

Up in Frames: AgroFlight

(Technical Paper)

Social Implications of Drone Technology on Migrant Farm Workers

(STS Paper)

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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

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Introduction

Drones, formally known as Unmanned Aerial Vehicles (UAV's), for the longest time have been viewed as a niche product for hobbyists. In recent years, however, commercial drones have massively grown in popularity due to decreased costs of drone parts and availability of open-source software used to program these robots. In 2016, the drone industry took flight when the Federal Aviation Administration (FAA) granted hundreds of exemptions for companies to operate drones through the FAA Part 107 (Intelligence, 2021). The FAA's loosened reins on drone regulation removed the barriers preventing industries from innovating and utilizing this technology. Even though drones are in the early stages of adoption and usage, the drone services market size is expected to grow up to \$63.6 billion by 2025 (Intelligence, 2021). Industry giants such as Amazon are using drone technology to perform remote shipment and deliveries. The government is also using this technology for surveillance and recon with its ability to record visual, audio, and location data in real time. UAV's have the ability to increase work efficiency, decrease production costs, and reach the most remote areas which can benefit many industries including the agricultural industry (Intelligence, 2021).

AgroFlight: The Remote Soil Testing Drone

The agricultural industry has evolved immensely over the years as the small family farms that were common prior to the Industrial Revolution transformed into large-scale farms with complex technological systems. Modern day farming involves many technologies that improve the efficiency and automation of agricultural processes, also known as "smart farming" technology (Ku, 2021). These include autonomous tractors, robotic harvesters, automatic

watering and seeding robots, and drones (Ku, 2021). Farmers use drone technology to automate many of the mundane, time-consuming processes in food production resulting in greater efficiency and profit. These applications include remote mapping, surveying, crop-dusting, and spraying (Meola, 2021). Drones also increase worker safety as they can avoid the dangers of manual farm labor including pesticide exposure, heat exhaustion, and other health conditions. Drones will continue to revolutionize the agricultural industry as this technology becomes more advanced and reliable in this setting.

A problem scope that could be further explored by drone technology is soil analysis. Farmers must collect data of vast stretches of farmland in order to monitor crop health and soil nutrients. Soil technicians, geologists, and farm laborers are hired to obtain soil samples, send them to labs, and analyze the results, which is often a long, arduous process. My capstone group hopes to improve the efficiency of soil analysis by automating a part of this process using a drone. AgroFlight, a soil testing drone, is a modern, custom built agricultural tool designed to assist in the remote collection of soil data. The operator will manually control the drone through the use of a ground station control application and record the nitrogen, phosphorus, and potassium (NPK) data collected in real time using a soil probe. AgroFlight will make quantifying soil parameters more efficient by removing the need for manual labor and reducing the time and cost of formal laboratory analysis. While the future is bright for drone technology, especially with regards to the superfluous applications in agriculture, we must consider the social ramifications of this technology with relation to the migrant farm worker population as it increasingly becomes integrated into society.

Effects of Agricultural Drones on Migrant Farm Workers

Agricultural workers come from ethnically and socioeconomic diverse backgrounds. According to the National Center for Farmworker Health, there are about 3 million agricultural workers in the United States with 75% being foreign born, 71% speaking little to no English, and only 10% obtaining some form of higher education (NCFU, 2020). As drones become more integrated into the agriculture industry, engineers must consider the effects of this technology on the economic outcomes of these individuals. Drones decrease the need for manual labor because they can automate the process of watering, seeding, spraying, and surveying of farmland with greater productivity and less cost. While studies have shown a rise in the number of agricultural workers over the last decade, eliminating the need for farm manual labor negatively impacts the number of jobs available to these workers (NCFU, 2020). As an engineer working on an agricultural drone, these concerns must be addressed. A case study will be performed to analyze the impacts of drones on the migrant farm worker population through an analysis of different resources related to the marginalization of agricultural labor, farm worker impressions of drones, workforce displacement, and potential solutions for agricultural technology in the future.

In 2019, the Journal of Rural Studies published a paper that analyzed the impacts of agricultural digitalization on diverse agricultural laborers and rural communities in Canada. The author synthesized findings from scholars, farmers, and practitioners familiar with digital agriculture and automation based on the potential impacts on employment opportunities for this population. The paper begins with describing the history of labor and rural communities in North American agriculture and how the demand for temporary unskilled labor increased as large-scale farms became more common. Due to increasing land costs and stagnant market prices, farmers were incentivized to exploit the migrant farm worker population. Even though these workers had

support from government programs, they've experienced lower wages, long shifts, hard labor, and dangerous working conditions (Rotz, 2019). In addition, migrant workers were unable to negotiate for better working conditions due to restricted mobility and threat of replacement. Despite the terrible working conditions, there's animosity amongst these workers about the integration of robot and drone technology into these farms. While this technology creates new economic opportunities for the agriculture sector, a significant number of migrant labor positions will be displaced via automation and higher skilled jobs (Rotz, 2019). Due to their lack of education and older age, there is limited upward mobility for these workers, and their farm work may be their only means of livelihood, which is a concern engineers should address. This resource will provide context related to the work environment and social conditions of the migrant farm worker population in Canada and how their backgrounds affect their opinions about agricultural drones.

Another study was conducted in 2020, where a small Japanese company incorporated drone technology into their commercial farms in Rwanda. Because agriculture in Rwanda is considered to be the country's economic backbone and major initiative against food insecurity, the Rwandan government has provided support for integrating autonomous devices and sensors onto their farms (Hanrahan, 2020). During this study, researchers interviewed everyone considered a stakeholder, which is defined by the author to be any worker on the farm who's affected by the drone implementation initiative (Hanrahan, 2020). These interviews will provide insight into the sociotechnical imaginaries (the conceptions of, expectations for, and anxieties about technologies) of the Rwandan farm worker population (Hanrahan, 2020). The results shows that the workers acknowledge the positive benefits of drone technology, but express concerns about privacy and job security. With the recent major digital revolution occurring in the

Rwandan agricultural industry, this study would be especially relevant in analyzing the initial reactions of the Rwandan farm workers to the integration of drone into their workplace.

The findings of the research conducted in Canada and Rwanda both suggest that farm workers are concerned about how agricultural technology will cause them to lose their jobs. In the book, *Surrogate Humanity*, Atanasoski and Vora analyze ways in which robots serve as replacements for human workers in the labor system. The authors argue that these technologies promise a revolutionary future, but also enforce racialized and gendered ideas about devalued work, exploitation, dispossession and capitalized accumulation (Atanasoski and Vora, 2019). In addition to the exploitation and marginalization of the unskilled worker population, the book analyzes the presence of technological unemployment, the fear humans will become obsolete as machines become better at our job. The authors emphasize this as an alarming problem because technological developments outpace society's ability to find uses for human labor, resulting in unemployment. Through this piece, we can learn more about the causes of technological unemployment and ways we can mitigate this problem in the migrant farm worker population.

While the employment concerns of the unskilled worker population become more prevalent, there is even greater motivation to use drones in every industry as this technology becomes cheaper and more advanced. While the benefits of increased efficiency and reduction of labor are undeniable, we must avoid engaging in technical chauvinism, the idea that technology is always the solution to a problem. In the book, *Artificial Unintelligence*, Broussard argues that society is eager to incorporate technology into every aspect of human life without considering the social ramifications. She explains that new problems arise when people use new technology, and often times there are unintended social consequences (Broussard, 2018). While drones have the ability to automatically water, seed, and fertilize crops, there is the unintended consequence

of displacing the migrant farm worker population, who's unskilled labor is deemed redundant. Without proper understanding of these consequences, we'll end up marginalizing this demographic and reducing their job security. By analyzing how the introduction of new technology has disrupted the workforce in the past, we can better address the concerns of this population in the future.

The conclusions drawn from these case studies will model the concerns and views migrant farm workers will have on the integration of drones like AgroFlight into the workplace. While a comprehensive case study would be ideal for analyzing the impact of drones on this demographic, it's not feasible in one semester. This would involve interviews with several farm workers which would require Institutional Review Board (IRB) approval for human research study. Instead, using the resources described in this prospectus and additional research on government initiatives to support these workers, we can provide a framework for scholars to address this issue in the near future.

Conclusion

The drone industry is growing at a rapid pace, and more companies are integrating this technology into their business model, but with new technology comes unintended social consequences. In the agricultural industry, drones have demonstrated more efficiency and reliability in performing common tasks that are often left to farm workers, who are demographically known to be primarily an immigrant population. The incentives to further integrate drones into agricultural technological systems have raised concerns among the migrant farm worker population related their job security and economic outcome. Through the analysis of

previous research conducted in the realm of drone integration into farms and their impacts on the economic outcomes of those workers, we can learn more about how to address their concerns regarding technological unemployment. These considerations must be made as more technology like my capstone project, AgroFlight, is introduced into the agricultural industry, and it's essential to have a plan to mitigate the negative social consequences that comes with introducing drone technology into these industries.

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