Thesis Project Portfolio

Bridging Deep Learning and Socio-Technical Adoption: AI for Family-Owned Farm Conservation

(Technical Report)

Social Construction of AI in Farmland Conservation: Lessons from the Adoption of Conservation Tillage

(STS Research Paper)

An Undergraduate Thesis

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical project and my STS research paper are closely connected through the central theme of integrating artificial intelligence (AI) into farmland conservation striving to support small-scale family-owned farms in Virginia. Both projects explore how advanced technology can address significant agricultural challenges, from distinct yet complementary angles. My technical project focuses on the practical implementation of deep learning technologies, while my STS research paper examines the broader socio-cultural factors influencing technology adoption among farmers.

In my technical report, I proposed a deep learning based system designed to enhance the United States Department of Agriculture's (USDA) land conservation programs. Utilizing Sentinel-2 satellite imagery and deep learning models like U-Net to automate crucial conservation tasks like crop health assessments, and crop monitoring with land use tracking being the primary goal of this system. By decreasing the need for manual evaluations, this technological solution aims to make conservation practices more accessible and less taxing for USDA staff and small-scale farmers. The anticipated outcomes include more effective resource allocation by the USDA, decreased operational burdens on farmers, and ultimately, the preservation of Virginia's rich agricultural heritage by ultimately empowering family-owned farms against corporate competition.

My STS research paper complements by investigating the social factors that influence the adoption of new technologies by farmers. I used the Social Construction of Technology (SCOT) framework to look at historical examples of agricultural innovation. Particularly, the adoption of conservation tillage, in order to find important lessons that can be applied to the adoption of AI today. I found that while technological solutions can offer clear operational benefits, their adoption among farmers heavily depends on cultural attitudes, economic conditions, and perceived risks. On the other hand, policymakers and technology providers often emphasize efficiency and sustainability. Making farmers overly cautious often weighing concerns about autonomy, and financial risks. This research underscores the importance of understanding these diverse perspectives to facilitate more inclusive and successful technological adoptions.

Working on these two projects simultaneously has been extremely beneficial to my comprehensive understanding of this situation. The technical project provided practical insights into the capabilities and limitations of deep learning technologies in agricultural settings, enhancing my understanding of the logistical and technical challenges involved in deploying advanced systems on a large scale. Conversely, my STS research informed my understanding of the social aspect by highlighting crucial non-technical barriers, such as farmers' economic realities, social dynamics, and ethical considerations. Synthesizing these perspectives forced me to critically consider how my technological solutions must be designed to be socially acceptable and ethically responsible all while still remaining technically effective.