

# **The Impacts of Crop-based Biofuels on Food Insecurity in the United States**

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**Thomas “Hunter” O’Quinn**

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

S. Travis Elliott, Department of Engineering and Society

## **Introduction**

Biofuels are a new, innovative attempt at addressing climate change that is based on moving away from traditional petrochemical-based fuels. One of the most common methods of producing biofuels in the United States is the conversion of corn into ethanol. There are a couple of questions that are commonly posed when discussing the subject of food versus fuel. What if there are negative aspects associated with biofuels? What if the materials used to produce biofuels were better suited to feed those who are in need? The goal of this paper is to explore how food insecurity and biofuels are related, and it seeks to exemplify the impact that corn-based ethanol has on food insecurity in America. This paper will use the Social Construction of Technology and Co-production frameworks to help evaluate how different groups in the United States perceive corn-based ethanol, how these different perceptions mold ethanol into what we know it as today, and how these groups might be affected by the development of ethanol.

## **Social Construction of Technology (SCOT)**

Social Construction of Technology (SCOT) is a framework that analyzes the interaction and relationship shared between different social groups and a technological artifact; SCOT provides a lens to examine how technology is shaped by humans. Interpretive flexibility is a defining feature of the SCOT framework that claims technological artifacts are open to different interpretations by the various social groups that interact with them, leading these artifacts to be different things to different groups (*Social Construction of Technology | Encyclopedia.Com*, n.d.). When any new technology is developed, it is subject to interpretation by these different social groups. The development of a technological artifact is described in SCOT as an alteration of variation and selection, and this results in a multi-directional model that highlights the fact that the “successful” stages in development are not the only stages possible (Pinch & Bijker, 1984). The framework of SCOT was developed by Pinch & Bijker in response to technological

determinism. Technological determinism is built on two basic tenets: technology develops independently from society and technology has a powerful effect on the character of society when it is used (*Social Construction of Technology / Encyclopedia.Com*, n.d.). A few major criticisms that SCOT faces involve its excessive emphasis on agency, neglect of structure, and the view that society is composed of equal groups, which leads to a failure to adequately acknowledge power asymmetry between groups (Klein & Kleinman, 2002).

The SCOT framework was used in this analysis to examine the ways that different groups perceive biofuels as a technology. For this analysis, the relevant social groups will include the producers of corn ethanol, those who are in need and experience food insecurity, the farmers that produce the corn, the consumers of corn-based ethanol, and the government. Interpretive flexibility plays a key role when it comes to discussing how these different groups view corn-based ethanol. Someone who is experiencing food insecurity may see biofuels as taking valuable cropland away that could be used to produce food, but the person that grows the corn may see biofuels as an economic opportunity. Some of the feelings the social groups may experience are summarized by Figure 1. There may be feelings and reactions that these different groups feel may not be shown in Figure 1, but the figure highlights the applicability of SCOT to the adoption of corn-based ethanol and its impact on food insecurity in the United States. Thus, SCOT is a useful tool to help evaluate how different groups may view corn-based ethanol and helped show the impact corn-based ethanol has on these groups.

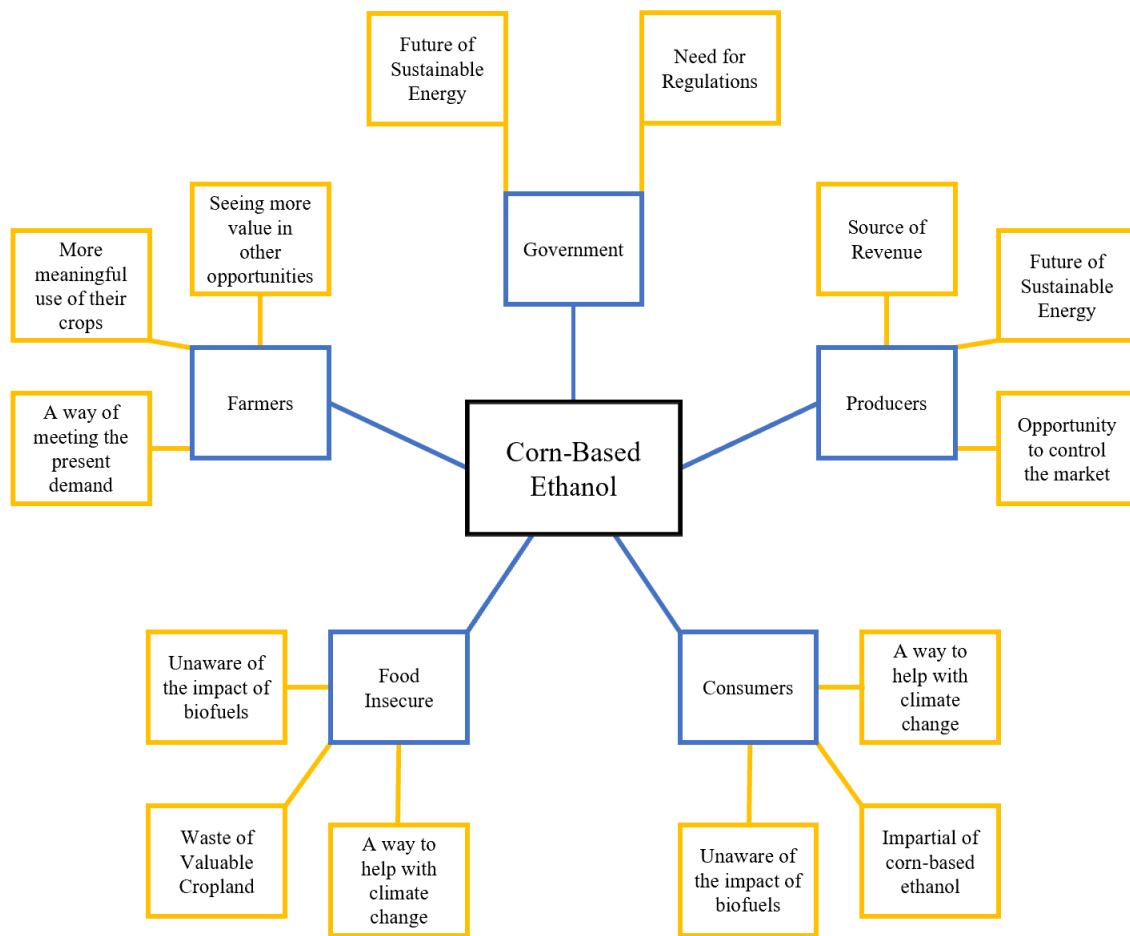


Figure 1: A Summary of Potential Interpretations of the Various Social Groups

## Co-production

Co-production is an STS framework that includes elements from both social constructivism and technological determinism, and it was developed by researchers seeking an integrated framework to explain the simultaneous production of scientific knowledge and the numerous, complex social relations that developed alongside it (Miller & Wyborn, 2020). Social constructivism implies that society is what leads to technological progress, and technological determinism suggests that technology is what causes social progress. Co-production is the

simultaneous process through which modern societies form their epistemic and normative understandings of the world, and it shows how scientific ideas and beliefs, and associated technological artifacts, evolve alongside the representations, identities, discourses, and institutions that give practical effect and meaning to ideas and objects (*Sheila Jasanoff*, n.d.). The framework implies that society and technology have a relationship in which society produces a technology, and in return, the produced technology influences the society continuously. Common critiques of co-production include the following: concerns surrounding its ability to meet the promises of improving complex problems, the lack of evidence supporting claims of outcomes and impact, fear that the process is very resource intensive without the ability to produce usable findings, and its failure to adequately account for power within science-society relationships (*Co-Producing Sustainability: Reordering the Governance of Science, Policy, and Practice / Annual Review of Environment and Resources*, n.d.).

Co-production is applicable for the analysis of how corn-based ethanol impacts food security in the United States by providing a way to investigate how these biofuels as a technology and society impact one another. Some of the potential influences that may occur between society and corn-based ethanol are shown by Figure 2. With this in mind, co-production was chosen for this analysis due to it providing insight into how society and biofuels live in tandem, constantly evolving one another. It was paired with the SCOT analysis in order to acknowledge the impact that corn-based ethanol has on society while at the same time showing how the different social groups view corn-based ethanol and how their interpretive flexibility plays a role into the issue.

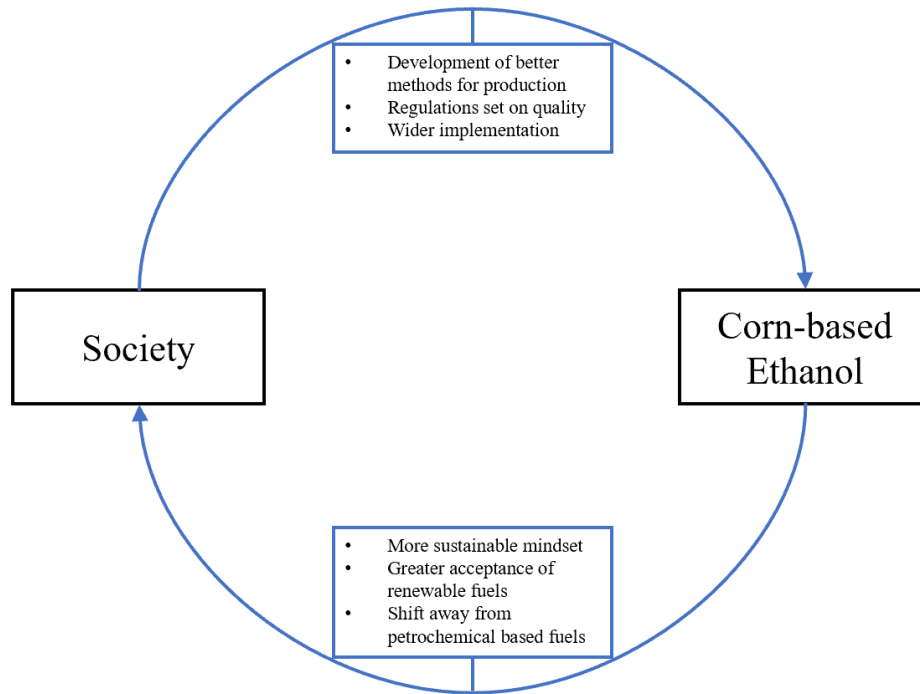


Figure 2: Co-production’s Application to Corn-based Ethanol and Society

### Background Information on Food Insecurity

Food insecurity is a major challenge faced by a large number of people in the United States. There are a couple of key things to mention when discussing food insecurity. Firstly, food insecurity is actually a reference to the USDA’s measure of lack of access, at times, to enough food for an active, healthy life for all household members and limited or uncertain availability of nutritionally adequate foods (*Hunger & Poverty in the United States / Map the Meal Gap*, n.d.). There are many reasons that a household may experience food insecurity, but a common reason is a household's need to make trade-offs between buying nutritionally adequate food and other important basic needs, such as housing and medical bills (*Hunger & Poverty in the United States / Map the Meal Gap*, n.d.). A second important point regarding food insecurity is that it is not

always permanent. Households that experience food insecurity are not necessarily food insecure all of the time (*Hunger & Poverty in the United States / Map the Meal Gap*, n.d.).

There are various groups that are attempting to track food insecurity in the United States. One of these groups pursuing the metric of food insecurity is the government. Since 1995, the USDA has conducted an annual survey of 40,000 nationally representative homes to measure food insecurity (*Food Insecurity and Food Insufficiency*, n.d.). Beyond the government, there are numerous organizations working towards measuring food insecurity, with one of the largest being Feeding America (*Food Insecurity and Food Insufficiency*, n.d.). With the data obtained by groups like Feeding America, a better understanding is able to be gained surrounding the issue of food insecurity. In 2019, there were a total of 35.2 million people, or 10.9% of the population, facing food insecurity, with 10.7 million being children (*Food Insecurity and Food Insufficiency*, n.d.; *Hunger & Poverty in the United States / Map the Meal Gap*, n.d.). With the data collected by these groups, it also can be shown that certain factors lead to some being more susceptible to food insecurity than others. Households with children, households headed by a single woman, black and Hispanic Americans, where people live, and those with a lower income were all at a higher risk of being food insecure (*Food Insecurity and Food Insufficiency*, n.d.). Food insecurity is remaining fairly constant during times without external stressors. With 10.5% of households experiencing food insecurity, the prevalence of food insecurity remained relatively unchanged from 2019 to 2020 (*USDA ERS - Food Security and Nutrition Assistance*, n.d.). When external stressors are present, food insecurity begins to rise. One example of this occurred when the economic recession that began in 2008 (*USDA ERS - Food Security and Nutrition Assistance*, n.d.).

## About Corn Ethanol

Corn was chosen as the focus of this paper due to it being one of the most produced crops in the United States; therefore, the data surrounding corn is ample. The production of corn based biofuels as we know it today began in the 1970s due to expensive petroleum-based fuel and a need for octane, and corn became the main feedstock for ethanol production due to its abundance and easy conversion to alcohol (*History of Ethanol Production and Policy — Energy*, n.d.). With this initial spark, the corn-based ethanol market began to solidify in the United States. This solidification of the market was aided by federal and state subsidies in the 1980s when ethanol prices fell and the “Minnesota Model” of ethanol production was introduced that allowed for farmers to add value to their corn through the production of ethanol (*History of Ethanol Production and Policy — Energy*, n.d.). As the years continued, the demand for corn-based ethanol continued to increase for different reasons. A note-worthy reason for this increase in demand was the first Renewable Fuels Standard (RFS) becoming law as part of the United States’ energy policy in 2005, which led to goals being set that significantly increased the usage of ethanol in the United States (*History of Ethanol Production and Policy — Energy*, n.d.).

91.7 million acres of land in the United States are dedicated to growing corn for various purposes (*Corn Is America’s Largest Crop in 2019*, n.d.). Assuming the United States consists of around 2.43 billion acres (*Ranking Of States By Total Acres*, n.d.), around 3.77% of the land in the United States is used for the production of corn. During 2020, 14.99 billion bushels of corn were produced in the United States, with 5.05 billion bushels being used as a feedstock for ethanol (*Alternative Fuels Data Center: Maps and Data - U.S. Corn Production and Portion Used for Fuel Ethanol*, n.d.), meaning that 33.7% of the corn produced was used as a source for biofuels. An important note is that different species of corn are used for different purposes. Field,



or dent, corn comprises approximately 99% of the corn production in the United States, and it is used to produce products such as livestock feed, ethanol, plastics, cornstarch, and more (*Corn Types & Uses – Texas Corn Producers*, n.d.). Thus, around 90.8 million acres are dedicated to producing field corn. The other 1% of corn produced in the United States consists of sweet corn, which is the corn that is produced for human consumption (*Corn Types & Uses – Texas Corn Producers*, n.d.). The number of calories in sweet corn is another important discussion point when talking about whether corn should be the source of food or fuel. Sweet corn has about 485 calories per pound, and in each ear of corn, there are approximately 0.2 to 0.25 pounds that are edible (*Food for Fuel*, n.d.).

### **Analysis of the Impact Corn-Based Ethanol has on Food Insecurity**

The impact of corn-based ethanol will be explained in the next section through the explanation of the analytical process and the findings of this paper. Corn-based biofuels have been impacted through numerous societal beliefs in America. Using a SCOT based analysis of corn-based ethanol, the impacts of society on corn-based ethanol were made clear as well as how it fits into society and how the interpretive flexibility of the different groups plays a role. This analysis involved examining the different relevant social groups and how their beliefs impact the use and production of corn-based ethanol. Corn-based ethanol's place in society will be examined as well. Corn-based ethanol has also left its mark on American society. Thus, co-production was used to help explain the relationship of change that is experienced between society and corn-based biofuels.

The potential for economic benefits is a belief that could be held by the government, the producers of biofuels, and the farmers of the corn. The farmers and producers may view the concept of corn-based ethanol as a way for them to earn a tidy sum compared to other avenues of

revenue. The government more likely sees corn ethanol as having the potential to grow into a substantial industry that promotes economic growth, which may explain their regulatory support of corn-based ethanol. The growth and development of corn-based ethanol has helped pave the path for other biofuels to be discovered and developed, which has led to a substantial market being developed.

The government and producers of corn-based ethanol may view corn-based ethanol as the future of sustainable energy. As mentioned, it is likely that these groups saw corn-based ethanol as a building block towards new and improved biofuels. Thus, corn-based ethanol may be viewed as the initial stepping stone into a much greater field of scientific discovery. The government and producers may view the development of corn-based ethanol as a stepping stone to launch their future projects off, and as a result, the time frame of corn-based ethanol's success was limited from the start. This is supported by the new RFS that states only around 41% of the ethanol should be produced using corn as the feedstock with ethanol produced from advanced and cellulosic feedstocks making up the rest (*History of Ethanol Production and Policy — Energy*, n.d.). As with any fuel, the government sees the need for regulations to be placed on corn-based ethanol. This allows the government to have a greater sense of control over corn-based ethanol both as a market and as a technology. By limiting the allowable composition and regulating the price, the government effectively is able to limit the producers of the ethanol.

The producers of corn-based ethanol may have the view that the ethanol is their source of revenue. This could lead them to take pride in their product and continually seeking to improve it, for corn-based ethanol could be their main source of revenue. This could lead to continuously changing systems for the production of corn-based ethanol due to the producers' attempts to better the final product. Corn-based ethanol could be seen by the producers as a chance to gain

control of the biofuel market in the United States. It may not be their sole source of revenue, but it could be the gateway for them to develop a name for themselves and effectively build a reputation in the biofuel market.

The farmers may see the production of corn for the production of ethanol as a more meaningful use of their crop. It could be that the farmers have a greater sense of pride when producing corn to be used as a feedstock for ethanol production versus something like animal feed. The opportunity may entice them simply because it is so different from all of the other uses for their corn. They may also just see the use of their corn as a way of meeting the current demand. It may not make a difference to the farmer what their corn is being used for as long as it is being bought. Either of these feelings that may be held by the farmers is likely to decrease the amount of corn that is being grown for food. Other opportunities, such as growing corn for animal feed or growing sweet corn, could appear more valuable than corn-based ethanol to the farmers depending on their personal values and economic values of the different alternatives.

The two relevant social groups that are not directly linked with the production of corn-based ethanol, those experiencing food insecurity and the consumers, may be completely unaware of the impacts that corn-based ethanol has. They may be uninformed about corn-based ethanol and unable to draw conclusions about it one way or the other. These two groups may also be impartial of corn-based ethanol and other biofuels. They could be informed about the technology and aware of its uses, but they may not develop any opinion. With these groups being unaware or not developing an opinion, an argument could be made that they have little impact on the use of corn-based ethanol. The two relevant social groups not directly linked with production may also see the use of corn-based ethanol as an opportunity to help the environment. The use of corn for the production of ethanol is more likely to be swayed if these groups are supporting its

use. Their support creates the opportunity for these groups to sway the farmers, producers, and the government to produce more ethanol from corn.

Those experiencing food insecurity could be more apt to see the production of corn ethanol as a waste of valuable cropland. They could be aware that crop land is being used to produce ethanol, and as a result, they may believe that there is a better use of the crop land, whether it be the production of sweet corn or another crop that would be able to provide them with food. The use of corn-based ethanol could ultimately frustrate or even anger them due their need. With this in mind and provided they had enough resources, they could sway the farmers, producers, and the government to produce less ethanol from corn and use the land for other purposes.

It is also important to note the impact that corn-based ethanol has played on American society. The use of corn to produce ethanol has effectively set up an opportunity for biofuels to be used in our everyday lives. Thus, it has more of an impact on society than one may initially think. The use of corn-based ethanol may inspire people to be more sustainable in choices. Corn-based ethanol also has aided in creating the market and infrastructure that is needed for the future of crop-based biofuels, which in turn promotes society to think of and develop new and more effective biofuels. The use of corn-based ethanol could promote the development of other sustainable energy practices through the development of a sustainable mindset.

## **Conclusion**

Corn-based ethanol and American society have become intertwined in recent years, and as a result, they impact one another significantly. Food insecurity is also impacted by the use of corn to produce ethanol. This paper shows that the different social groups' interpretation and opinions regarding corn-based ethanol affect how it is used and that corn-based ethanol affects the society that produces it in return. Both positives and negatives surround the use of corn as a feedstock for the production of ethanol, but there is no right or wrong use of corn found by this paper. No solution for the debate of food versus fuel was found, so further research into a more effective structure of resource allocation to help decrease the number of those experiencing food insecurity, while honoring the technology that is corn-based ethanol, is a next step that could be taken to further this research.

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