-SA)

It seems unlikely that beer would deplete a significant amount of water, but it does. Not many people take into account the large amount of water needed to produce, cool, and wash cups. For example, over a year 1.34 billion hectoliters of water were used by the brewing industry (Fillaudeau, 2006). Additionally, growing the ingredients needed to produce beer (such as wheat and barley), uses an abundant amount of water. Within the ethics section, we will explore the ethics of water use in beer production. By extending moral consideration to our environment we begin to question if our actions are morally just. That being the case, in the case of beer, we will explore if beers use of water is right or wrong. In turn, by looking at beer in this perspective we are able to question if we should continue our actions. Additionally, this section includes real-life examples of how mass consumption of beer is affecting water and the implications it has on the world and its people right now.

Next, we will look at the role beer plays as a commodity in our markets. As previously stated, beer is the most consumed beverage in the world. This has made a heavy demand for beer. So far, people have been able to supply the desired amount of beer, which keeps the price low. However, what will the future of beer look like? Will the changing Earth and emerging effects of climate change disturb the balance of beer in the market? Will farmers be able to supply enough to meet the demands of customers? Will beer prices skyrocket to become only consumable by the wealthy?

Lastly, we discuss how the social constructs of breweries are further impacting this issue. This analyzes breweries as a social construct, that is society has created a specific idea or way of looking at different breweries. This reveals how the social construct we hold of breweries may not be as accurate as it seems. In

turn, this shows how the production, regardless of amount, is impacting our environment. However, before we begin discussing the previously stated issues regarding beer, we must first look at the past. Meaning, in order to understand our current situation, first we have to explore the history of beer. This next section explains when and where beer was first emerged historically. Thus, we are able to see the immense progress we've made in the beer industry today.

A Short History of Beer

Whether it's been a positive or a negative experience, beer has always been at the heart of entertainment. Since the time you've turned twenty-one or in some cases maybe even younger, beer has been the go-to drink for dinners, concerts, hangouts, sporting events, parties, holidays, and even celebrations. Consuming beer is more than just the life of a party. Beer is perfect for just about any occasion. After all the great memories beer has brought and will continue to bring into our lives, one might just wonder how it became the world's favorite drink. It all started with the very humans who found the **fermentation** process. The fermentation process has been thought to have occurred as early as 12,000 years ago as hunters and gatherers experimented with wheat, rice, barley, and maize. However, scientist and historians alike can only trace the evidence of the first brewers back nearly 9,000 years. In fact, just recently an archaeologist named Patrick McGovern discovered the oldest known proof of humans brewing beer- "The earliest recorded evidence is from the Chinese site of Jiahu, dating back more than 9,000 years" (Nelson, 2014). Beer is well-known for its intoxicating properties, but something people don't know is that it just so happens to be the oldest recorded recipe in the world and even in some cases the first source of currency. In ancient Mesopotamia, it has been found that beer was an extremely valuable currency when trading between countries (Andrews, 2014).

Fermentation: the chemical breakdown of a substance by bacteria, yeasts, or other microorganisms, typically involving effervescence and the giving off of heat.

The Ancient Ones

Ancient Egyptians were the first to record their own recipes of beer on papyrus around 5,000 BC. The process of recording new recipes and methods for creating new beers has since continued to be reinvented throughout time. The process has become a science of which people all across the world participate in for fun. To many people currently in the world, it's a beloved hobby. Beer throughout the ages transcended even further than just a currency or hobby as many cultures quite literally began to worship its intoxicating properties. There have been hundreds of goddesses and gods throughout time who have been worshipped for the belief of creating beer. One of the first to be worshipped was the

The Rule of St. Benedict: A book of precepts written by Benedict of Nursia of which played a large influence of the way communal monks live in 500 AD

Sumerian Goddess Ninkasi, the Goddess of beer and brewing who was known for satisfying the needs and desires of humanity. Another example is the Egyptian God of Grain, Osiris. Osiris is credited for showing Egyptians how to brew beer from barley (Godlaski, 2011). Not only did the Egyptians worship the intoxicating properties of beer, but they also believed it was a medicine and drank it specifically to cure diseases. Probably the most popular of all was the Greek God Dionysus. Dionysus is believed of being the god of intoxicating drinks and liberation. The Greeks believed that the properties of beer and wine gave

liberation to the people and their antics. Beer has always been popular throughout humanity, but it wasn't until around the 5th century until this beverage was marginally available everywhere.

The Progression

The progression of the beer industry was mainly due to European monks around AD 480. These monks were encouraged to sell beer by a rule acknowledged by the Catholic Church called **The Rule of St. Benedict** (Guevue, 2010). This rule stated that all monks should earn their own keep and donate the proceeds to the poor. Monks commuted across Europe traveling from monastery to monastery. Selling beer was ideal for the monks as the majority of the water they came across in their travels was likely contaminated with sewage. Brewing beer gave these monks the opportunity to drink a fully cleansed beverage. It is evident that beer also allowed monks to go long periods of time without eating. Anytime they needed money for tithes they would sell this beer away and donate the proceeds to the needy. This is significant, because without these monks traveling afar learning new methods of brewing while also sharing their recipes, there very well may never have been so many different varieties. Monks also helped inspire and establish local taverns and pubs all across Europe (see Figure 2). Some of the most prominent being in Germany, Scotland, Belgium, and Ireland. These places would go on to create some of the most popular beers in the world. Monks were the first to mass produce beer, but it wasn't until the Industrial Revolution in the early 1700's that the facilities and transportation methods would progress enough to be able to supply the thirsting demand of beer. Since then, nearly every country has its own regional breweries making beer one of the most culturally diverse products in the world.



Figure 2. “Rhodon” by Daniel Jolivet licensed by (CC BY 2.0)

Sociological Impact

It is evident that beer has played a large role in the sociology of people. In fact, some of the most influential moments in history have been directly correlated to the consumption of this precious beverage. Beer has even influenced some of the most important social gatherings in history. Probably the most influential series of meetings in the history of the United States of America were held in 1773 by the Sons of Liberty in the Green Dragon Tavern located in Boston, Massachusetts. These meetings were held to plan the Boston Tea Party which eventually led to the American Revolution.

Although beer has positively impacted history, there are also some cases where it has been extremely detrimental to society. For instance, ever since the creation of the automobile there have been problems with drinking and driving. According to the Centers for Disease and Control and Prevention, 29 people die every day in America due to car crashes of which one of the drivers was intoxicated (Stahre, 2014). This statistic isn't directly correlated to beer alone but it's

important to understand the impact beer may have when driving under the influence of it. Beer and its intoxicating properties have also led people down the wrong path towards alcoholism when consumed repetitively for long periods of time. It doesn't stop there as beer doesn't just impact humans, in some cases, beer has impacted the very planet of which we live. This being said, when consumed responsibly beer has proven to be a great influence on society. The mind-altering properties of beer have fired up our creativity and fostered the development of language, the arts, and religion for more than 9,000 years. After understanding the history and the significance of the creation of beer we can now begin to discuss the very Ethics surrounding beer and its environmental properties.

Ethics, Justice, and Equity

The brewing of beer consumes a significant volume of water due to the multiple processes that accompany producing such a historically and sociologically important beverage; such uses of water resources involve cooling, production, and washing (Geoffrey, 2011). In this section we analyze how water consumption for beer production in arid regions fits into the shallow, deep, and social ecology thought experiments, as discussed by Robbins et al. (2014). It may be easy to imagine a few millennials enjoying their local beers in the swanky bar tucked in the corner of your city's art district, but is there an ethical dilemma with the beer they are consuming? If we assume so for a moment, how can ethics help society solve these issues? We explore these ideas by investigating the systematic progress needed to meet the desired environmental outcomes.



Figure 3 “Colorado River flowing to Hoover Dam” by Bud Ellison is licensed under ([CC BY-SA 2.0](https://creativecommons.org/licenses/by-sa/2.0/))

An Ethic-ale Dilemma

The Industrial Revolution that Americans owe their success to was enabled by a scientific enlightenment that studied the world by breaking things down into understandable pieces. Recently, those truths have become blurred and even proven by science to often be uninfluential on human behavior (Robbins, 2007). This current era may well be marked in history as the post-science movement. This modern phenomenon has left a void that may be filled by holistic thinking - using multiple tools to justify actions versus just one, such as science plus ethics. In science, humans divide things into a million parts to better understand them, but they must be able to reassemble those things to make use of a cohesive set of information. Thus, society is now grappling with the idea that in order to make change, it has to begin with the individual. Then, and only then, a reciprocal relationship with the whole can develop, and progress can be achieved. The system that decides how

to make use of the results of science for practical applications are ethics. Ethics are a philosophical construction, agreed upon by some portion of a society, to justify human behaviors. They allow us to

interact with one-another and the world in a respectful way. However, ethics are shaped by the human experience, ever-adjusting with empathy, sympathy, and knowledge.

Shallow ecology is an ethic that uses those divided pieces of the whole to identify individual problems and solve them. However, shallow ecology does not aim to find the source of the problem, it simply provides a temporary solution. For example, the Central Arizona Project (CAP) which brings water across the Sonoran Desert to give life to millions of people is a shallow ecological solution to living in Phoenix, an arid region. So, should society view this phenomenon as an engineering accomplishment? Well it is an achievement, undoubtedly, but that answer also depends on your ethics. From a shallow ecological view

Shallow Ecology: refers to the philosophical or political position that environmental preservation should only be practiced to the extent that it meets human interests.

Deep Ecology: A philosophy of environmental ethics that distances itself from 'shallow' or mainstream environmentalism by arguing for a 'deeper' and supposedly more truly ecologically-informed view of the world. It asks deeper questions about the root cause of 'shallow' issues.

CAP would appear to have met its goal, after all Phoenix is one of the most beautiful places to live and outdoorsmen have great access to the desert's natural resources (Ruiz, 2012). However, the breweries in Phoenix that craft pints locally use the water that comes from CAP - so on second thought, the phenomenon has anthropogenically drained the Colorado River (Figure 3 above) to the point that it no longer reaches the ocean (Zielinski, 2010). This is the Achilles heel of shallow ecology, it typically solves one issue but creates another. It may seem arbitrary that the river never reaches the ocean, but "shellfish, shrimp and waterfowl have declined dramatically as fresh water has dried up" while breweries are allowed to exploit this precious resource due to their lack of geography and political capabilities (ibid). If the solution, however, is to halt all water use for beer production, even then it

seems unlikely that the water would be given back to the river to flow for its own intrinsic value because other stakeholders would drain it for use elsewhere. To further understand potential solutions to breweries in drought-stricken areas, a broader critique is helpful. **Deep ecology** investigates the relationship between the environment and society to gain a more holistic view of the problem. This critique might be poised to ask why the city exists in the desert to begin with. This no longer criticizes just beer connoisseurs but passes fault to all inhabitants. This question is fair, but outside of the scope of this text. On the other hand, this ethic might also suggest that consuming beer at high volume is unethical and thus should be reduced to carrying capacity. What is a high volume? The answer seems arbitrary, but nationwide, breweries produced 196,278,490 billion barrels of beer in 2017 (Watson, et al., 2017). However, one barrel of beer needs 7 barrels of water to produce it, so this number needs to be multiplied by a factor of seven - 1,373,949,430 billion barrels of water. In addition, and for more context a barrel of water contains 31 gallons (ibid). In other words, an absurd volume of water is being used to produce beer, not only in Phoenix, but nationwide and presumably globally. So, as you may infer at this point, deep ecology struggles to offer immediate, practical solutions to the problem at hand, but it allows us to begin thinking about how society can plan for "decisions that evaluate all benefits and consequences" of decision making (Robbins et al., 2014).

Shallow and deep ecological solutions both exist as some part of **Social Ecology** which makes claim that environmental problems are "rooted in typical social structures and relationships, since these tend to be hierarchical, state controlled, and predicated on domination of both people and nature." As an example, the CAP project is state controlled - they not only control the water but also the society that depends on it.

Social Ecology: A philosophy that asserts our environmental issues are socially rooted in our hierarchical-government controlled society that seeks to control people and nature

Therefore, the problems presented throughout this section are rooted in social structures, indicating that social revolution is necessary to truly solve these environmental issues.

Consequently, Robbins et al. (2014) points out that “until an egalitarian, *just* society is established, people have no hope of ceasing environmental destruction, no matter what ethical lens

people use to view nature.” However, this is unlikely to occur soon, but progress should nonetheless be pursued.

Assuming society agrees then, that brewing beer wherever water is not *overly* abundant, in any region of the world is at some level unethical - how can we holistically use all these tools to address the problem? With shallow ecology, begin by conducting life cycle analysis of beer production to prioritize water conservation practices, adequately raise water use fees to breweries to reflect the water’s true ecosystem services value, or engineer water desalination systems capable of offsetting breweries water use. While these may seem difficult and not greatly impactful, consider these as one of many potential solutions to entire systems of stakeholders versus just one industry. For deep ecology, solutions might be to remove an entire group of consumers from the market until population and consumption allows the society to live within its own carrying capacity – meaning that all breweries would need to be geographically relocated or abolished altogether in order to deter over-consumption.

Lastly, social ecology ethics might suggest that to really get at the environmental degradation of water resources for beer (or otherwise), a social movement ought to occur that casts beer outside of social norms or upends the governments that established the CAP to replace it with a simpler, less consumptive way of life.

By analyzing shallow, deep, and social ecological ethics of brewing beer in Central Arizona and its implications nationwide, these ethics become useful when considering holistic solutions to several environmental problems. Thus, this understanding provides to each of us the ability to make changes that are within our own realm, immediately. This is the first step towards addressing environmental destruction, by using science, ethics, and understanding the limitations of our social constructs. As for the millennials reading this article and drinking local brews from the swanky art-district pub, consider easing up on those beverages, weigh the other consequences not discussed here, and strive to make progress for the next generation’s well-being. Cheers!



Figure 4. UC Davis College of Engineering licensed by (CC BY 2.0)

Box 1 Brewing Up Solutions

Beer has been in the top 5 of most consumed beverages in the world since the beginning of time. In order to keep up with increasing production, there are steep environmental costs to pay such as heavy water use, eutrophication from raw materials, and acidification from packaging and transporting elements. With the current social pressure to produce goods in an environmentally friendly manner, breweries are finding ways to become more sustainable and efficient. For example, one of the most sustainable breweries in the United States is the Sierra Nevada Brewing Company. They have one of the largest privately held solar installation over 10,000 panels that provide close to 100% of their energy consumption (See figure 4). In addition, by growing their own barley and hops, they were recently able to create their first USDA certified organic beer. They also use high quality water conservation equipment such as their onsite wastewater treatment plant in order to cut down on the large amount of water that is wasted in the brewing process. This also strips out greenhouse gases by capturing methane (Carley & Yahng, 2018). With this new technology, it will cause beer prices to significantly rise and could put those breweries out of business compared to cheaper ones. However, the push for using more sustainable brewing methods continues to press forward. Consumers must ask themselves if a little more expensive beer is worth having a sustainable water source and clean air that will last for generations to come.

Social Construction of Beer

As a society, people have many preconceived notions about breweries and sometimes choose them based on their claim of environmental friendliness and sustainability. In fact, according to Carley & Yahng (2018), people are willing to pay more for beer it is sustainably brewed. Yet how much are breweries actually sustaining the environment, and how much is simply a social construct that people believe to be true? The truth is that the beer industry is highly energy-intensive and has high levels of carbon output in order to maintain the brewing process. However, many craft breweries are becoming more energy efficient by installing solar panels or finding ways to recycle the massive amount of wastewater. Some even have created sustainability webpages so that consumers can verify their environmental efforts (Carley & Yahng, 2018). In this section, we will mainly be looking at craft breweries and the social constructs that society has developed in their minds, both true and false.



Figure 5. "Tour Crowd Shot" by Christopher Paulin licensed by (CC BY 2.0)

Does Craft Equal Sustainable?

Society still regards craft breweries as more environmentally friendly than regular, large breweries since they are typically smaller in size and use traditional brewing methods. In the last couple of years craft breweries have become symbols of sustainability, emphasizing quality over quantity and promoting unapologetically local brand storytelling (Figure 5). The craft industry connects people of all backgrounds together, budding new relationships and

strengthening old ones. Fortunately, most recognize that many beer consumers also place high priority on sustainable, “green” products and are aware of the purchasing power they possess, meaning they will give their money to those breweries that recognize environmental stewardship. As a result, some of these breweries have even incorporated environmental advocacy in their mission statements, fighting acidic runoff or pollution.

However, the inputs of beer production are fairly detrimental. The production of packaging elements and transportation poses the biggest environmental impact at 35 percent of total beer production impact. This contributes to global warming and **acidification**, which is when carbon dioxide is absorbed by the ocean and reacts with seawater to produce acid. Raw material production is the second category that most heavily impacts the environment as it causes **eutrophication**, which is excessive richness of nutrients such as phosphorus and nitrogen in a body of water (Hospido & Feijoo, 2005). This can cause a dense growth of algae blooms and death of animal life from lack of oxygen. Many people don’t know the extent to which these raw materials are extracted and then wasted, which includes barley, water, hops, and yeast. As noted

Acidification: used to describe significant changes to the chemistry of the ocean by reducing the pH over an extended period of time. It occurs when carbon dioxide gas (or CO₂) is absorbed by the ocean and reacts with seawater to produce acid.

Eutrophication: excessive richness of nutrients such as phosphorus and nitrogen in a lake or other body of water, frequently due to runoff from the land, which causes a dense growth of plant life and death of animal life from lack of oxygen.

in the ethics section of this chapter, beer is roughly 90 percent water and is used in every step of the brewing process while most of it is eventually wasted in evaporation (Boden 2012). While many people are quick to fight over-consumption of water especially in regions of drought, they don’t realize that beer is one of the worst culprits. This is even more startling when you factor in the rate at which breweries are growing, as the number has now reached over 4,000 (Boden, 2012). This represents a way in which society places a social construct on water consumption- where it is “bad” to use thousands of gallons of water to water a golf course, but it is “good” to use an equal amount of water in the brewing process, as it takes 7 gallons of water to produce one gallon of beer (Hospido & Feijoo, 2005).

Breweries in Desert States

With these social perceptions in mind, why are there an abundance of craft breweries in drought-stricken areas with growing populations such as California and Arizona? It all comes down to the ability of craft breweries to create “brand humanization, which is the notion that marketers and consumers co-create narratives that humanize brands” (Hede & Watne, 2013). They can connect with society on a similar sense of place attachment and pride of their local region. People will always advocate for local companies that can empathize and personally get to know its consumers, and this creates an even stronger positive social construct- because these breweries care about me as an individual, they also care about our environment in which we live. Because of this notion and the ability to import products, craft breweries can be located just about anywhere. In order to compete with mega-breweries for market share, many crafts also use social media and local beer events to connect with consumers. These crafts recognize the environmental conditions of their region and most are adopting more efficient and sustainable practices, but there is still room for improvement. In California, a state with massive droughts and water shortages, many companies import inputs from other states which reduces the stress on their irrigation systems. The Half Moon Bay Brewing Company located in San Francisco is innovating the brewing process by using recycled greywater, which is water from household use (Wong, 2016). Though this could be a revolutionizing innovation, it

will need to get the support of legislation and have a strong recycle process before this can be implemented. Most people don't want dirty laundry water in their beer!

Solutions that Close the Constructionist Gap

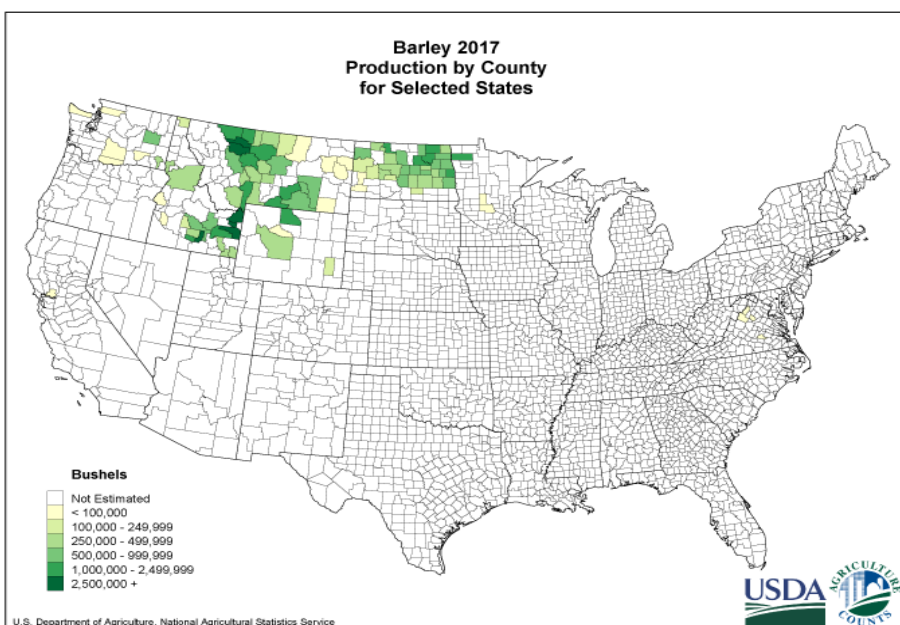
On a global scale, many craft breweries are adopting greater sustainability approaches in order to educate consumers on the brewing process and how they have made it more efficient. For example, many breweries like the Sierra Nevada Brewing Company and New Belgium have installed solar panels in order to provide 100 percent of their energy. Since such high levels of water are used and wasted, some breweries have invested in more efficient boiler systems, enhanced insulation, and use captured steam to recycle water (Carley & Yahng, 2018). Others have installed wastewater treatment facilities in order to break down the nitrogen and methane gases (Wong, 2016). This innovated technology consequently leads to consumers paying more for beer as breweries are forced to raise the prices, but many agree that the benefits of a sustainable environment outweigh the higher cost of beer. As breweries continue to grow at such a fast pace across America, they will become more successful at reducing their environmental impact. The key is in emphasizing accountability between breweries and creating transparency for the consumer so that all consumers can be fully and honestly informed.

Markets and Commodities

The relationship between beer and people is a very interesting one. Why do people love beer, and can they live without it? If the current heat and drought weather patterns continue, they may have to. People do not need beer to survive, although some may feel they cannot live without it. Beer is a universal favorite and is consumed and enjoyed daily. It is consumed at many types of gatherings, and consumers can indulge on the malty flavorful taste of their favorite beer at entertainment and sports venues, family gatherings, celebrations, etc. These vicinities are where large amounts of beer are consumed by both young and old.

Brewers, large and small, have set the market cost at a reasonable price where consumers of low-income to high-income are able to acquire it. The market for beer has grown over the past ten years (Thompson, 2018), and the increase in demand has put pressure on producers to increase their production.

According to the Bureau of Labor and Statics, small craft-beer, production has exploded by a factor of six (Thompson, 2018) in the last ten years and continues to grow due to consumer demand.



Consumers are willing to pay more for a higher quality product. Craft beer producers concentrate on a more desirable product with a variety in taste for consumers to choose from. Local brewers in all likelihood established partnerships with local farmers to purchase and utilize the main grain ingredient, barley. Today brewers control the product by choosing fresher quality grown barley, some brewers may even grow their own product for beer production. The larger producers of beer however, due to their high production, may have their barley imported from other countries to meet the demand. With the consumer demand for quality beer, will this growth rate continue? How will the changes in climate factor into production? The two main ingredients of this beloved beverage, water and barley, are threatened by the current weather changes that we are experiencing today. Barley, an important type of grain, is one of the main ingredients in beer and is grown by farmers all over the world. In the United States, most of the barley crop is grown in the North Midwest states. According to the recent report released by the U.S. Global Change Research Program (2018), U.S. farmers are the most productive farmers in the world. According to the report, agriculture will be affected including the supply of barley which is expected to decline due to the changes of weather patterns which has created stress felt by farmers and consumers. Within the next couple decades, the forecasted changes yield losses range from 3% to 17% depending on the location (Wei, 2018). This dilemma will most likely become a reality for farmers across America and the rest of the world, according to future climate scenarios published by the National Climate Assessment report which was published November 2018. The demand for beer barley is growing throughout the world where breweries are feeling the affect due to the decline in barley availability. Barley demand will not be met because this pattern of rising temperatures will continue and affect barley farmers both small and large. As barley supplies start to become scarce over the next couple of decades, producers will begin to pay higher prices for the quality they seek to produce their high-quality beer. This demand thus will be put on the consumer to cover the costs of products needed for production. The impact of these changes will have both consumer and producer participating as contestants in the **market response model** game, as the demand and availability of resources becomes more and more scarce each passing year. Consumers will have some options, paying higher prices for their beloved beverage or finding less expensive alternative beverages to share with friends.

Market Response Model: A model that predicts economic responses to scarcity of a resource will lead to increases in prices what will result either in decreased demand for that resource or increased supply, or both.

Market-Based Solutions

If the consumption of beer products decreases due to the decline in crop yields, will the United States fall into the same dilemma other countries have experienced? If predictions are correct and drought becomes a normal occurrence, there will be stress on barley production which will cause an impact on availability, causing prices for barley to increase. Smaller beer crafters will turn to finding other alternatives, because for hundreds of years people demand some form of fermented barley-based beverage. Smaller producers can opt for finding a replacement for barley since they have the equipment for creating new beer products and are experimenting with tastes often. Farmers who partner with smaller breweries may try growing experimental grains or finding other ways of growing barley. Studies in many countries, as early as 1928 have been researching barley for breeding, yield production, and grain quality. Today, research is ongoing and is in place for finding a new breed of barley that can sustain drought. (Honsdorf, 2014). Many groups

Green Certification: Programs to certify commodities for the purposes of assuring their ecological credentials, such as organically grown vegetables or sustainably harvested wood products.

including brewers, farmers, botanists, and researchers have been researching for many years for alternatives to producing barley. With the threat of warming temperatures and drought, there is pressure to develop new strategies for improving crop yields. Some alternatives involve improving farming techniques which may include developing efficient irrigation systems. The growing

scarcity of barley may trigger searching for other alternative ingredients or looking for alternatives for growing barley, such as a barley plant that consume less water, or a faster growing plant. Can scientists and researchers create the same quality of the current grain? Currently there are ongoing experiments to develop a barley type that would be “drought” proof. The barley grows a longer root which grows deep into the Earth to consume water and nutrients to thrive. Another market-based solution is to implement green incentives for farmers who conserve water. This would involve local and state governments to become more involved in monitoring and tracking farmers with their use of water. The incentives would involve monetary payments to farmers who conserve water while creating the same yield of barley. Currently, the USDA has many programs and services in place for farmers who are struggling or farmers who are starting from scratch, but do not have a program for rewarding farmers for conserving water. The idea of monetary incentives is to incorporate a green behavior to conserve water. This green program could be supported by the USDA to help with barley production while performing water conservation. The farmers who receive these incentives would be considered Green Certified. This **Green Certification** would advertise to consumers that the farmers are meeting water conservation standards.

Although beer is a luxury and not needed for survival, concerned consumers, researchers, and farmers have taken on the task of finding alternatives for growing barley, which can also be used for other means such as feed for livestock. Will consumers care enough about beer shortages to make changes in the way they currently live? Will the price of beer doubling be a wake-up call for consumers for change that must be made today?

The Beer Puzzle

In this chapter we have learned:

- The conception and progression of beer throughout history and its sociological impact.
- Consumers will pay more for beer in the upcoming years due to changing weather patterns.
- The demand for beer will push for alternative approaches in brewing beer.
- Most consumers are willing to pay more for beer if it is sustainably brewed.
- We each possess the ability to make changes for environmental benefits by combining science, ethics, and understanding the limitations of social constructs
- Most consumers carry the social construct that craft breweries are much more environmentally friendly than regular breweries due to the local, personal feel.

Though breweries contribute a highly desired beverage to people around the world in many different flavors and styles, it’s also negatively impacting our environment due to the large amount of water, crops, and other raw materials used. Many would argue that our society cannot live without beer, so efforts are currently being made in the United States by several craft breweries to cut down on water and greenhouse gas emission. If other larger breweries across the globe follow this pattern, we can continue to enjoy both

beer and a sustainable environment for generations to come. Next time you're at a brewery, take a moment to discover what environmentally friendly methods were used to make your beer.

Questions for Review

1. How might the issues regarding beer consumption produce change from within society?
2. From cradle to grave, how can beer degrade environmental well-being?
3. By looking at the history of beer, to the role it plays now, moving forward how can beers consumption and production become more environmentally sustainable?

Exercise 1

In this chapter, we have covered the negative impacts beer has through ethics, markets, and social construct. Discuss the difference between Micro and Macro-breweries from an ethical standpoint, which is more environmentally sustainable? Is it ethical to continue consuming beer in mass quantities after knowing the impacts it has on the environment? Do you think that beer production has a big impact on climate change or resource depletion? Using three or more key terms from this chapter explain what beer is doing to our environment, why it is important to be aware of the impact, and what you think should be done to reduce or make production more sustainable.

Exercise 2

In this chapter, we have talked about the history of beer and how it has affected mankind. Discuss the 3 ways in which alcohol and its properties were first developed. Why is there no clear answer to the date of which beer was first created? What is one way in which beer has played a large role in the history of mankind?

Exercise 3

Read the "General" & "History" section of [this](#) web page about the Central Arizona Project. Then consider that there are over 30 breweries in the Phoenix metropolitan area, not to mention the other municipalities who depend on the Central Arizona Project. As discussed in this chapter: how does this phenomenon relate to the ethics of water resource use? how do markets and commodities enable this practice? what role do social constructions play in these breweries' existence? and how does the history of beer help us to understand its future in our society? Think through these questions and present your overall thoughts about brewing beer in arid regions.

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