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**GENEVA SCHOOL OF ECONOMICS
AND MANAGEMENT**

Individual Assignment: Disruptive Technology Memorandum

Course: Disruptive Technology

Professor: Professor Lee Howell

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Name: Rajendra Laxmi Dhamala

Student ID: 24-332-769

Master of Responsible Management

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MEMORANDUM

To: Executive Committee of CropScience Division

From: Rajendra Laxmi Dhamala

Date: April 12, 2025

Subject: Adoption of Predictive Analytics with AI for Precision Agriculture with AI-Driven Solutions.

Purpose

Through this memorandum, I recommend that Bayer CropScience (Division of Bayer AG) to implement integrated AI-driven agricultural technologies to maintain market leadership and address emerging competitive threats. By adopting advanced predictive analytics, precision monitoring systems, and autonomous field operations, Bayer can strengthen its position in the rapidly evolving crop protection sector. We should prioritize three interconnected AI technologies:

1. **AI-Enhanced Weather Prediction Systems** that provide hyperlocal forecasting to optimize planting, treatment, and harvest timing.
2. **Advanced Crop Monitoring Solutions** utilizing satellite imagery, drone surveillance, and field sensors to detect disease, pest pressure, and nutrient deficiencies before they impact yield.
3. **Autonomous Precision Spraying Systems** that reduce chemical usage while improving application accuracy and effectiveness.

These technologies will help us address competitive pressures from emerging agtech startups and changing regulatory landscapes. This would also help Bayer CropScience in meeting increasing consumer demand for sustainable agricultural practices.

Bayer AG's Current Market Position and Future Plan

Bayer CropScience, specializing in crop protection and pest control products, has shown significant historical growth but faces challenges. From generating 5.9 billion euros in revenue in 2005, the division expanded dramatically to 24 billion euros by 2022. However, revenue has declined for two consecutive years, falling to 22 billion euros in 2024 (Figure 1).¹

The division's core business focuses on developing seeds with desired plant traits and producing crop protection and pest control products for both agricultural and non-agricultural applications.² To reverse the recent downward trend, Bayer has established an ambitious growth strategy that aims to add over one billion euros to annual earnings by 2029 through enhanced product offerings, research and development, manufacturing improvements, and optimized sales and support functions. This plan includes a comprehensive program to improve cash efficiency. Looking forward, Bayer anticipates stronger-than-average growth for the Crop Science division, specifically targeting an additional 3.5 billion euros in sales from new innovations by 2029.³

Key Trends and Change Drivers

1. **Sustainability Pressure:** The EU's Green Deal, launched in 2019, aims to make Europe climate-neutral by 2050, with specific agricultural goals including halving

pesticide use by 2030 and increasing organic farming to 25% of arable land.⁴ As a leader in crop protection, Bayer faces regulatory risks from potential restrictions on pesticides and herbicides like glyphosate. To address these challenges, AI-powered crop monitoring and autonomous sprayers would enable targeted applications, reducing overall chemical use while aligning with regulations and consumer expectations. For example, monitoring drones could detect pests early, significantly reducing required pesticide amounts, while precision sprayers would minimize runoff, effectively addressing environmental concerns.

2. **AI Adoption Surge:** The agritech AI market's growth reflects widespread adoption of advanced technologies across the agricultural sector. Tools like machine learning for pest prediction and computer vision for crop health analysis are driving this expansion.^{5, 6} Bayer's Climate FieldView platform (digital agriculture platform developed by The Climate Corporation, a subsidiary of Bayer AG, designed to help farmers optimize crop management through data-driven insights)⁷ has already integrated AI capabilities. However, to maintain its competitive edge, the company must scale its predictive analytics and precision agriculture tools, such as satellite-based monitoring systems. Without continued investment in these technologies, Bayer risks ceding ground in a market expected to be frontiers in agriculture in coming years.
3. **Climate Volatility:** In 2023, we saw extreme weather events, including droughts, floods, heat waves and storms.⁸ Prolonged heatwaves and flash flooding have also been observed in Europe in the last few years. Advanced weather forecast systems that can predict weather patterns with high accuracy can recommend precise planting times, reducing crop losses. For instance, AI models integrating data from the National Oceanic and Atmospheric Administration (NOAA) or The European Centre for Medium-Range Weather Forecasts (ECMWF) can predict rainfall with high accuracy, helping farmers avoid failed sowings. This strengthens Bayer's value proposition, especially in climate-vulnerable regions like Latin America.
4. **Cost Sensitivity:** Inflationary pressure on commodities required for manufacturing herbicides and pesticides, as well as disrupted supply chains in an uncertain geopolitical environment, will continue to increase production costs. Autonomous spraying systems and AI monitoring could offer solutions by cutting input use while maintaining yields. While all the savings make Bayer's products more attractive to farmers, potentially boosting adoption and customer loyalty. However, these solution may simultaneously impact the company's revenue as customers purchase fewer inputs. This presents a strategic challenge that requires balancing short-term revenue considerations with long-term market position.

Problem Identification of Customers (Farmers)

Biotic and abiotic stresses are major contributors to crop losses. Biotic stresses refer to plant diseases caused by infections from bacteria, insects, and fungi, while abiotic stresses include unfavorable environmental conditions like drought, heat, and flooding. Farmers use insecticides and pesticides to combat biotic stresses and protect crops, while herbicides are applied for effective weed removal in fields. However, application of these chemicals is often inefficient, with significant waste that negatively impacts the surrounding environment, reducing their sustainability (Wu et al., 2025).⁹ Research has focused on developing more effective ways to apply agrochemicals. Scaling and further developing nanoinsecticides

represent one promising alternative, offering a smarter approach to pest management with less waste, though questions regarding environmental safety measures remain (Anbalagan et al., 2024).¹⁰ By identifying and addressing the need for specific technologies in these areas while ensuring environmental safety, Bayer can gain competitive advantage in the agricultural industry.

Competitive Challenge: Disruption in Crop Protection Markets

Bayer AG deriving over 40% (Table 1) of its revenue from crop protection solutions, faces a disruptive threat as traditional pesticide and herbicide models could lose ground to technology-driven alternatives.¹¹ Established competitors like Corteva and Syngenta are integrating AI, robotics, soil sensors, and precision tools to offer farmers cost-effective, sustainable options, potentially eroding Bayer's market share.^{12,13} The threat extends beyond traditional agricultural markets, as commoditization of advanced weather prediction tools enables farmers to make planting decisions based on forecasted conditions or even select different crops (beyond Bayer's Seed portfolio) better suited to changing environmental patterns.

Without adopting these innovations, Bayer risks becoming a high-cost, low-efficiency player in a \$60 billion market increasingly dominated by data-driven precision agriculture. The challenge is twofold: (1) farmers demand reduced input costs and environmental impact, (2) competitors are scaling AI solutions faster, threatening Bayer's dominance in key regions like North America and Europe. Failure to act could shrink our crop protection revenue within few years, necessitating urgent action from senior management.

Business Opportunities: Disruption in Crop Protection Markets

Bayer can drive significant revenue growth and operational efficiency by embedding AI and precision agriculture into its crop protection offerings, which will enable early pest diagnosis.¹⁴ These smart products enhance the effectiveness and sustainability of traditional agricultural tools.¹⁵ Platforms like Climate FieldView can be upgraded to generate recurring revenue by providing farmers with real-time insights into spraying, planting, and pest management. These technologies would boost yields, reduce chemical waste, and strengthen customer loyalty in a competitive landscape dominated by players like Corteva and Syngenta.

Additionally, AI accelerates research and development, cuts input costs, and optimizes Bayer's supply chain by synchronizing production with real-time field data which are important factors to achieve its €1 billion earnings target by 2029. These innovations provide Bayer with a competitive advantage in sustainability, regulatory compliance, and brand perception. AI-powered solutions enable farmers to comply with increasingly stricter EU and U.S. pesticide regulations while supporting global sustainability goals, including the EU Green Deal and Bayer's vision to "Produce 50% More, Restore Nature."¹⁶

In emerging markets such as Southeast Asia and Latin America, Bayer can lead the digital transformation of agriculture, reaching smallholders with affordable, AI-based tools. Strategic technology partnerships, an open data ecosystem, and strengthened support for retailers and cooperatives would further solidify Bayer's leadership in smart, sustainable farming solutions reducing risk, boosting profits, and creating long-term competitive advantage.

Why proposed technologies are best-suited

1. Predictive Analytics with AI

By integrating weather data, soil metrics, and historical yields into AI models, Bayer can forecast optimal planting and spraying schedules. This reduces crop losses and tailors protection strategies to specific fields, outpacing generic solutions. We can extend these services as SaaS to farmers or industrial farms.

Predictive analytics leverages machine learning to process real-time inputs like weather forecasts from NOAA or ECMWF, soil moisture from IoT sensors, and Bayer's 20-year yield database into models that predict the best times to plant or apply crop protection products. For example, AI can determine with high accuracy whether rain will delay herbicide efficacy, recommending precise application windows (e.g., "spray on April 15, 8:00 AM").

With large number of farmers seeking technology to combat climate volatility, predictive analytics positions Bayer as a trusted partner, especially in regions, where the degree of climate impact on crop production is high. Integration with Bayer's Climate FieldView, already used on 250 million acres, allows seamless delivery of these insights, generating subscription revenue while countering Syngenta's Cropwise, which offers similar forecasting capabilities.

By preventing yield losses, Bayer strengthens farmer loyalty, critical when rivals like Corteva (7% sales growth in Q4 2024) are gaining ground.¹⁷ It also reduces over-application costs, supporting Bayer's €1 billion earnings target by 2029, as outlined in its 2024 Annual Report.

2. Precision Agriculture & AI-Driven Solutions

a) AI-Powered Crop Monitoring

Drones, satellites, and sensors with computer vision detect pests and diseases early, cutting pesticide use while maintaining yields. Drones equipped with high-resolution cameras and satellites with multispectral imaging scan fields daily, while ground sensors measure soil and plant health. Computer vision algorithms trained on Bayer's pest databases identify issues like aphid infestations or fungal spots within hours, flagging them via FieldView for immediate action (e.g., "spray quadrant 3 with fungicide").

This technology aligns with the EU Green Deal's 50% pesticide reduction goal by 2030, critical for Bayer's €7 billion European market. It enhances Bayer's ForGround¹⁸ platform (ForGround by Bayer supports growers in considering, adopting and expanding regenerative agriculture practices), rewarding farmers for sustainable practices, and counters Corteva's drone partnerships, which target similar precision gains. By minimizing chemical reliance, Bayer also mitigates litigation risks tied to products like Roundup.

Reduced pesticide use would lower Bayer's production costs, boosting margins, while sustained yields ensure farmer trust, vital against Syngenta and Taranis (the world's leading AI-powered crop intelligence platform) AI collaboration. This supports Bayer's goal of €3.5 billion in innovation sales by 2029, as precision tools drive adoption.

b) Autonomous Spraying Systems

These systems target herbicides and pesticides only where needed, slashing waste and aligning with sustainability goals. Autonomous sprayers mounted on tractors or drones will use AI to analyze real-time field imagery, identifying weeds or pests with high accuracy. They will apply chemicals only to affected areas (e.g., 10% of a field), guided by GPS and FieldView data, unlike blanket spraying that coats entire fields.

With farmers prioritizing cost savings and regulations like the EU's tightening, these systems make Bayer's herbicides more compliant and affordable, preserving market access. They align with Bayer's vision to "Produce 50% More, Restore Nature," enhancing its ESG rating. Competitors like Corteva are testing similar sprayers, but Bayer's global distribution network gives it a scaling advantage.

Lower input use reduces Bayer's supply chain costs, supporting its €1 billion earnings goal, while eco-friendly spraying attracts lots of consumers favoring sustainable brands, boosting sales.

Deployment and Development Plan

Bayer can pursue three strategic options for implementing AI-driven precision agriculture technologies:

1. **Partnering with Agritech Firms:** Collaborating with established companies like Climate Corp offers Bayer a fast, cost-efficient path to deploy AI solutions. By leveraging Climate FieldView's footprint, Bayer could rapidly roll out predictive analytics in key markets such as the U.S. Midwest within 6 to 12 months. This would deliver immediate value to farmers and help counter competitive pressure from Corteva and Syngenta. While this approach accelerates market entry, it also introduces long-term risks related to reliance on external intellectual property and limited customization for diverse crops. I recommend using this strategy as a short-term solution to regain market momentum by Q4 2025, while simultaneously preparing to transition toward more proprietary, in-house solutions.
2. **Building In-House AI Capabilities:** Developing AI tools internally would give Bayer full control over its technology stack, integrating predictive analytics with Monsanto's¹⁹ proprietary seed and trait data for highly customized, crop-specific solutions. This could reduce R&D cycles from 5 to 6 years to 3 to 4 years, supporting Bayer's goal of achieving €3.5 billion in innovation-driven sales by 2029. However, this path requires a substantial investment of \$50 to 80 million and involves a slower rollout of 24 to 36 months, creating the risk of lagging behind faster-moving competitors. I suggest focusing internal development on high-value, differentiated applications such as autonomous spraying systems with the aim of achieving market leadership by 2028.
3. **Hybrid Approach:** A blended strategy combining partnerships with in-house development would balance speed, innovation, and long-term control. Partnering with firms like Climate Corp would enable a 2025 rollout of AI-powered crop monitoring in markets such as Germany and Brazil, while concurrently developing proprietary predictive tools internally for a 2027 launch. Although this model involves coordination

challenges and a \$30-50 million investment, it optimizes market responsiveness and future-proofs Bayer's competitive position. This approach positions the company to capture leadership in the growing \$4.5 billion agritech AI market by 2030.

Recommendation:

The hybrid approach is recommended to maximize both speed-to-market and long-term competitiveness. Bayer should begin with a pilot program in Germany and Brazil to drive early adoption, while building proprietary capabilities to secure lasting leadership in sustainable, AI-driven crop protection.

Conclusion

Bayer CropScience faces mounting challenges from climate volatility, regulatory pressure, rising input costs, and accelerating competition from AI-powered agritech firms. Farmers are increasingly burdened by biotic and abiotic stresses, inefficient chemical applications, and volatile weather conditions leading to reduced yields and higher operational risks. At the same time, Bayer's traditional crop protection model is being disrupted by agile, technology-driven competitors offering precision, sustainability, and cost-efficiency.

To address these interconnected problems and secure long-term market leadership, Bayer must rapidly transition from conventional crop protection to AI-driven, precision agriculture. This transformation should prioritize the integration of three complementary AI technologies:

1. **AI-Enhanced Weather Prediction Systems** for hyperlocal, real-time insights that optimize planting, spraying, and harvest timing.
2. **Advanced Crop Monitoring Solutions** leveraging drones, satellites, and sensors to detect disease, pest, and nutrient threats before they impact yields.
3. **Autonomous Precision Spraying Systems** that reduce chemical use while increasing application accuracy, aligning with strict environmental regulations and farmer cost concerns.

Together, these interconnected technologies will enable Bayer to deliver smarter, more sustainable, and cost-effective solutions for farmers improving yields, reducing chemical waste, and ensuring compliance with evolving global sustainability standards. A hybrid strategy combining partnerships and in-house AI development offers the fastest, most scalable, and future-proof path to leadership in the \$4.5 billion agritech AI market, positioning Bayer to regain growth momentum, strengthen farmer loyalty, and achieve its €1 billion earnings target by 2029.

Annex

Figure 1

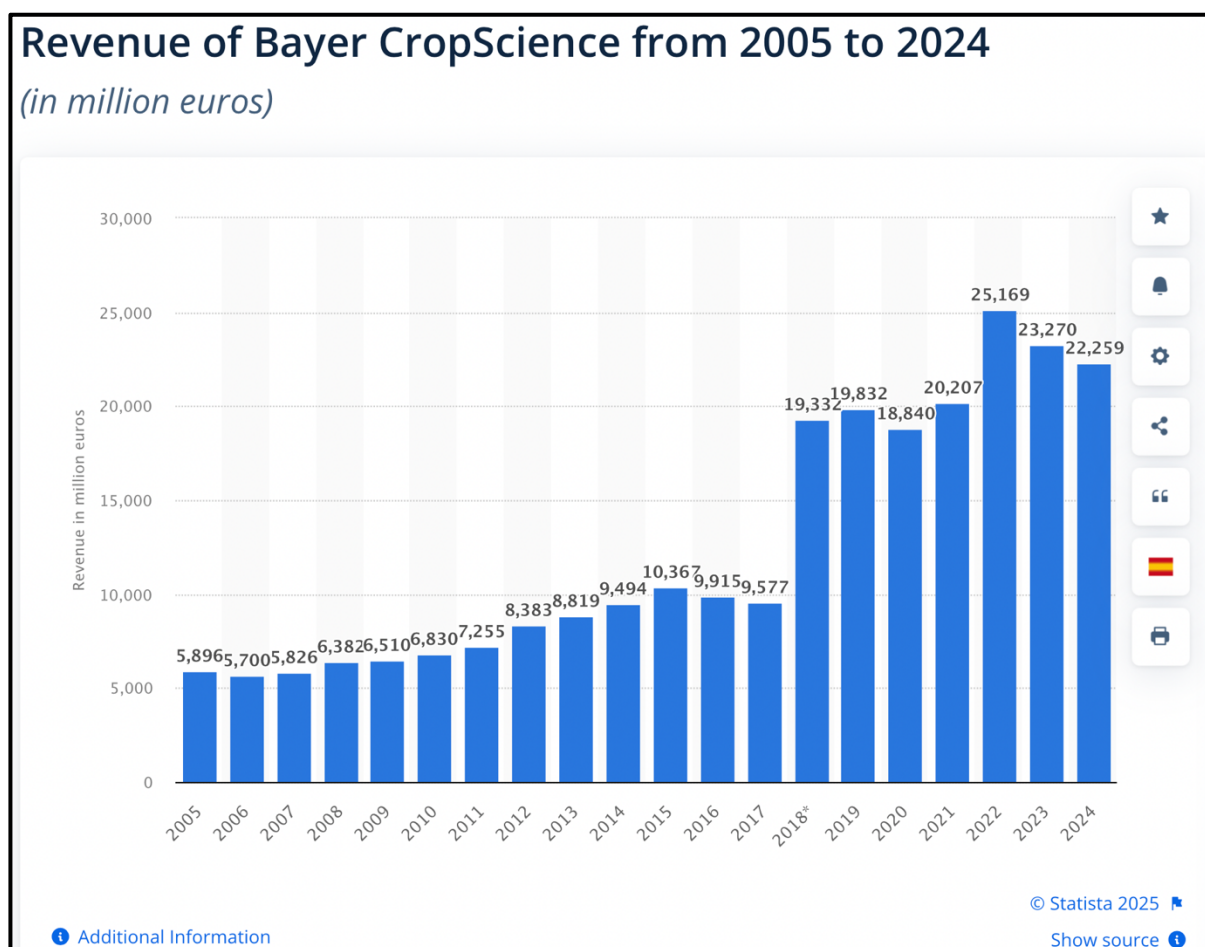


Figure 1: Revenue of Bayer CropScience from 2005 to 2024

Table 1

€ million

Division	Revenue 2023	Revenue 2024	Share 2023	Share 2024	Difference
Crop Science	23270	22259	49.12%	48.11%	-1.01%
Pharmaceuticals	18081	18131	38.16%	39.2%	1.04%
Consumer Health	6027	5870	12.72%	12.69%	-0.03%

Table 1: Calculation of revenue percentage of Bayer AG on the basis of business division for the year 2023 and 2024

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