Project Title: More Sustainable Beef Optimization Project: Phase I

Principle Investigator(s): Thomas Battagliese, Juliana Andrade, Isabel Schulze, and Bruce Uhlman

Institution(s): BASF Corporation

Completion Date: July 2013

Background

A sustainable beef industry is critically important as we work toward the goal of feeding more than 9 billion people by the year 2050. Experts estimate that this future global population will require 70 percent more food with fewer available resources. The goals of this study were to benchmark the eco-efficiency of the U.S. beef industry and to analyze the positive and negative trends associated with changes in practices over time. This provides a starting point for ongoing analysis and a journey of continuous improvement within the industry. Any established trends will be used to set the U.S. beef industry on a more sustainable pathway through various opportunities, which may include sharing and communicating best practices, embedding improvement opportunities throughout the industry, prioritizing solution-oriented research on sustainability criteria that are determined to be critical, and empowering the industry through ongoing education.

This Eco-Efficiency Analysis (EEA) submission is the first phase (Phase 1) of an ongoing study of the U.S. beef industry funded by the Beef Checkoff Program. Phase 1 is intended to provide specific on-farm data from the largest research farm in the U.S. combined with post-farm data that is representative of the entire US beef industry. Phase 2 of the life cycle assessment will require additional on-farm data to be collected at a regional level to provide complete value chain data that is representative of the whole U.S. beef industry.

Methodology

Phase 1 of this program consisted of multiple projects as described below:

- *Hot Spot Analysis* (HSA): The HSA was intended to provide a qualitative perception analysis of the sustainability attributes of the U.S. beef industry. The HSA consisted of an analysis of more than 150 literature sources and a survey reaching out to 39 stakeholders by means of an online questionnaire, telephone, or face-to-face interviews. The survey covered six different groups that included industry, retailers/restaurants, NGOs/NPOs, government, capital markets, and academia.
- *Eco-Efficiency Analysis* (EEA): The EEA was intended to provide a quantitative assessment of the environmental and economic sustainability attributes of the U.S. beef industry using life cycle analysis. The EEA was originally intended to review the ecoefficiency attributes of the beef value chain over time by evaluating data for the years 1970, 2005, and 2011. The 1970s were chosen to represent the industry's transition to boxed beef. The second point in time, 2005, was selected to represent the feeding of significant volumes of distiller's grains and the 2011 calculations represent present day. Unfortunately, insufficient data was available for the 1970 analysis, with the exception of data for the on-farm phases of the value chain. Therefore, the final EEA contained an on-farm scenario that included the 1970 data while the base case EEA considered only 2005 and

Funded in part by the Beef Checkoff.

2011. Additionally, while the post-farm phases of the EEA are representative of the entire U.S. beef industry, the on-farm phases of the EEA represent the U.S. Department of Agriculture's Roman L. Hruska Meat Animal Research Center (USMARC) located in Clay Center, Nebraska.

- *SEEbalance® Analysis*: The SEEbalance® analysis was intended to expand upon the EEA and integrate the social impacts of the U.S. beef industry in order to assess a more complete sustainability framework that considers environmental, social, and economic issues.
- *Eco-Efficiency Manager* (EEM): The EEM was intended to provide the U.S. beef industry with an on-line, web-based interface that allows users to create scenarios of the EEA results in order to see how changes in their individual operations could positively or negatively impact the sustainability attributes of the industry.

Findings

Hot Spot Analysis

As a result of the desktop research and survey, 21 hot spots were identified for the U.S. beef industry. These include 7 environmental, 7 social, and 7 economic hot spots of either high or medium relevance. Figure 1 summarizes these hot spots that were identified.

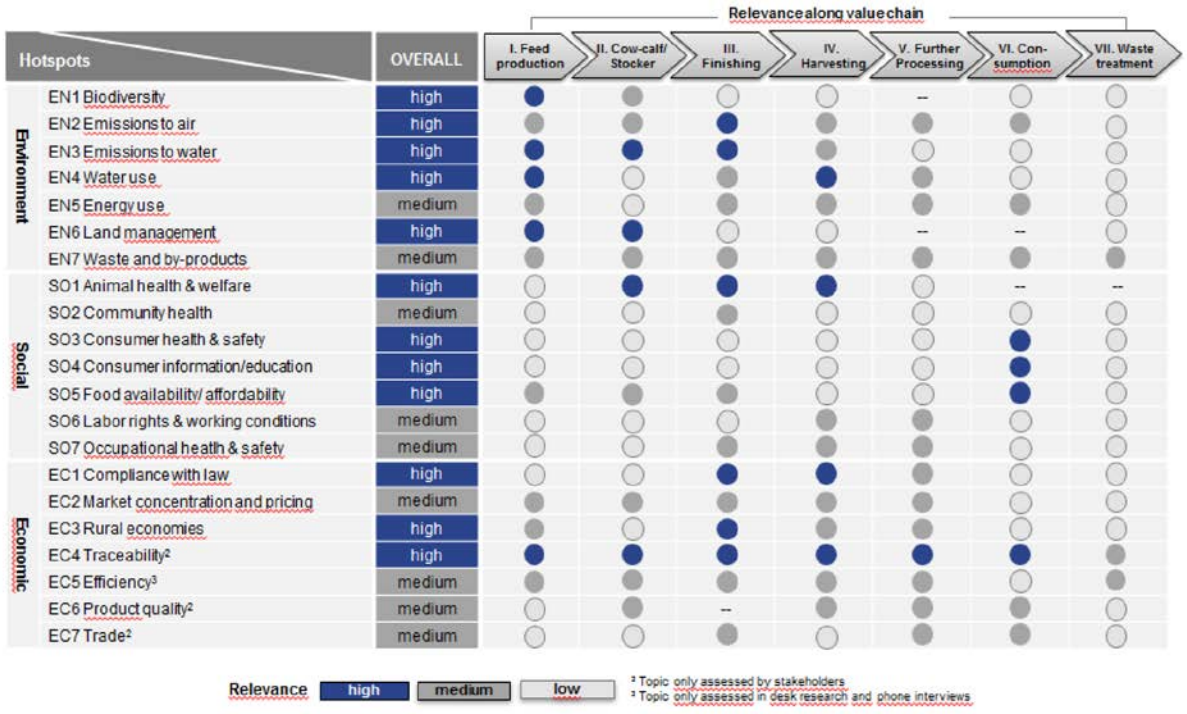

Figure 1: HSA Results

Eco-Efficiency Analysis

As presented in the EEA portfolio analysis in Figure 3, there has been a 5% improvement in the eco-efficiency of the U.S. beef industry between 2005 and 2011 as represented by the system boundary of this study. This correlates to a 6% increase in cost (based on consumer retail price) and a 7% decrease in environmental impact (as represented by the environmental fingerprint analysis in Figure 2) over that same timeframe.

Funded in part by the Beef Checkoff.

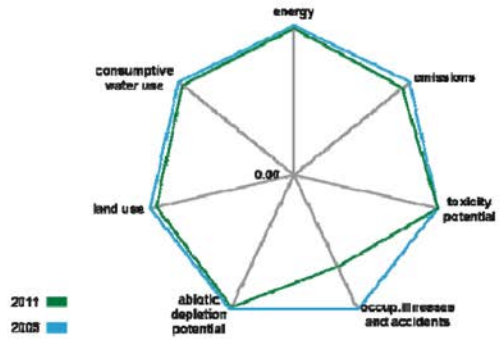

Figure 2: Environmental Fingerprint - U.S. Beef Phase 1

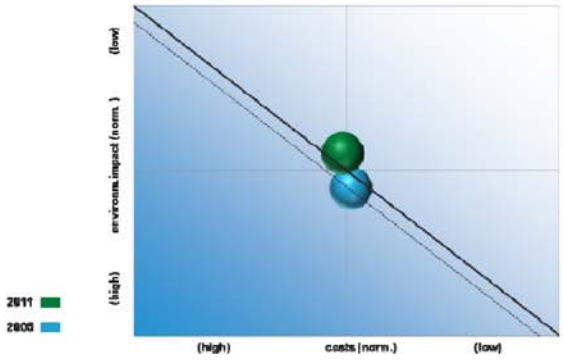

Figure 3: EEA Portfolio - U.S. Beef Phase 1

While environmental impacts stem from all phases of the beef value chain as represented throughout the study analysis, the majority of the impacts are attributed to on-farm processes. Likewise, many of the impact reductions have been made on-farm. These reductions relate directly to improvements in on-farm efficiencies. For example, improvements in yield of feed crops and animal performance result in less system inputs being required per unit of land in order to achieve the same desired output of edible beef.

In general, it appears that the overall eco-efficiency of the beef value chain is improved, at least to a small extent, with the use of the distiller's grains. Additionally, using distiller's grains as a feed source provides a beneficial use of a by-product of bioethanol processing, thus providing additional environmental benefit outside of the beef value chain. The processes associated with the post-farm phases, while generally contributing less overall value-chain impacts, present significant opportunities for improvement. Additionally, these opportunities generally may be more straightforward in terms of implementation with examples such as biogas capture and recovery at the harvesting facilities, packaging optimizations, and energy efficiency opportunities throughout.

SEEbalance® Analysis

While the SEEbalance® analysis shows some overall improvement in the socio-eco-efficiency attributes of the U.S. beef industry from 2005 and 2011, the overall analysis is deemed to be inconclusive due to the state of U.S. industry sector data quality. Due to extreme trending that was noted throughout several of the social impacts analyzed, the significant lack of quality for the available data is evident.

The main reasons for the lack of data quality include changes over time in the way that data is aggregated for industry sectors as well as the reliance on both national economic data and perunit product pricing in order to derive social impacts at a product level. As a result of these issues, it is extremely difficult to pinpoint specific and reliable trends at this time that relate to the social attributes of the U.S. beef industry. Social life cycle analysis is in its infancy and this was further proven with this study. It is recommended that the U.S. beef industry revisit a social analysis once national data is more readily available in outputs that allow correlation at the product level.

Eco-Efficiency Manager

The Eco-Efficiency Manager (EEM) for the harvesting and case-ready phases of the beef value chain was designed and is being tested by beef industry partners. This web-based optimization tool provides the opportunity for sector members to analyze how changes in

Funded in part by the Beef Checkoff.

specific inputs to their production systems can positively or negatively impact the eco-efficiency of their operations as well as the overall beef value chain. Further research is necessary for design of the EEM for the remainder of the value chain. This is particularly the case for the on-farm phases of the value chain, which consider not only the anthropogenic inputs to the system, but the complex biological interactions related to agricultural and livestock systems. Additionally, expanded analysis with the retail and restaurant sectors in Phase 2 of this project will provide primary data for the post-harvesting phases that will be used to expand upon this initial EEM and provide improved insight for the entire beef value chain.

Implications

The work completed in Phase 1 of the More Sustainable Beef Optimization Project provides the U.S. beef industry with qualitative information from the HSA as well as quantitative data and results from the EEA that is necessary to understand perceptions, trends, and opportunities for improving the sustainability attributes of the beef industry. The EEA results provide the roadmap to identify and prioritize those opportunities and to allow better understanding of the specific practices that can be used to further reduce the environmental impacts of the beef value chain, while maintaining the overall economic value proposition for the U.S. beef industry.

Improvements to data quality on the post-harvesting phases as well as analysis of regionalized data for the on-farm phases in Phase 2 will provide even more clarity to these trends and opportunities. However, with the results from Phase 1, the industry can already begin to enhance the current pathway of action for making a more sustainable beef value chain.

BEEF®
Funded in part by the Beef Checkoff.