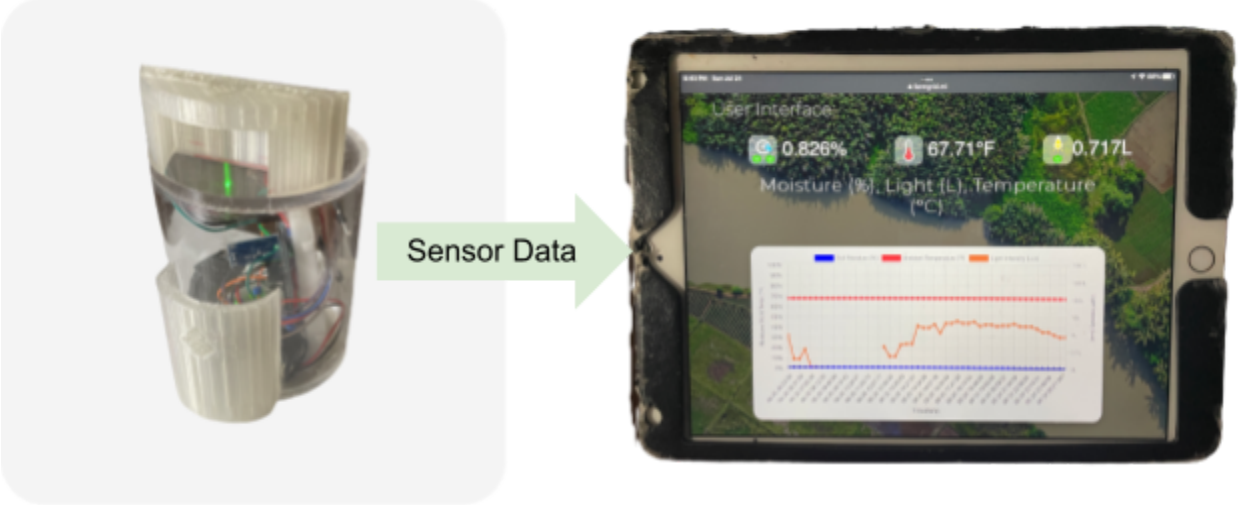
Business Plan and Operations

Executive Summary:

Approximately 800 trillion gallons of water are wasted globally every year due to poor water management practices[1]. FarmGrid offers a low-cost line of wireless sensors to remotely monitor soil moisture levels across farmer's fields. Our mission is to service small farmers and remote farming communities with a self-connecting grid of sensors that requires minimal maintenance on the farmer's part, through our unique solar-powered and energy-saving design. Unlike common industry-grade sensors, our sensors relay data remotely and at a 1/3rd of the cost by sourcing off-the-shelf parts. That way, farmers can gain more insights from their fields for less. Our success lies in our team, which has a unique combination of technology and business planning experience, from managing databases and servers at startups, to conducting due-diligence at venture capital firms. We have built a small inventory of weather rugged devices ready for deployment, and have been featured at the annual Minnedemo showcase and BizPitch from the Carlson school, garnering recognition and leads to test and iterate our idea.



Rugged Device Custom User Interface

Description of Business Concept:

The Problem:

Water mismanagement is a costly problem for farmers and unsustainable for the environment. The average farm in the U.S. spends approximately $18,000 on irrigation water alone yearly, or $41 per acre[2], amounting to a staggering $4,000,000,000 spent on water total across the United States[3]. By uniformly applying water across a field, farmers are losing 40% of

the potential value of their water, which amounts to thousands of dollars lost annually depending on the farm and their irrigation practices, with the worst case being $7,200 average yearly wasted on water. Although this figure appears small, nearly half of farms across the U.S. are family owned or rural farms operating at a gross farm income of $10,000 or below[4]. Saving a few thousand in utility costs such as water can quickly add up.

A $6.7B market for precision agriculture grew around this problem to help farmers manage their water using on-field sensors, which can either provide manual or wireless readings[5]. With the explosion of Internet of Things (IoT), wireless devices have become more commonplace in industrial applications, from factories to farms. However, the limited online presence of most farmers, the relative isolation and remoteness of farms, and the tendency for farmers to be adverse or hesitant to adopt new technologies means nearly half of the farming market is untapped with water management needs poorly met by current solutions.

There are a few common issues shared by current precision and water management solutions:

1. They measure infrequently - drones and harvesters equipped with sensors cannot be at all points of the field at the same time, every minute of the day.
2. The solutions are not 100% passive; regular sensors force farmers to take manual readings consistently, while drones and robots require human supervision.
3. Automation is extremely costly - drones can cost $2,000 to $5,000 - robots are often $10,000 or more. Renting automated solutions are inconvenient, infrequent, and not passive.
4. The average industrial grade soil moisture sensor costs $150-$270 per unit, while wireless sensor kits can cost $1,000.
5. In-field sensors require some technology proficiency to install and maintain, such as changing batteries and troubleshooting errors. Devices are also difficult to track down again on a remote location.

The Solution:

FarmGrid offers a solution that provides frequent measurements on an automated cycle and is ~95% passive (no supervision required) while being at just 1/3rd of the cost of current industrial sensors on the market, allowing farmers to get more sensors on their fields at the same cost, and close this gap in insight without worrying about the high price of autonomous equipment and industrial sensors. While battery replacement and maintenance of most sensors requires technological proficiency, the FarmGrid device aims to be self-sufficient by using energy-saving Bluetooth low energy (BLE) to connect to the cloud, which uses 1/100th the power of conventional bluetooth and allows the device to operate completely off of a solar cell. The device sends its battery level remotely, so farmers can monitor the device without needing

to track it down on the field. The water-tight enclosure allows the device to withstand heavy rainfall and flooding on the fields, ruggedizing it for outdoor applications, not just greenhouses.

Business Model:

Our business model will be direct to consumer (D2C) in the early stages. We want to gather additional feedback from early adopters to hone in on an optimal design that is intuitive for farmers and works best for large midwestern farms. A D2C strategy will accomplish this by helping us build relationships with local farms without a third-party distributor mediating our transactions. Early feedback is important to us because we plan to iterate through several devices as soon as possible through field-testing. Crop and irrigation strategies can vary between farms, as well as soil profile, crop height, and weather conditions. To test the hardiness and intuitiveness of our design we want to have direct control over the transaction strategy so we can hear feedback straight from our farmers.

We'll distribute our user-interface under a Software-as-a-Service (SaaS) model that will initially be freemium to gather feedback from local farmers. As our site traffic increases, we plan to offer a subscription fee for our software users, which will cover the costs of hosting a database on our remote servers, with a 40% profit margin. Specific projections shared under financials.

Partners and Vendors:

Our vendors will be electronics and small-batch manufacturers who will supply off-the-shelf parts. The current version of our product uses $16 worth of electronic components purchased from Digi-Key, an electronics distributor, and uses an additional $12 worth of plexiglass tubing, covers, and 3D printing plastic to ruggedize the device. These costs are overestimates because our current product is larger than intended to accommodate housing the prototyping board. We're working to reduce costs by replacing the prototyping board with smaller printed circuit boards (PCBs), which will bring the electronics cost to $10 and will reduce the device enclosure costs since we'll be able to cut the diameter of our tubing by half.

We'll outsource manufacturing to JLCPCB as our second vendor, a small-batch PCB manufacturer. Within the next 6 months, we will use JLCPCB and Digi-Key as our main vendors to develop 5 sensors of our current design to deploy at local farms as a pilot test. We'll develop 10 additional sensors after considering extensive feedback and design changes, which we'll redeploy and collect metrics from, such as % monthly water saved.

Progress:

Beginning in March 2022, we finished developing the software to run our first FarmGrid prototype, and received $100 funding from BizPitch. To motivate the next version of our device, we conducted target market research with students who worked on midwestern farms, and an additional marketing student with experience at an AgTech startup in California. The insights we gained around minimizing technology adversity for farmers helped motivate our second design,

a minimal viable product (MVP) that survives outdoors. We added database and web-server expertise to our team, and now have finished three rugged devices, developed a user-login page to access the user-interface, and set up preordering. Our main focus is working with our advisors to speak directly with farmers through Minnesota's Agricultural Utilization Research Institute (AURI), who are otherwise difficult to reach, and aggressively conduct market research to build on our findings from the literature.

Market Summary - Opportunity:
Description:
Growth and General Overview:

FarmGrid exists within segments of the precision agriculture market and the wireless sensor networks market. The global market for precision agriculture is expected to grow from $6.96B in 2021 to $11.25B in 2025 with a forecasted compounding annual growth rate (CAGR) of 12.8% during the period[5]. The market for wireless sensor networks is expected to grow from $29.06B in 2021 to $68.04B in 2025 with a CAGR of 18.6% during this period[6]. The wireless networking algorithm we're developing for FarmGrid devices will be valuable for applications outside of just precision agriculture, which is why we consider the wireless sensor networks market as relevant to our company.

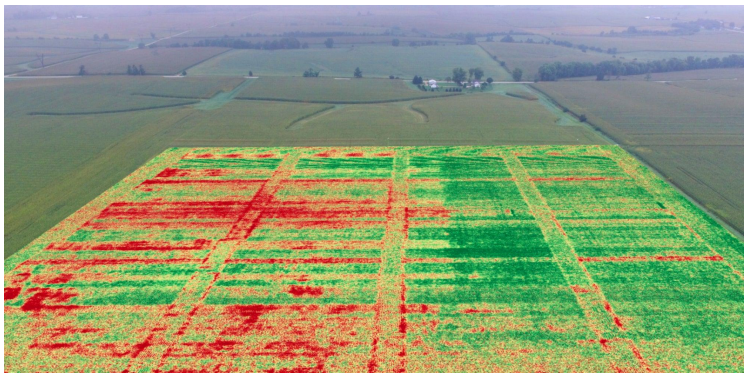
Major Trends:

Precision farming is a fast-growing and technology-driven industry, whose trends closely reflect the strengths and weaknesses of technology - we noted the following trends are particularly important[7], and in response to these trends, we elaborate on steps in the risks and mitigation section.

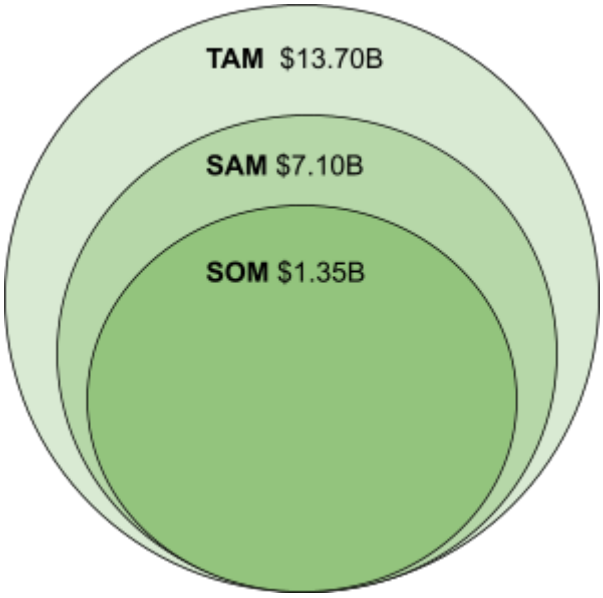
1. Domestic demand for precision agriculture fell during COVID-19 - major companies in the U.S. space such as John Deere and AGCO saw a decline in export shipments and and order intakes during 2020, and overall short-term demand is expected to stagnate.
2. Precision farming has seen a rise in AI-based solutions, which offer farmers automated guidance in water management, pest control, weather forecasting, and crop health.
3. Semiconductor shortages due to COVID-19 have adversely impacted precision farming, as the leading segment of the market involves hardware devices. These supply-chain issues are expected to recover within 3-5 years.

Market Segmentation:

FarmGrid is currently a soil-monitoring application, as each device passively relays soil moisture data at only its location throughout the day. However, a key detail in our mission is to offer a low-cost self-connecting grid of sensors, which places our product strategically in two ways. A grid of sensors will allow us to help farmers with crop-mapping, a major segment of the market, while a low-cost design will allow farmers to place *more* sensors in their fields, increasing the resolution of the crop-mapping interface we are able to offer, like increasing the pixels on a screen to enhance graphics. Below is an example of drone-based soil-moisture crop-mapping:



Our market segments are primarily crop mapping (~51%), yield(~12%), and soil-monitoring (~7%), which together account for 70% of the precision agriculture space. Although our product is currently geared towards soil monitoring for agriculture, our addressable market is not limited to agriculture - lawn and turf maintenance benefit from soil moisture monitoring as well. FarmGrid's addressable market is decomposed in the circle mapping below:

~$13.7B Total Addressable Market - the global market size of soil moisture monitoring devices ($8.8B turf/lawn and 70% of precision agriculture market, or $4.9B). **~$7.1B Serviceable Addressable Market** - the U.S. market size of soil moisture monitoring devices ($4.4B turf/lawn, $2.7B agriculture). **~$1.35B Serviceable Obtainable Market** - or half of the $2.7B U.S. market segment (rough estimate), as half of all farms in the U.S. are small or family-owned.	

We plan to target small-businesses because they will be most receptive to purchasing low-cost and lower-precision solutions compared to the other half of the market, which are large agribusinesses. Given our product angle and the underutilized small-business market, we believe within a 5-10 year timeline, it's reasonable to make headway on 1% of our realistic obtainable market (~$10M to $13M) by marketing our low-cost, sustainable, and small-business friendly thesis through local platforms in order to reach our end-users (see marketing strategy).

Competitive Landscape:

The following are the main U.S. competitors that provide soil-moisture monitoring and field-mapping solutions:

1. **AgEagle Aerial Systems** provides farmers with crop-mapping services through drones that pinpoint low-points of growth, indicative of low-soil moisture. The company is the #1 platform for drone-based agriculture mapping in the U.S.
2. **Soil Scout** sells the leading underground wireless soil moisture sensors in the United States. These soil moisture sensors are installed completely underground and are used by popular turf/lawn venues such as Wembley Stadium and Philadelphia Phillies.
3. **Onset Weather Station** sells one of the only commercial wireless sensor network solutions on the market. The sensors are able to route data between themselves across a large field without the need for external WIFI.
4. **Zynect** offers wireless soil moisture, temperature, and humidity sensors for use in soil-monitoring. The devices log data onto a user-interface for users to view and plan their watering schedules.

Within the competitors listed above, our product offering will have the following differentiators: Green = current product features, Yellow = in progress features

	FarmGrid	AgEagle	ZYNECT SENSORS	SOIL SCOUT	ONSET
Passive	X		X	X	X
Multiple Sensors per Device	X	X		X	X
Energy autonomous*	X			X	X
Wireless Grid	X				X
AI Insights	X				
Automated Irrigation	X				
Pricing	$50/device	$15,000/dev.	$150/device	$300/device	$159/device

*Energy autonomous devices - devices that do not need battery replacement and are completely self-sufficient (i.e. solar powered).

Sales and Marketing

Marketing Strategy:

Our strategy is broken down into two steps to help our business gain greater exposure - tapping into channels where we'll find a high concentration of local agriculture businesses, and showing farmers tangibly how our product can help them (save money). Given the limited online presence of our customers, the fastest connections we'll develop are ones where both industry and students will be pooling together; namely, university hosted platforms within agriculture business and sciences. The benefit is local industry experts most interested in engaging students will aggregate at events hosted by these clubs, such as Ag Business in the Carlson School and Agriculture Communication in the College of Food/Agricultural Sciences. As these industry individuals are more perceptive in engaging students, they may either be ecstatic early-adopters if they own gardens or happily give insight on local connections interested in our solutions.

Once potential clients are identified, we will employ the substance of our marketing strategy - run soft tests on sites of our clients free of charge, while pivoting our design to the feedback of our clients and most importantly, documenting how much water and money our product is helping to save. As businesses are often risk averse, they will want to see tangible results, which soft tests and word of mouth will provide. We'll leverage the AURI (Agriculture Utilization Institute) as our distribution channel to reach actual customers (local farmers), not just users interested in trying our product. The AURI provides grants and disseminates information on local agriculture innovations. They are well known in the industry, and backed by our initial soft launch, we'll target AURI publications to pull in local farmers with our results, and direct them to our website to learn more and build sales.

Sales Strategy:

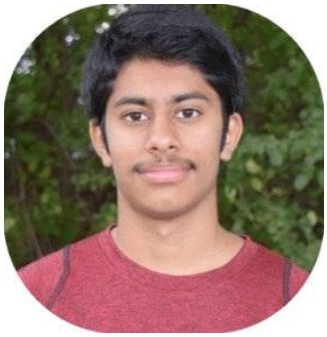
Once we have a portion of our addressable market excited about our initial results and have reached our website, we'll employ the final stretch of our strategy to transform potential viewers into sales: real-time demonstrations. The front of our website will have a short 30-second demonstration of how the device is used, and what previous users have been able to save. We'll offer testimonials from soft launches beneath the video, and use the backend of our website to monitor conversion rate, and adjust our website format, demo, and testimonials accordingly to maximize our rate to make sure we're closing the deal on the greatest portion of our traffic. Unlike our competitors who hide their high prices and ask for customer inquiries before revealing their details, we'll use our low costs as a selling point to offer a radically transparent persona on being a part of the customer's side of the journey. Since customers will need to push less to obtain details on the product, the hypothesis is they'll be more likely to place an order on the outset.

Operations:

To accelerate our company's exposure in the short-term, our operations will target the two most critical aspects of our product development and testing: 1. maintaining low-cost, and 2. validating our product works correctly end-to-end, beginning with the physical device in the field to the software on the customer's computer or phone. Low costs will ensure we can soft-launch our devices as quickly as possible with minimal capital. We are maintaining low costs by

sourcing off-the-shelf parts from our vendors, Digi-Key and JLCPCB, and using our knowledge in interfacing our vendor's parts together to create our devices. Our software was built by us, and our servers can support traffic for over 500 users *for free*, enough to support a soft-launch and even some customers. Secondly, we are running a field-test to make sure our product works correctly before we soft launch. Our family owns a garden where we will conduct field testing this summer, and our first target for the soft launch this fall will be the local garden near the Carlson building at the University of Minnesota - owned by one of the agriculture student groups.

Team:

		
Aditya Prabhu, Founder	Tanush Nadimpalli, CTO	Susan Otten, MBA, ABC, Advisor

Our team is a strategic mix of deep software experience, hardware design, and a solid foundation in business planning, conducting due-diligence, and maintaining exceptional connections within the midwest VC and startup space. Additionally, with the help of advisors with decades-worth expertise in growing and supporting early-stage startups, we together have the complemented skills needed to launch and sustain this unique user-centered venture within precision agriculture.

Aditya Prabhu, Founder - Aditya is a Computer Engineering major and a rising Junior at the University of Minnesota. He has spent multiple semesters on researching human-centered technology design, and is a co-author of a graduate-level robotics research paper. As an analyst at Atland Ventures, Aditya has spent a year conducting due-diligence and studying business plans of actual startups for investment decisions. He started FarmGrid this year to solve an untracked water-loss problem in his family's garden, and has since presented FarmGrid as one of seven companies at the annual MinneDemo competition, and placed 2nd at the 2022 spring BizPitch in Carlson.

Tanush Nadimpalli, CTO - Tanush is a Computer Science major and a rising senior at the University of Minnesota. Tanush has extensive experience in dealing with various web technologies and creating scalable services. His previous experiences include Helping Hands Community, Microsoft, and is currently working at Datavant (a health data startup near Silicon Valley). With his extensive experience with agile tech stacks, Tanush has developed a scalable portal for FarmGrid that is able to support traffic from over 500 users at no cost.

Susan Otten, Advisor - Founder of IndieDoGood, Susan has decades of experience supporting early-stage companies with managing and storing inventory, product distribution, and supply chain consulting. Susan's experience complements the inventory management and D2C product distribution strategy FarmGrid utilizes, and her advising in this area will be valuable in supporting FarmGrid's inventory management strategy to seamlessly distribute our products during soft launches and beyond.

Financial Summary and Projections:

Income Statement

Input Cells	Projection Period									
	Year 1 2022	Year 2 2023	Year 3 2024	Year 4 2025	Year 5 2026	Year 6 2027	Year 7 2028	Year 8 2029	Year 9 2030	Year 10 2031
Sales	$3,000	$6,000	$30,000	$90,000	$300,015	$600,030	$1,200,060	$3,000,150	$6,000,300	$9,000,450
% growth	-	*100.0%*	*400.0%*	*200.0%*	*233.4%*	*100.0%*	*100.0%*	*150.0%*	*100.0%*	*50.0%*
Cost of Goods Sold	1,200	2,400	12,000	61,200	204,010	408,020	816,041	2,040,102	4,080,204	6,120,306
Gross Profit	$1,800	$3,600	$18,000	$28,800	$96,005	$192,010	$384,019	$960,048	$1,920,096	$2,880,144
% margin	*60.0%*	*60.0%*	*60.0%*	*32.0%*	*32.0%*	*32.0%*	*32.0%*	*32.0%*	*32.0%*	*32.0%*
Selling, General & Administrative	300	600	3,000	9,000	30,002	60,003	216,011	540,027	1,080,054	1,620,081
% sales	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*
Other Expense / (Income)	0	0	6,300	6,300	6,300	17,521	18,001	75,004	75,004	74,254
EBITDA	$1,500	$3,000	$8,700	$13,500	$59,703	$114,486	$150,008	$345,017	$765,038	$1,185,809
% margin	*50.0%*	*50.0%*	*29.0%*	*15.0%*	*19.9%*	*19.1%*	*12.5%*	*11.5%*	*12.8%*	*13.2%*
Depreciation and amortization	30	60	300	900	3,000	6,000	12,001	30,002	60,003	90,005
EBIT	$1,470	$2,940	$8,400	$12,600	$56,703	$108,485	$138,007	$315,016	$705,035	$1,095,805
% margin	*49.0%*	*49.0%*	*28.0%*	*14.0%*	*18.9%*	*18.1%*	*11.5%*	*10.5%*	*11.8%*	*12.2%*
Interest Expense										
Revolving Credit Facility	-	-	-	-	-	-	-	-	-	-
Term Loan A	-	-	-	-	-	-	-	-	-	-
Term Loan B	-	-	-	-	-	-	-	-	-	-
Total Interest Expense	-	-	-	-	-	-	-	-	-	-
Interest Income	-	-	-	-	-	-	-	-	-	-
Net Interest Expense	-	-	-	-	-	-	-	-	-	-
Earnings Before Taxes	1,470	2,940	8,400	12,600	56,703	108,485	138,007	315,016	705,035	1,095,805
Income Tax Expense	147.0	294.0	840.0	1,512.0	6,804.3	23,866.8	30,361.5	75,603.8	260,863.0	405,447.8
Net Income	$1,323	$2,646	$7,560	$11,088	$49,898	$84,619	$107,645	$239,412	$444,172	$690,357
% margin	*44.1%*	*44.1%*	*25.2%*	*12.3%*	*16.6%*	*14.1%*	*9.0%*	*8.0%*	*7.4%*	*7.7%*

Critical Assumptions - The Assumption Percentages for the projections above is in Appendix:

Sales Growth: Farmers generally place 1 device per 80 acres - given the average farm size, this amounts to $600 in sales per client on average (12 devices, $50/device). There are approximately 20,000 "small" farms in Minnesota (<$10,000 income) and 1,000,000 "small" farms in the U.S. Aiming to gain 5 clients within this market segment in the next year, and roughly tripling the number of new clients each year, we arrive at our sales numbers above. In year 10, we would have accumulated 10% of the "small" farm market, without consideration for the vast other opportunities (greenhouse farms, vertical farms, lawns, golf courses, residential).

Cost of Goods (COGS): Buying parts in bulk, each device is expected to cost $22 to construct (sensors, chips, insulation, 3D print, plexiglass), and $8 additional for shipping, packaging, warranty, and trade-spend for marketing - for a COGS of $30/device. We plan to sell at a 40% profit margin (profit/sale); that is, retail of $50/device.

Selling General & Administrative (SG&A): In the first 3-4 years, SG&A costs will be incurred due to online advertisements via Google search and display ads. Cost per click is $3 on these

channels and 10% of leads generally turn into sales, which yields to the SG&A rates above, increasing proportionally to the increasing number of new clients per year. After year 6, SG&A % increases dramatically because we are aiming to advertise in agriculture journals to gain exposure in outside states to maintain our projected client growth. Ads cost $5,000-$10,000 per journal, and we plan to increase the number of journals we advertise in each year.

Other Expense (Income): In the first 1-2 years, we will be able to support our 15-20 clients by constructing and shipping the 100-200 devices by hand (they are fast to build). After year 2, we are accounting for costs of purchasing a small room (50 ft^2), 3D printer, laser cutter, and assembler to automate constructing the 600-1000 new devices for our inbound clients, (space and equipment have projected cost $6,300). Manufacturing capabilities upgraded again in year 6 ($17k-$18k yearly for 500ft^2 space + additional equipment to support manufacturing 50,000-60,000 devices) and again in year 6 ($75k yearly for 1000$ft^2$ space + additional equipment to support manufacturing 100,000-192,000 devices).

Taxes: Based on the U.S. income tax rate for the earnings bracket our company falls in.

Risks, Mitigation, and Conclusion:

Security - Ensuring the security of the data transferred between the devices and the server is a potential risk we are working to solve. IoT devices are generally more vulnerable to security risks because they do not have the same encryption standards and layers as PCs and desktop computers. To mitigate this, FarmGrid plans to add a cybersecurity specialist from the Computer Science department onto our team to conduct security maintenance and penetration testing as we scale (in 1 year) and add real users onto our platform. Within the next month, we will also switch our handmade WiFi hardware setup to a pre-built ESP32 microcontroller which has built-in standard encryption, and WiFi on the circuit. This will add $2 to our current COGS and will add a new vendor to our list - Expressif systems, who create the chips.

Sourcing Materials - Sourcing off-the-shelf parts may have unintended risks during this semiconductor shortage. The shortages will impact our vendors, but the supply chain changes may ripple towards as, as acquiring our electronics and sensors may increase. However, we have noticed no changes within our vendor's pricings within the last 1.5 years; rather, delivery times of parts have taken longer (1-2 weeks more). To mitigate this, we'll order parts in larger batches to ensure we have inventory between scheduling new orders.

Small Inventory - Using our $100 funding, we have built an inventory of 3 devices and can conduct tests on at most 3 separate gardens until we need to construct more devices. For the next 3-4 months we'll mitigate our small inventory risks by bootstrapping $100-$200 to construct at least 3-6 more devices, allowing us to do several additional launches.

Marketing - We plan to grow our main team to 3 members in the next 4-8 months by adding a marketing specialist with agriculture industry experience. We already have leads from our team's connections in Atland Ventures and in the College of Food and Agriculture.

Appendices:

Demos:

FarmGrid 1-Minute Video:
https://youtu.be/vn53brV7Vd0

In-Depth Technical Overview:
https://www.youtube.com/watch?v=pcWhgQNtV1U

References:

Section 1: The Problem

[1] https://htt.io/water-usage-in-the-agricultural-industry/ - 2 quadrillion gallons of water used globally in agriculture and 40% wasted due to poor irrigation infrastructure and soil quality, leading to 800 trillion gallons wasted.
[2] https://www.ers.usda.gov/webdocs/publications/41964/30286_wateruse.pdf?v=41143 - USDA water use and pricing; farmers spend approximately $41 per acre on water when the water is sourced off the farm.
[3] https://www.nass.usda.gov/Publications/Todays_Reports/reports/fnlo0220.pdf - USDA land and farm summary; the average farm-size is 444 acres.
[4]https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/farming-and-farm-income/ - USDA farming and farm income; ~51% of farms in the U.S. have a gross farm income of <$10,000.

Section 2: The Market & Competition

[5]https://www.alliedmarketresearch.com/precision-agriculture-market#:~:text=The%20precision%20agriculture%20market%20size,13.4%25%20from%202020%20to%202030. Size of the Precision agriculture market & relevant market trends.
[6]https://www.expertmarketresearch.com/reports/precision-agriculture-market - Segmentation of precision agriculture market into crop-mapping, soil-monitoring, yield-monitoring, and more.
[7]https://www.marketsandmarkets.com/Market-Reports/wireless-sensor-networks-market-445.html - Size of the wireless sensor networks market & relevant market trends.
[8]https://www.alliedmarketresearch.com/lawn-and-garden-consumables-market-A11866 - Size of the turf, lawn, gardening, and consumables market & relevant market trends.

Section 3: The Competition

[9]https://www.marketsandmarkets.com/Market-Reports/precision-farming-market-1243.html - Leading competitors in the precision agriculture market, future opportunities, trends, & challenges.
[10]https://www.emergenresearch.com/industry-report/precision-agriculture-market - Competitors and challenges in precision agriculture; main challenge being **large upfront cost of modern farming equipment**.

Preliminary Market Research - Insights:

Only been able to reach students who have lived on family farms so far, but are working with university platforms to reach farmers directly.

- Contacted 3 students through mutual connections. Two students have worked on family farms in the midwest, and one student has worked with a AgTech company based out of Salinas CA, a farming region in California.
- Two students met through IEEE - Institute of Electrical and Electronics Engineers at the University of Minnesota
- One student met through Atland Ventures - Marketing student with a major in marketing. Suggested to conduct market research as early on as possible.

Insights with the Students who have Midwest Farming Connections [Temperate Climate]:

- Farmers in the midwest rely on rain to water most crops. This is because the outdoor climate in the midwest is best suited for non-specialty crops, such as seeds, grasses, forages (alfalfa, clover), and grains (corn and wheat). Non-speciality crops generally don't have as stringent watering needs and are able to survive outside given periodic rain. However, drier seasons in the summer may require sprinkler support to mist the crops in the mornings
- Have not used agricultural sensors on their farms, as non-speciality crops do not require climate controlled precision to ensure reasonable crop yields.
- However, precision agriculture can be a useful tool to help reach more optimal crop yields, especially in the drier months of the summer, where sprinklers are more commonly used to water crops.
- Mentioned have heard agricultural sensors used in orchards - believe orchards and tree growers are able to benefit most from

Insights with Student who have Western Farming Connections [Subtropical Climate]:

- Agricultural sensors are often best used in climate controlled conditions, such as greenhouses, seed banks, and vertical farms. In such conditions, knowing how water level changes over time is valuable information, as it is a variable that can be adjusted and controlled, unlike the outdoors.
- Orchards, speciality-crops, and other high-value crops are another common use case for agricultural sensors. Orchard trees take years to grow and mature, and are a long-term investment for many farmers who want to ensure their investment is protected.
- Agricultural sensors are worth the investment for many farmers, who want to ensure trees are healthy enough throughout the year to produce a strong yield. Sensors can help monitor water intake so farmers can avoid root rot due to too much water, and beetle and pest infestations due to too little water weakening the tree.
- Specialty crops include trees, shrubs, vegetables, fruits, flowers, and spices. Such crops are often either grown in climate controlled conditions such as greenhouses and vertical farms, or are monitored to ensure the crops are healthy due to their longer maturity time (trees, shrubs, and fruits) or fickle growing requirements (vegetables, spices, flowers)

- Many farmers are based on rural areas and towns - often do not have a very high online presence and are often hard to reach.
- Farmers often are not as tech-savvy, and prefer to find non-technical solutions to their problems
- Farmers are often change-averse and risk-adverse- “if it’s not broken, don’t fix it mentality,” may need tangible market insights early on before deciding whether to use the technology systems in their own gardens.
- Farmers may be hard to convince without enough specific information on how much water they can save with an end-to-end IoT system. Aim to test a fully-functional FarmGrid irrigation system right now at our local garden.