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Leveraging AI for Farmers: An
End-To-End Plant Monitoring,
Pest Detection, and Robotic
Scouting System

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Table of Contents

I. Executive Summary	1
II. Problem	2
III. Customer Segments	3
IV. Unique Value Proposition	4
V. Solution	5
VI. Conclusion	9
VII. Bibliography	10
VIII. Appendix	10

1 EXECUTIVE SUMMARY

Every year, pests destroy enough crops to feed over 2 billion people, and most farmers don't find the problem until it's too late. LeAF (Leveraging AI for Farmers) is a revolutionary and comprehensive AI-powered crop protection system, designed to empower farmers and **disrupt the conventional agricultural technology market**. Addressing the "Innovator's Dilemma," LeAF offers a unique value proposition unlike traditional pesticide and large farm equipment corporations, which may be less incentivized to reduce chemical usage.

LeAF uniquely combines **cutting-edge computer vision** (Convolutional Neural Networks), accessible hardware options like a mobile app for smaller farms or the **BRANCH robot (Budget-friendly Robot for Autonomous Nonintrusive Crop P[h]otography)** for larger fields, and a user-friendly **Large Language Model (Chatbot) interface** to provide farmers with in-depth, plant-by-plant data. This scalable solution empowers farms of all sizes, from smallholders using just a smartphone to large-scale operations potentially deploying robots on tractors or drones, to minimize crop losses (currently responsible for 40% of global production losses, or \$220 billion annually), reduce chemical usage (targeting a \$60 billion/year pesticide market), and maximize yields. LeAF is built on a simple yet profound idea: **farmers should not have to sacrifice profitability for sustainability, or vice versa**.

LeAF addresses the **critical problem of plant anomalies – pests, weeds, and diseases** – that cost farmers billions of dollars annually and contribute to environmental damage through excessive pesticide use. These are not minor inconveniences; they are major threats to global food security and the livelihoods of farmers worldwide. Unlike traditional methods that rely on manual scouting (which is time-consuming, inaccurate, and often too late) or blanket chemical applications (which are wasteful, expensive, and environmentally harmful), **LeAF provides precise, plant-by-plant monitoring and targeted treatment recommendations**. We are shifting the paradigm from reactive to **proactive crop management**.

Our target customers include small to medium-sized farms, organic farms, and larger agricultural operations seeking to adopt sustainable practices. We are focusing initially on mid-to-large scale crop farmers in North America (growing corn, soybeans, wheat, etc.) – the innovators who understand the value of precision agriculture. Our secondary market is organic farmers, who need effective, non-chemical pest and disease management. **The system is offered via a freemium subscription model (free, \$100/month Basic, \$200/month Premium)** and an optional, low-cost (\$499) BRANCH robot for autonomous field scouting. Farmers can purchase multiple BRANCH robots based on acreage and desired scanning frequency.

The LeAF system consists of three core, seamlessly integrated components:

1. **LeAF Vision:** Using Convolutional Neural Networks for over 90% accurate anomaly detection from images
2. **LeAF Field Mapping:** Creating detailed field health maps using object tracking and plant stem detection
3. **LeAF Advisor:** An LLM-powered natural language interface providing tailored advice

Our financial projections indicate a path to **significant profitability**, targeting \$1.2M, \$7.5M, and \$36M in revenue over the first three years, respectively. LeAF provides a compelling value proposition: reducing pesticide use by up to 60%, increasing yields, and offering a substantial ROI (estimated at 358% within the first year for a 100-acre farm).

LeAF is not just a concept; it's a working solution already deployed in farms in Washington State, demonstrating its practicality and effectiveness in real-world conditions. We are seeking a seed investment of **\$500,000 in exchange for 25% ownership** of the company to scale up production, expand our marketing efforts (through direct sales, partnerships, online marketing, and government collaboration), and continue developing advanced features, such as predictive analytics for pest infestations. We are not just building a product; we are building a **platform for the future of farming**.

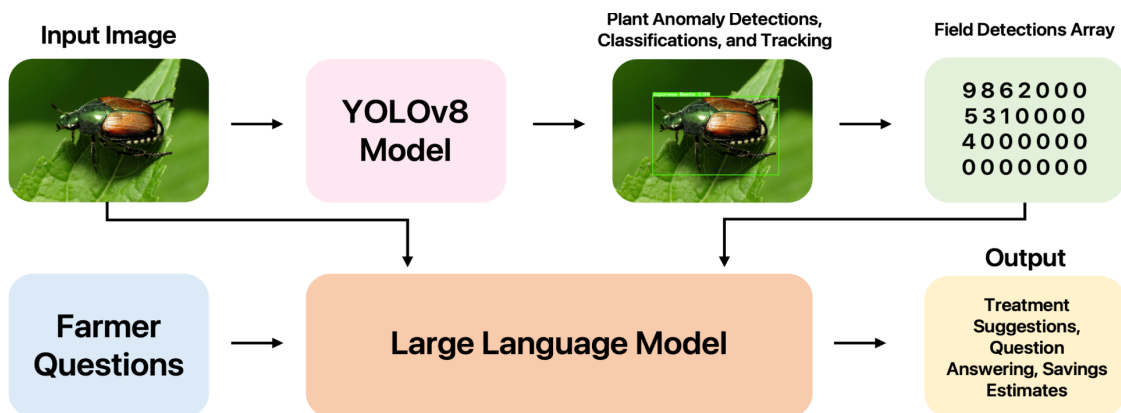


Diagram showing LeAF end-to-end pipeline to help farmers with efficient pest & plant anomaly management.

2 PROBLEM

Farmers worldwide face a constant, multifaceted battle against plant anomalies – pests, weeds, and diseases – that threaten their livelihoods, global food security, and the health of our planet. According to the FAO and the World Economic Forum, these anomalies are responsible for up to **40% of all global crop production losses**, amounting to over **\$220 billion annually** [Bhalla, 2021]. The impact is especially severe in regions with limited access to early detection or treatment tools. For instance, Sub-Saharan Africa alone loses **\$4.1 billion in maize** annually to the fall armyworm [FAO, 2021]. The problem is far more complex than crop loss; it is a systemic issue with cascading consequences:

- **Economic Losses:** Direct crop losses significantly impact farmers’ income, particularly for smallholder farmers who represent a large portion of the agricultural workforce and are often the most vulnerable to economic shocks. The loss of even a portion of their crop can be devastating.
- **Environmental Damage:** The traditional response to plant anomalies often involves the excessive and indiscriminate use of pesticides, herbicides, and fertilizers. This "blanket" approach, while sometimes necessary, leads to a host of serious environmental problems:
 - **Greenhouse gas emissions:** The production and application of agricultural chemicals contribute significantly to greenhouse gas emissions, particularly nitrous oxide (a potent greenhouse gas) and methane. Global pesticide use now exceeds **4.2 million tons per year**, a figure that has **increased by over 50% in the past 30 years** [Ritchie, 2023]. Agricultural chemicals account for over **11% of agriculture’s total GHG emissions**, particularly due to nitrous oxide, which is **298x more potent** than CO2 [Ritchie, 2023].
 - **Soil and water contamination:** Chemical runoff pollutes waterways, harms aquatic life, and can contaminate drinking water sources. Pesticide residues can also persist in the soil, disrupting the delicate balance of soil ecosystems. **90% of U.S. waterways** contain pesticide traces, and **60% of global farmland** is at risk of long-term residue accumulation [USGS, 2020].
 - **Harm to beneficial insects, wildlife, and human health:** Pesticides can harm beneficial insects (like pollinators), birds, and other wildlife. Exposure to pesticides can also pose serious health risks to farmworkers and consumers (with over 20,000 new cancer cases annually linked to pesticide residues). The World Health Organization estimates **385 million cases of unintentional pesticide poisoning** every year, with over **20,000 deaths** from occupational exposure [Organization, 2020].
 - The sheer cost of pesticides is enormous, exceeding **\$60 billion annually**, placing a significant financial burden on farmers.
- **Inefficient Practices:** Manual scouting of fields is time-consuming, labor-intensive, and often tragically inaccurate. Farmers may miss early signs of infestation, leading to larger outbreaks, increased chemical use, and greater crop losses. The vastness of many fields makes thorough manual inspection simply impractical. Blanket application of chemicals is wasteful, expensive, and environmentally damaging, often treating areas where no problem exists.
- **Lack of Data:** Farmers often lack access to real-time, granular data on the specific types and locations of anomalies in their fields. This makes it incredibly difficult to make informed decisions about treatment strategies, leading to inefficient resource allocation and potentially ineffective interventions.
- **Shrinking Arable Land:** Due to factors like climate change (which is exacerbating pest and disease pressures), urbanization, and soil degradation, less and less land is available for agriculture, making it even more crucial to maximize the productivity of existing farmland. Only **15–20% of farms** worldwide have access to some form of precision agriculture, and fewer receive real-time, plant-level insights [Company, 2022].

These challenges are further exacerbated by the increasing global demand for food (driven by population growth), the growing resistance of pests and weeds to commonly used chemicals, and the urgent need for more sustainable agricultural practices that protect our planet’s resources. Farmers are caught in a difficult position, needing to produce more food with fewer resources while minimizing their environmental impact. They desperately need a solution that is affordable, effective, easy to use, and environmentally responsible – a solution that empowers them to be both productive and sustainable.

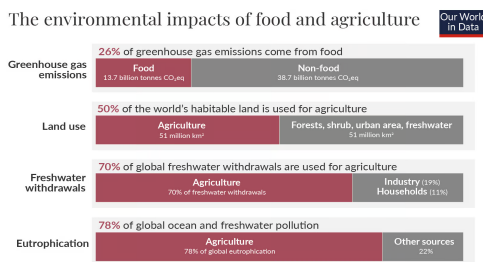
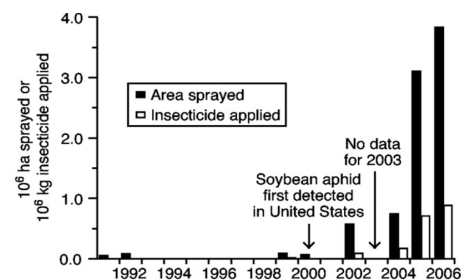


Diagram showing the environmental impacts of agriculture. [Bhalla, 2021]



Graph showing increase in usage of pesticides in agriculture. [Ritchie, 2023]

3 CUSTOMER SEGMENTS

LeAF is designed to serve a diverse range of customers within the agricultural sector, recognizing that different types of farms have different needs and resources. However, we are taking a phased approach to market entry, focusing initially on segments where we can have the greatest immediate impact. Our primary target segments include:

- **Small to Medium-Sized Farms (10-500 acres):** These farms often lack the resources for expensive, complex technology or large labor forces for manual scouting. LeAF offers an affordable and efficient solution that can significantly improve their crop management practices, leveling the playing field with larger operations. This includes family farms, specialty crop growers (e.g., fruits, vegetables, nuts), and vineyards, who often face unique pest and disease challenges.
- **Organic Farms:** Organic farmers face unique and significant challenges in managing pests and diseases without the use of synthetic chemicals. LeAF's precise monitoring and support for non-chemical treatment options (e.g., beneficial insects, biological controls, organic-approved sprays) make it an ideal solution for this rapidly growing segment. LeAF helps organic farmers maintain their commitment to sustainability while protecting their yields.
- **Large Agricultural Operations (500+ acres):** While larger farms may have access to some advanced technology, LeAF offers a scalable and cost-effective solution for plant-by-plant monitoring, which is often impractical with traditional methods, even on large-scale farms. Our system can integrate with existing farm management software and data platforms, providing a seamless flow of information.
- **Agricultural Consultants and Agronomists:** LeAF can be a valuable tool for agricultural professionals who provide advice and services to farmers. It allows them to offer more precise, data-driven recommendations, improving their clients' outcomes and strengthening their relationships.
- **Developing Countries/Small Holder Farmers:** Our low-cost BRANCH robot is specifically designed to make our solution more accessible to farmers in developing countries, where resources are often limited, and the need for efficient crop management is particularly acute.
- **Educational Farms and Research Institutions:** LeAF can be used as a valuable teaching tool and research platform, allowing students and researchers to study plant health, pest dynamics, and the effectiveness of different treatment strategies.

Secondary Target Segments:

- **Government Agencies:** Agricultural departments and environmental protection agencies can use LeAF to monitor pest outbreaks, track pesticide use, promote sustainable farming practices, and gather data for policy decisions.
- **Agricultural Input Suppliers:** Companies that sell seeds, fertilizers, and pesticides can use LeAF to offer value-added services to their customers, demonstrate the effectiveness of their products, and promote responsible chemical use.



Farm workers spraying large scale pesticides to fields.
[Ritchie, 2023]



Farmer in tractor spraying pesticides to large areas of fields. [Organization, 2020]