Solar Agrotech

High-Level Feasibility Study

Submitted to:

The Ministry of Digital Economy and Entrepreneurship

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Executive Summary

SolarAgrotech aims to improve the agricultural sector in Jordan by integrating AI with solar-powered water pumps to provide an energy-efficient and cost-effective irrigation solution. This feasibility study analyzes market dynamics, technical considerations, and financial aspects necessary for launching SolarAgrotech, supporting informed decision-making and strategic planning.

Jordan's energy situation is challenging due to its heavy reliance on imported energy. Despite governmental efforts to increase the use of local energy sources, oil and gas imports remain significant. The agricultural water sector faces high energy demands, making the shift to renewable energy essential for maintaining reasonable water costs and leveraging local resources.

SolarAgrotech's offerings include photovoltaic (PV) systems for water pumps, AI-driven optimization of irrigation timing, intelligent monitoring, and integration with existing solar pumps. The revenue model comprises installation fees, IoT system integration, and annual subscriptions for advanced AI features.

The operational team includes a CEO/Founder, an Agricultural Expert, a Renewable Energy Engineer, and an IT Technician, supported by strategic partnerships. By addressing energy and water challenges, SolarAgrotech aims to improve irrigation efficiency, enhancing agricultural productivity and sustainability. This approach aligns with government policies promoting renewable energy and sustainable agriculture, providing substantial benefits to farmers and stakeholders.

Financial analysis shows positive projections with potential for market growth. SolarAgrotech is positioned to be a significant contributor to Jordan's agricultural sector, driving economic and environmental benefits through sustainable practices and advanced technology integration.

1. Introduction

SolarAgrotech integrates advanced AI with solar-powered water pumps to create an energy-efficient irrigation system. This system analyzes real-time data such as soil moisture levels, weather forecasts and water quality to optimize irrigation schedules, ensuring efficient water usage and improving crop yields. This high-level feasibility study aims to provide an analysis of market dynamics, technical considerations, and financial aspects associated with launching SolarAgrotech, facilitating informed decision-making and strategic planning.

Jordan's energy situation is precarious due to its heavy reliance on imported energy. Despite efforts by the Jordanian government to boost the use of local energy sources, oil and gas imports remain predominant. According to the Ministry of Energy, Jordan's energy mix in 2022 consisted of 45% oil, 37% natural gas, 15% renewable energy, 2% coal, and 1% oil shale.

Oil and gas together make up 82% of the energy mix and are almost entirely sourced from abroad[1].

The water sector, a crucial strategic area, faces high energy demands and is expected to receive a significant portion of the planned increase in renewable energy use. Therefore, transitioning to renewable energy is vital to maintaining reasonable water costs and utilizing local energy sources for water pumping and distribution, rather than relying on imported energy. The significance of this problem is profound and impacts agricultural productivity and sustainability. For farmers, specifically smallholder farmers in rural areas, the high cost of energy and the reliance on a traditional approach can limit their ability to provide efficient irrigation.

Moreover, the reliance on imported energy exposes the agricultural sector to global market fluctuations, which can lead to sudden and unpredictable changes in energy costs.

SolarAgrotech addresses these issues by offering a sustainable solution that combines solar energy with AI technology to optimize agricultural water use, encouraging the adoption of smart practices that generate better yield at lower cost. This approach aligns with government policies promoting renewable energy and sustainable agriculture.

The impact on the target market - farmers and agricultural stakeholders - is significant. Smallholder farmers stand to benefit from the cost savings and efficiency gains offered by SolarAgrotech. Larger agricultural enterprises can also leverage this technology to improve their operational efficiency and sustainable practices. Additionally, environmentally conscious farmers and organizations supporting sustainable agriculture will find value in the eco-friendly aspects of SolarAgrotech.

2. Market Analysis

Jordan's economy has faced, and continues to face, various challenges. However, the government has been making efforts to stabilize the economy and promote sustainable development. The focus on renewable energy and sustainable agricultural practices is part of that effort. The Economic Modernization Vision outlines goals for economic growth, sustainability, and improved public services which create a supportive backdrop for startups like SolarAgrotech.

The agricultural sector in Jordan is a significant part of the economy, contributing around 4% to the GDP and employing a substantial portion of the population. However, the sector faces challenges such as water scarcity, high energy costs, and outdated irrigation practices. There is a strong push towards modernizing agriculture through the adoption of sustainable practices and advanced technologies.

Moreover, Jordan faces severe water scarcity, with an annual renewable water deficit of approximately 400 cubic meters per person[2]. Approximately 48.6% of water is consumed by

[1] https://www.memr.gov.jo/ebv4.0/root_storage/ar/eb_list_page/%D8%A8%D9%8A%D8%A7%D9%86%D8%A7%D8%AA_%D9%85%D9%8A%D8%B2%D8%A7%D9%86_%D8%A7%D9%84%D8%B7%D8%A7%D9%82%D8%A9_2022.pdf
[2] April 2024 Jordan Situation Report Draft

irrigation of agricultural crops[3] necessitating improved farm-level water use efficiency through innovative technologies and improved irrigation water management. The demand for electricity accounts a considerable portion of the country's total electricity consumption which stands at 14%[4].

Inflation in Jordan has been driven mainly by energy prices[5]. The heavy reliance on imported energy exposes the country to global market fluctuations, affecting energy prices. According to EDAMA energy association in 2020, the largest cost borne by the agricultural sector is that of electricity for water pumping. Utilizing renewable energy for water pumping can reduce a substantial portion of these costs, which amount to JOD 220 million per year[6].

The electricity tariff for the agricultural sector is currently structured to support different usage patterns and needs. For agricultural subscribers on a flat rate, the tariff is set at 59 fils per kWh (kilowatt hours), the nighttime supply rate is 49 fils per kWh, and the maximum load charge is 3.79 JOD per kW per month[7]. These rates illustrate the significant costs associated with energy consumption for agriculture, highlighting the economic burden on farmers and the potential savings from adopting renewable energy solutions like SolarAgrotech.

The regulatory environment in Jordan is increasingly supportive of renewable energy initiatives. Policies such as the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP) aim to increase the share of renewable energy in the country's energy mix. These policies offer incentives and subsidies for renewable energy projects, creating a conducive environment for SolarAgrotech. Additionally, the National Water Strategy (2023 - 2040) promotes the use of renewable energy in the water sector, aligning with the goals of SolarAgrotech.

The competitive landscape for SolarAgrotech includes traditional irrigation systems, conventional solar pump providers, and emerging agricultural solutions. Conventional solar pump providers offer basic solar-powered irrigation systems. However, these systems lack the advanced AI-driven features of SolarAgrotech. Public programs by entities like the National Energy Research Centre (NERC) also contribute to the competitive environment by promoting renewable energy solutions. SolarAgrotech differentiates itself through its integration of AI for intelligent monitoring and scheduling, which provides significant advantages in terms of efficiency and cost savings. This technological edge, combined with government support for renewable energy, strengthens its competitive position.

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[3] National Water Strategy 2023-2040

[4] https://www.ceicdata.com/en/jordan/energy-consumption/electricity-consumption-agriculture-and-water-pumping

[5] Request for an Extended Arrangement Under the Extended Fund Facility and Cancellation of the Current Arrangement Under the Extended Fund Facility-Press Release; Staff Report; and Statement by the Executive Director for Jordan; IMF Country Report No. 24/10; December 18, 2023

[6] https://alghad.com/Section181/%D8%A7%D9%82%D8%AA%D8%B5%D8%A7%D8%AF/%D8%AE%D8%A8%D8%B1%D8%A7%D8%A1-%D8%AA%D9%88%D8%A7%D8%B6%D8%B9-%D8%AA%D9%88%D8%B8%D9%8A%D9%81-%D8%AA%D9%82%D9%86%D9%8A%D8%A7%D8%AA-%D8%A7%D9%84%D8%B7%D8%A7%D9%82%D8%A9-%D8%A7%D9%84%D9%85%D8%AA%D8%AC%D8%AF%D8%AF%D8%A9-%D9%81%D9%8A-%D8%A7%D9%84%D8%B2%D8%B1%D8%A7%D8%B9%D8%A9-%D9%8A%D8%AD%D9%88%D9%84-%D8%AF%D9%88%D9%86-%D8%AA%D9%82%D9%84%D9%8A%D8%B5-%D8%A7%D9%84%D9%83%D9%84%D9%81-852448

[7] https://portal.jordan.gov.jo/wps/portal/Home/GovernmentEntities/Agencies/AgencyServiceDetails_ar/electricity%20distribution%20company/services/tarrif?lang=ar

Several key economic indicators are relevant to the success of SolarAgrotech:

- Energy Prices: the cost of oil and gas, which constitute a large portion of Jordan's energy mix, affects overall energy costs. Fluctuations in global energy prices can impact the economic viability of traditional energy-dependent irrigation systems, making SolarAgrotech's renewable energy solution more attractive.
- Agricultural Productivity: Measures of agricultural output and productivity are crucial. Higher productivity indicates a greater potential market for SolarAgrotech, as farmers seek to optimise their operations and reduce costs.
- Government Spending and Subsidies: The level of government investment in renewable energy and agricultural modernization directly influences the adoption of technologies like SolarAgrotech. Policies offering subsidies and financial incentives can significantly boost market penetration.
- Water Availability and Costs: Water scarcity and the cost of water are critical factors. Technologies that improve water efficiency are highly valued in regions facing water shortages, directly benefiting SolarAgrotech.

SolarAgrotech targets a range of agricultural stakeholders who are affected by high energy costs and water scarcity. The primary segments include smallholder farmers, large agricultural enterprises, and organizations supporting sustainable agriculture. Smallholder farms form a substantial portion of the agricultural sector and are crucial for food security. Smallholder farmers often face financial constraints and rely heavily on cost-effective irrigation solutions. According to the 2017 census by the Department of Statistics[8], there were 107,707 farms in Jordan, with 87% held by individuals or households, and the average farm size was 3.3 hectares in 2010[9]. Larger agricultural enterprises have greater financial resources and are more likely to invest in advanced technologies that enhance productivity and sustainability. Both smallholder and larger agricultural enterprises can both benefit from the cost savings and efficiency gains by SolarAgrotech. Additionally, NGOs, government agencies, and international organizations promoting sustainable agricultural practices are potential customers and partners for SolarAgrotech.

The demand for SolarAgrotech is driven by several factors: rising energy costs, water scarcity, government support, and technological advancements. The high cost of electricity for water pumping is a significant burden on farmers. SolarAgrotech offers a cost-effective alternative by harnessing solar energy, thereby reducing dependency on expensive fossil fuels. Efficient water management is critical in regions facing severe water shortages, and SolarAgrotech's ability to enhance water usage makes it an attractive solution for improving irrigation efficiency. Policies promoting renewable energy and sustainable agriculture provide a supportive environment for the adoption of SolarAgrotech. Subsidies and incentives can further boost demand. For instance, in 2019 79 farms benefited from the Ministry of Agriculture program for installing solar PV panels. The integration of AI for intelligent monitoring and scheduling enhances the value proposition of SolarAgrotech, making it a potentially preferred choice for forward-thinking farmers and enterprises.

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8 https://dosweb.dos.gov.jo/product/agricultural-census2017/

9 https://openknowledge.fao.org/server/api/core/bitstreams/e6d7a673-cebd-4be6-9b77-686d50d9171c/content

The competitive landscape for SolarAgrotech includes both direct and indirect competitors. Direct competitors include conventional solar pump providers and public programs. A handful of companies offer basic solar-powered irrigation systems, which are effective in reducing energy costs but lack the IoT features of SolarAgrotech that optimize water usage and improve efficiency. Public programs such as those initiated by the National Energy Research Centre (NERC), also provide renewable energy solutions but do not integrate AI capabilities. Indirect competitors include traditional irrigation systems and diesel-powered pumps. Traditional irrigation systems are widely used but are less efficient and more costly in terms of energy consumption compared to SolarAgrotech. Diesel-powered pumps are common in rural areas and have a lower initial cost but incur higher long-term costs and environmental impacts.

Competitor's strengths and weaknesses vary. Conventional solar pump providers have an established market presence and offer basic energy cost reductions, but they lack advanced IoT capabilities and are less efficient in optimising water usage. Public programs benefit from government support and large-scale implementation capabilities but typically lack advanced technological features like AI-driven optimisation. Traditional irrigation systems are familiar to farmers and require no high initial investment in new technology, but they have high energy costs, inefficient water usage, and are less environmentally friendly.

Research establishes that renewable energy appears to be an essential solution to enhance the three sectors (energy, water, and food) combined[10]. SolarAgrotech's introduction of an IoT-enabled smart irrigation system to the market that aligns with the global advancements in IoT technologies in agriculture. By integrating microcontrollers with WiFi interfaces and various sensors to monitor and control irrigation in real-time, SolarAgrotech improves water usage efficiency and enabling convenient farming operations.

3. Business Model

SolarAgrotech operates by providing a suite of products and services designed to enhance agricultural productivity and sustainability using advanced technology and renewable energy. The core offerings are:

- Photovoltaic (PV) systems for Water Pumps: Harness solar energy to power pumps, reducing dependency on traditional energy sources and lowering operational costs for farmers.
- Optimization of Irrigation Timing: Based on data from various sensors, the system optimises irrigation timing to ensure that crops receive the right amount of water at the right time, reducing water wastage and improving overall farm productivity.
- Advanced AI for Intelligent Monitoring and Scheduling: The integration of AI technology allows for real-time analysis of soil moisture levels and weather forecasts. This ensures water usage efficiency.

[10] Albatayneh, Aiman, et al. "Potential of Renewable Energy in Water-Energy-Food Nexus in Jordan." *Energy Nexus*, vol. 7, Sept. 2022, p. 100140, https://doi.org/10.1016/j.nexus.2022.100140.

SolarAgrotech's revenue model is designed to ensure accessibility for farmers while maintaining profitability. The revenue streams are:

- IoT-enabled Solar System and Pump Control: The solar systems are categorised according to the size of the pump that is required, recognising that farmers have different requirements. The pricing for the installation of the solar system depends on the rating of the water pump. Small pumps, rated at 2 horsepower, are suitable for smaller farms, medium pumps, rated at 7.5 horsepower cater to medium-sized farms, whereas large farms rated at 20 horsepower are designed for large-scale agricultural enterprises which are beyond the envisioned scope of SolarAgrotech. The installation of these solar systems is priced at JOD 500 per kW of energy output, ensuring a scalable and cost-effective solution tailored to the varying demands of farmers. This includes soil moisture, temperature, air humidity sensors, microcontroller, and a WiFi interface that enables access to sensor data and pump control through an app. Additionally, this service offers scheduling and data-enabled control based on present moisture levels.
- Irrigation-as-a-service: This subscription-based model involves small monthly instalments that enable farmers to add an AI dimension to their irrigation control practices. This service provides AI-driven features for intelligent monitoring, integration with weather data, real-time data analytics for enhanced irrigation management and improved efficiency.

The operational structure of SolarAgrotech is centred around several key activities and resources required to deliver its products and services effectively. Installation and integration are important activities, involving the installation of PV panels and IoT sensors, communication devices, and control systems with existing solar pumps, which requires skilled technicians and supply chains for sourcing components. The mobile application with its basic and extended AI features requires development and maintenance as well as the customization of existing algorithms to analyse sensor data which can be integrated with weather data to offer monitor and control to farmers through a user-friendly software interface[11].

The operational structure of SolarAgrotech is centred around four key personnel: a CEO/Founder, an Agricultural Engineer, a Renewable Energy Engineer, and an IT Technician. The Technical Lead and Manager oversees both the technical aspects and overall management of operations. The Agricultural Engineer interfaces with farms, providing tailored solutions and support based on their knowledge of irrigation techniques and water pumps. The Renewable Energy Engineer handles the procurement and design of PV systems, supervises the outsourced installation team, and ensures system integration with mechatronics skills. The IT technician manages the app and user interface development and design, while the implementation of the app is outsourced. SolarAgrotech also collaborates with strategic partners, including suppliers who provide PV panels, IoT sensors, and other essential components. Agricultural cooperatives and NGOs may assist in reaching target customers and promoting the adoption of SolarAgrotech solutions.

[11] Okomba, Nnamdi & Esan, Adebimpe & Omodunbi, Bolaji & Sobowale, Adedayo & Adanigbo, Opeyemi & Oguntuase, Oluwasegun. (2023). IOT BASED SOLAR POWERED PUMP FOR AGRICULTURAL IRRIGATION AND CONTROL SYSTEM. FUDMA JOURNAL OF SCIENCES. 7. 192-199. 10.33003/fjs-2023-0706-2056.

SolarAgrotech's management and operational procedures encompass PV and IoT system design, programming, assembly, installation, marketing, sales, and customer service. The installation process involves detailed procedures for installing PV panels and IoT sensors to ensure quality and efficiency, while the integration process includes steps for integrating IoT kits with existing solar pumps, including testing and calibration to ensure sound performance. Marketing and sales efforts focus on customer segmentation to tailor strategies to specific needs, clear communication of Agrotech's value proposition, and utilising various sales channels such as direct sales, partnerships, and participation in agricultural fairs and events. Customer service procedures include handling customer enquiries, providing technical support, resolving issues, regular maintenance schedules, emergency repair services, and systems for collecting and analysing customer feedback to improve products and services.

Solar Agrotech's growth strategy is centred around expanding its market reach, continuously improving its technology, and increasing its customer base. Key elements of the growth strategy include market penetration through marketing campaigns and partnerships with agricultural associations to enable geographic expansion in Jordan. The technology stack can continue to develop to integrate additional features such as predictive analytics.

The annual revenue projections for SolarAgrotech reflect the anticipated demand and pricing structure for both IoT-enabled solar systems with pump control and Irrigation-as-a-Service. The demand for IoT-Enabled Solar System and Pump Control starts at 45 units in Year 1 and increases to 350 units by Year 5, with each unit priced at an average of JOD 1,000 leading to incremental revenue growth from JOD 45,000 in the first year to JOD 350,000 in the fifth year. The second revenue stream, Irrigation-as-a-service sees demand starting at 45 units in Year 1, growing to 150 units by Year 5 since this subscription is an optional added-value beyond the initial installation of the solar system and remote pump control. The steady demand growth highlights potential for increasing acceptance and reliance on advanced AI-driven irrigation management systems among farmers. The combined revenues from both offerings result in total revenues of JOD 67,500 in Year 1 growing to JOD 425,000 by Year 5.

Table 1: Revenue projection

Description / Year	1	2	3	4	5
Projected Demand (Quantity) IoT-enabled solar system and pump control	45	120	180	240	350
Price / Unit IoT-enabled solar system and pump control	1,000	1,000	1,000	1,000	1,000
Sub-total IoT-enabled solar system and pump control	45,000	120,000	180,000	240,000	350,000
Projected Demand (Quantity) Irrigation-as-a Service	45	75	120	135	150
Price / Unit Irrigation-as-a-service	500	500	500	500	500
Sub-total Irrigation-as-service	22,500	37,500	60,000	67,500	75,000

Total Revenues (JOD)	67,500	157,500	240,000	307,500	425,000

The itemized revenue shows the different contributions of each stream in the product mix. In Year 1, the IoT-enabled solar system and pump control, and the Irrigation-as-a-Service each contribute equally to the quantity sold, with 45 units each, but generate different revenues with 67% of the total revenues attributable to the former. By Year 5, the IoT-enabled solar system and pump control dominates, contributing 70% of the total units sold (350 units) and 82% of the revenues (JOD 350,000). The irrigation-as-a-service while initially balanced at 50% with 45 units in Year 1, shifts to 30% of the units sold (150 units) and 18% of the revenues (JOD 75,000) by Year 5. This trend underscores the potential for further market penetration by the irrigation-as-a-service as farmers become more familiar with technology. Nevertheless, with the current projection, this service provides a reliable secondary revenue stream, maintaining steady growth and highlighting its value as an affordable AI-driven irrigation management solution for small and medium-sized farmers.

The charts below demonstrate the growth in quantity sold and revenues per year.

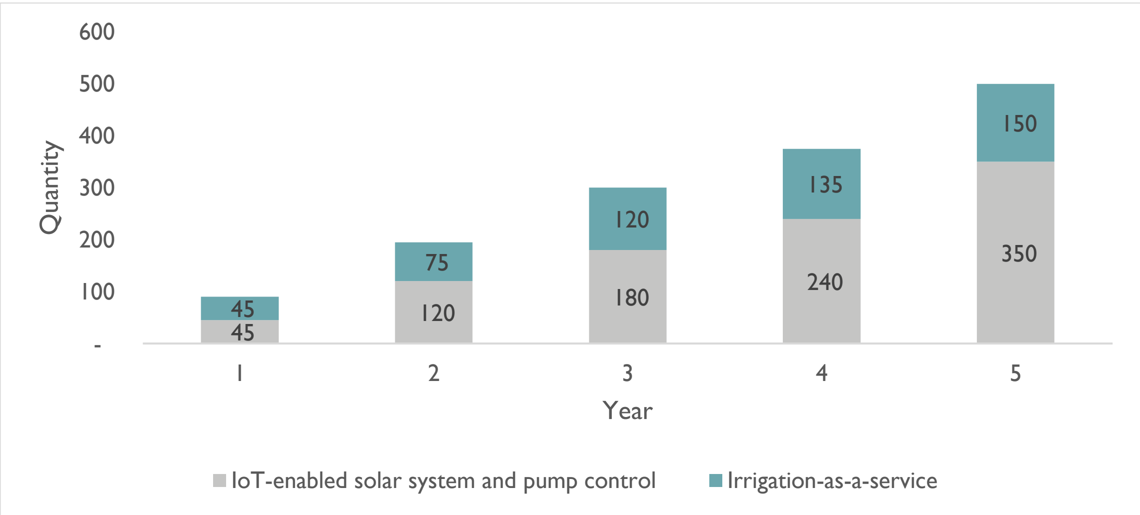

Figure 1: Product Mix by Quantity

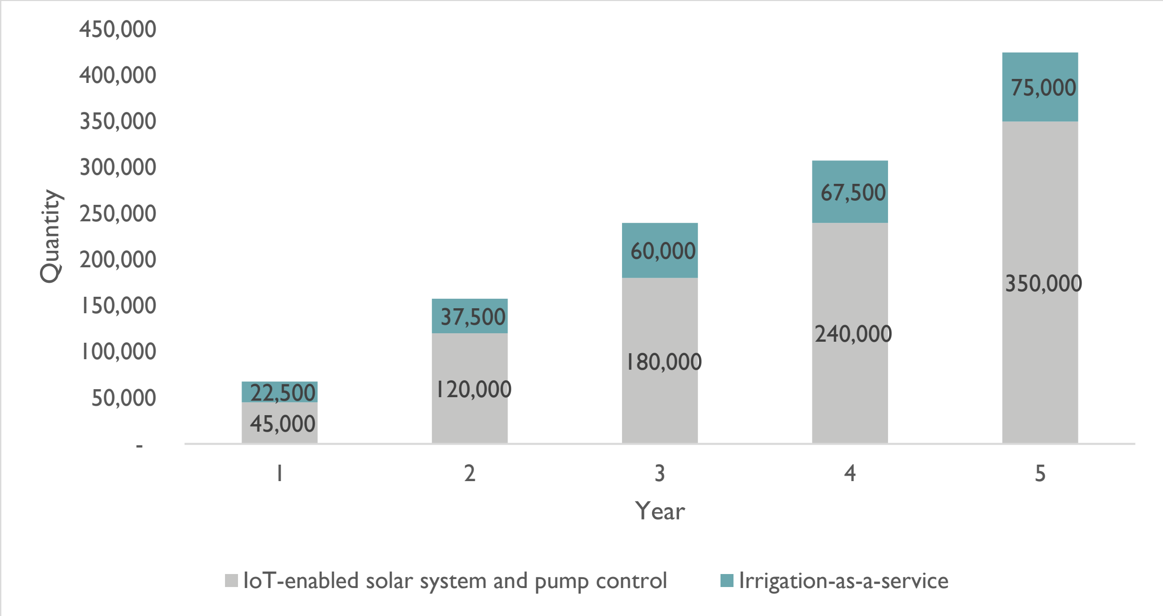

Figure 2: Product Mix by Revenue

4. Technical Analysis

The Cost of Goods Sold (COGS) for SolarAgrotech's IoT-enabled solar systems and pump control are projected to remain stable at JOD 500 per unit across the five-year period. In Year 1, with a projected demand of 45 units, the total COGS amounts to JOD 22,500. This increases to 120 units in Year 2 (JOD 60,000), 180 units in Year 3 (JOD 90,000), 240 units in Year 4 (JOD 120,000), and 350 units in Year 5 (JOD 175,000). The consistent per-unit COGS indicates a reliable cost structure for the solar systems, ensuring predictable cost management as demand scales up.

Importantly, the Irrigation-as-a-Service offering does not have any COGS associated with it. This service leverages existing infrastructure and technology, providing AI-driven irrigation management without additional material costs. This lack of direct COGS for the Irrigation-as-a-Service enhances its profitability, as the revenue generated from this service directly contributes to the bottom line without incurring significant variable costs. This distinction between the product lines highlights the financial efficiency of the service-based revenue stream, complementing the product-based revenue from the IoT-enabled solar systems.

Table 2: Cost of Goods Sold – five-year projection

Description / Year	1	2	3	4	5
Projected Demand (Quantity) IoT-enabled solar systems and pump control	45	120	180	240	350
COGS IoT-enabled solar systems and pump control	500	500	500	500	500
Total COGS (JOD)	22,500	60,000	90,000	120,000	175,000

The projected headcount for SolarAgrotech remains consistent over the first five years, reflecting a stable core team that can accommodate the growth in sales. The team comprises a CEO/Founder, an Agricultural Expert, a Renewable Energy Engineer, and an IT Technician.

Table 3: Manpower recruitment plan – five-year projection

Title / Year	1	2	3	4	5
CEO/Founder	1	1	1	1	1
Agricultural Expertise	1	1	1	1	1
Renewable Energy Engineer	1	1	1	1	1
IT technician	1	1	1	1	1
Cumulative Number of HR	4	4	4	4	4

The projected HR cost for SolarAgrotech demonstrate an incremental increase in salaries over the first five years, ensuring that the core team is adequately compensated to handle the growth in business.

Table 4: Manpower total cost – five-year projection

Title / Year	1	2	3	4	5
CEO/Founder	14,400	15,120	15,876	16,670	17,503
Agricultural Expertise	8,400	8,820	9,261	9,724	10,210
Renewable Energy Engineer	8,400	8,820	9,261	9,724	10,210
IT technician	7,200	7,200	7,200	7,200	7,200
Total HR Salaries	**38,400**	**39,960**	**41,598**	**43,318**	**45,124**
Social Security Cost	5,472	5,694	5,928	6,173	6,430
Health Insurance Cost	1,200	1,200	1,200	1,200	1,200
Total HR Cost	**45,072**	**46,854**	**48,726**	**50,691**	**52,754**

The project operational expenses (OpEx) for SolarAgrotech are outlined to reflect a balanced approach to managing ongoing costs while supporting the company's growth and operational needs. The expenses include utilities, office administration, rent, transportation, insurance, maintenance and consumables, advertising, legal and accounting fees, as well as the manpower cost.

Table 5: Operational Expenditures – five-year projection

Description / Year	1	2	3	4	5
Utilities & office admin cost	410	410	410	410	410
Office & Workshop Rent	3,000	3,000	3,000	3,000	3,000
Transportation	1,100	1,200	1,200	1,200	1,200
Insurance	100	200	300	400	500
Maintenance & consumable tools	1,000	1,800	2,500	2,600	3,000
Webhosting fees	2,000	2,000	2,000	2,000	2,000

Advertising	3,000	2,000	1,200	1,000	500
Legal & Accounting Fees	800	800	800	800	800
Sub-total OpEx	**56,482**	**58,264**	**60,136**	**62,101**	**64,164**
Other Costs	5,648	5,826	6,014	6,210	6,416
Total OpEx (JOD)	**62,130**	**64,091**	**66,149**	**68,311**	**70,580**

The projected capital expenditures (CapEx) are primarily focused on initial investments required for app development and essential tools, ensuring that the company is equipped with the necessary infrastructure to support its operations from the outset. The total capital expenditure amounts to JOD 30,000 made early to set up the initial infrastructure.

Table 6: Capital Expenditures Cost – five-year projection

Description / Year	0	1	2	3	4	5
App Development	12,500	12,500	-	-	-	-
Tools	5,000					
Total CapEx (JOD)	**17,500**	**12,500**	**-**	**-**	**-**	**-**

5. Financial Analysis

5.1 Financial Study Assumptions

The feasibility study is based on the following key assumptions:

Discount Rate: The study employs a conservative discount rate of 14%, reflecting a cautious approach to valuation.

Financing Structure: The project is entirely financed by equity. This conservative approach avoids the financial leverage and thus underestimates project value, given the lower cost of debt compared to equity.

Terminal Value: The project assumes a zero-terminal value at the end of year five, aligning with the study's conservative outlook.

Cash Flow Projection: Cash flows beyond year five are excluded from the analysis, focusing on the initial project phase.

Tax Rate: The assumed tax rate of 20% complies with Jordan's income tax law.

Depreciation Rate: Capital expenditure (CapEx) is depreciated at an annual rate of 20%. Any deviation from this rate may impact projected profitability but not project feasibility, as depreciation is a non-cash expense.

Working Capital Assumptions

Operational liquidity requirements are guided by the following assumptions:

- **Cash Reserves:** The project will maintain cash equivalent to 30 days of projected annual operational expenses, ensuring robust liquidity management.

- **Accounts Receivable (A/R) Collection Period:** The average collection period for receivables is 45 days, reflecting expected credit sales conversion into cash.
- **Accounts Payable (A/P) Payment Period:** The average payment period for payables is 0 days, indicating the timeframe for settling supplier obligations.
- **Inventory Management:** Inventory levels will be maintained to cover an average of two months of sales quantity, ensuring optimal stock levels to meet demand efficiently.

Capital expenditures expected to be incurred in the first year were included as part of the initial costs of the project.

Provisions were made within the initial cost to cover any potential negative net free cash flow that may arise during the first five years of operation, if needed.

5.2 Financial Study:

5.2.1 Projected Working Capital

This table shows that the net working capital needed for the project in its first year of operation is JOD 17,365, which has to increase steadily year over year to reach JOD 88,173 in its fifth year. The steady increase in working capital covers the rapid rise in project operations and the increase in projected revenues.

Table 7: Working capital projection (JOD)

Description / Year	1	2	3	4	5
Cash	5,178	5,341	5,512	5,693	5,882
Accounts Receivable (A/R)	8,438	19,688	30,000	38,438	53,125
Inventory	3,750	10,000	15,000	20,000	29,167
Net Working Capital	17,365	35,028	50,512	64,130	88,173
Change in Working Capital		17,663	15,484	13,618	24,043

5.2.2 Project Initial Cost

The project's initial cost is projected to be JOD 64,495, comprising JOD 30,000 as CapEx, JOD 17,130 as provisions for the first-year negative free cash flow and JOD 17,365 as net working capital.

Table 8: Initial Cost Summary (JOD)

Description / Year	JOD
CapEx	30,000
Provisions for first year(s) negative free cash flows	17,130
Net Working Capital	17,365
Total Initial Cost	**64,495**

5.2.3 Projected Income Statement

The projected income statement indicates that the project will lose JOD 23,130 in its first year of operation. However, the net profit is expected to be positive and increase gradually in the following years, reaching JOD 138,736 in its fifth year of operation.

Table 9: Projected Income Statement (JOD)

Description / Year	1	2	3	4	5
Total Revenues	67,500	157,500	240,000	307,500	425,000
COGS	22,500	60,000	90,000	120,000	175,000
Gross Profit	**45,000**	**97,500**	**150,000**	**187,500**	**250,000**
OpEx	62,130	64,091	66,149	68,311	70,580
Net Profit Before Tax and Depreciation	**17,130**	**33,409**	**83,851**	**119,189**	**179,420**
Depreciation	6,000	6,000	6,000	6,000	6,000
Net Profit Before Tax	**23,130**	**27,409**	**77,851**	**113,189**	**173,420**
Tax Expense		856	15,570	22,638	34,684
Net Profit	**23,130**	**26,553**	**62,281**	**90,551**	**138,736**

The project is anticipated to experience a -34.3% profit margin in its first year of operation. However, the net profit margin is expected to gradually increase in subsequent years, reaching 32.6% in the fifth year of operations.

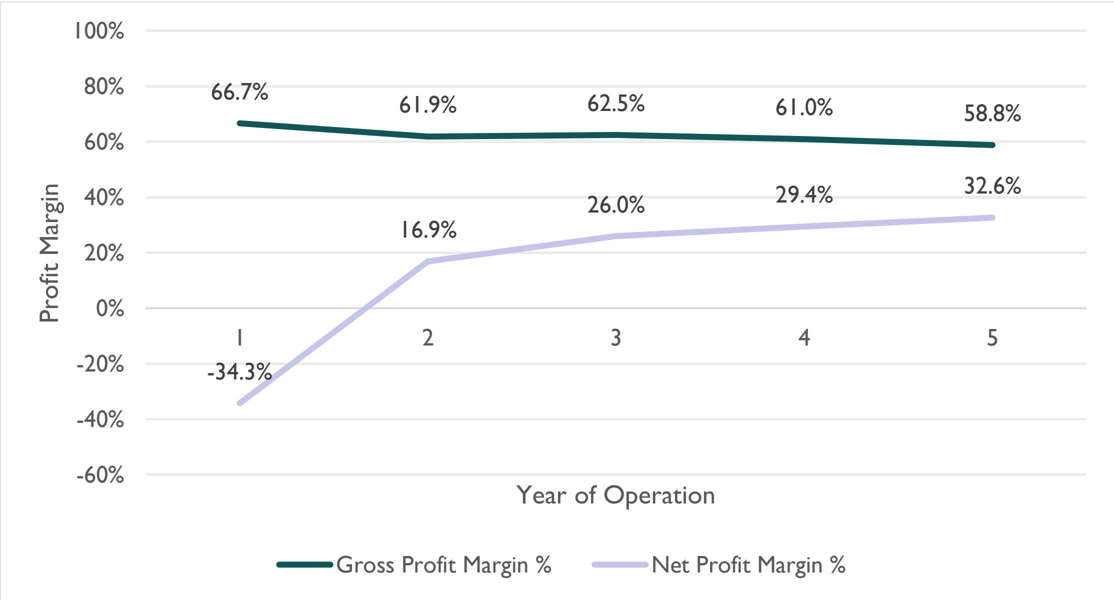

Figure 3: Gross vs Net Profit Margin

On the asset management side, the study shows that the return on investment will increase steadily from -48.8% in the first year of operation to 292.9% in the fifth year.

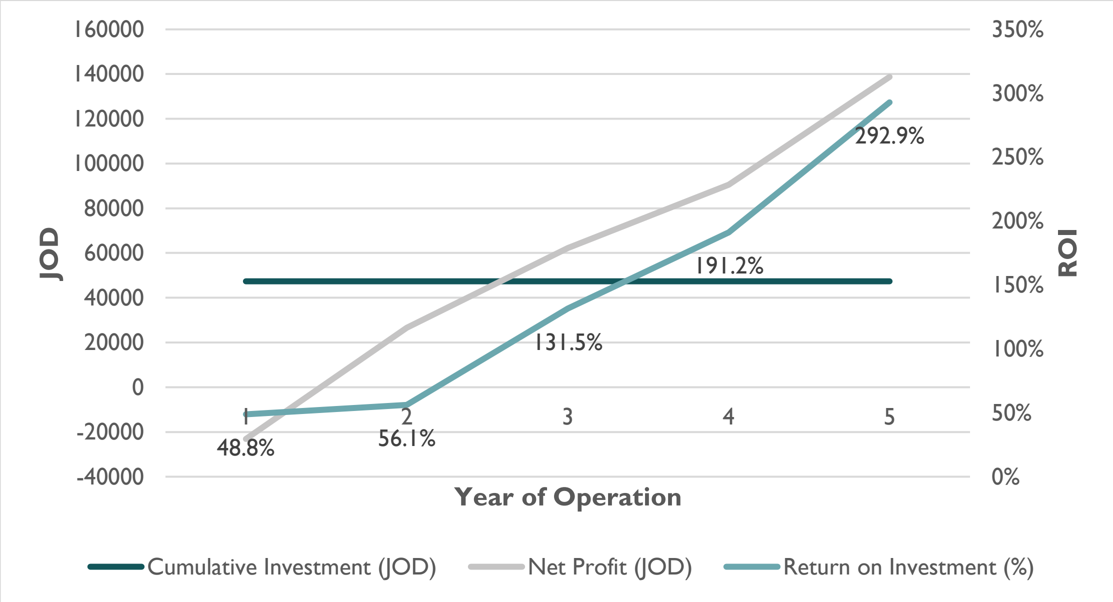

Figure 4: Return on Investment

5.2.4 Projected Free Cash Flow Statement

The table below demonstrates that the project will generate a negative free cash flow in its first year of operation, JOD 17,130. However, in the following years, it is expected to generate positive free cash flows that increase gradually to reach JOD 120,692 in its fifth year of operation.

Table 10 : Free Cash Flow (FCF) Projection (JOD)

Description / Year	0	1	2	3	4	5
Cash-In Flow						
Net Profit		-23,130	26,553	62,281	90,551	138,736
Depreciation		6,000	6,000	6,000	6,000	6,000
Injected Capital	64,495					
Total Cash-In Flow	**64,495**	**-17,130**	**32,553**	**68,281**	**96,551**	**144,736**
Cash-Out Flow						
Initial Cost	47,365		-	-	-	-
Changes in Working Capital			17,663	15,484	13,618	24,043
Total Cash-Out Flow	**47,365**	**-**	**17,663**	**15,484**	**13,618**	**24,043**
Free Cash Flow	**17,130**	**-17,130**	**14,890**	**52,797**	**82,934**	**120,692**

Based on these results, the project's feasibility indicators demonstrate its viability, with a net present value of JOD 79,359.4 and a profitability index 2.23. Moreover, the project's internal rate of return (IRR) is expected to be 37.01%, indicating feasibility is not sensitive to changes in market conditions.

Feasibility Indicators	
Net Present Value (NPV)	79,359
Profitability Index (PI)	2.23
Internal Rate of Return (IRR)	37.01%

5.3 Sensitivity Analysis

To assess the project's sensitivity to market conditions, a sensitivity analysis was conducted involving six unfavourable scenarios:

- Decrease projected revenues by 5% while keeping other variables constant.
- Decrease projected revenues by 10% while keeping other variables constant.
- Increase operational expenditure by 5% while keeping other variables constant.
- Increase operational expenditure by 10% while keeping other variables constant.
- Increase initial costs by 5% while keeping other variables constant.
- Increase initial costs by 10% while keeping other variables constant.

Table 11: Sensitivity analysis outcomes

Sensitivity Scenario	Net Present Value (NPV)	Profitability Index (PI)	Internal Rate of Return (IRR)
Original Case	79,359	2.23	37.01%
Drop in revenue by 5%	45,030	1.66	27.19%
Drop in revenue by 10%	-8,006	0.91	11.92%
Increase in OpEx by 5%	66,843	1.99	32.76%
Increase in OpEx by 10%	54,247	1.76	28.75%
Increase in initial cost by 5%	59,004	1.70	28.70%
Increase in initial cost by 10%	52,066	1.57	26.41%

The sensitivity analysis shows that, in general, the project is feasible and not sensitive to unfavourable market conditions. Apart from the 10% drop in revenues scenario, the project's economic feasibility is strong and viable under all the above-mentioned scenarios. The drop in revenues has a more dramatic impact on the project viability than the increase in the OpEx or initial cost by the same magnitude. It is recommended that investors check and further study the market to ensure that the projected revenues are achievable within the thresholds of the proposed initial cost and operational expenditures.

6 Integration with Other Sectors

Solar Agrotech can create synergies with other sectors in the economy, particularly water management, energy, and smart agriculture. By integrating with water management initiatives, In the energy sector, solar-powered systems can reduce reliance on fossil fuels, contributing to renewable energy goals and reducing carbon footprints. Smart agriculture can benefit from advanced AI and IoT technologies, enabling enhanced farming practices that improve crop yields and reduce resource wastage. Integrating with these sectors not only solves critical problems like water and energy scarcity but also enhances the marketability of SolarAgrotech by positioning it as a solution for sustainable farming. This cross-sector integration can lead to broader adoption, increased impact, and a stronger value proposition for stakeholders.

7 Entrepreneur Persona

The optimal entrepreneur for implementing SolarAgrotech is a leader with a blend of expertise in agriculture, renewable energy, and technology. They should possess a deep understanding of agricultural practices and the specific challenges faced by farmers, coupled with knowledge of irrigation techniques and water management. Experience in renewable energy, particularly solar power, is crucial, along with a strong background in AI and IoT technologies to drive the integration and innovation of the product. This entrepreneur should be a strategic thinker with excellent problem-solving skills and the ability to forge strong partnerships with stakeholders across various sectors. Strong leadership and management skills are essential to oversee the operations, inspire the team, and ensure the seamless execution of the business plan. Additionally, a passion for sustainability and a commitment to improving agricultural productivity through technological advancements will drive the success and impact of SolarAgrotech in the market.

8 Stakeholders

The stakeholders of SolarAgrotech encompass a diverse group. Key stakeholders include farmers and agricultural enterprises, who are the primary beneficiaries of the technology. Government bodies and regulatory agencies are critical stakeholders, providing necessary support, subsidies, and regulatory frameworks to promote renewable energy adoption. Agricultural cooperatives and NGOs play a vital role in facilitating the reach and adoption of SolarAgrotech solutions among smallholder farmers. Suppliers of photovoltaic panels, IoT sensors, and other components are also essential. Additionally environmental organizations and sustainability advocates are stakeholders who support the broader mission of reducing carbon footprints and promoting sustainable agricultural practices. Investors and financial institutions are also important, providing the capital and funding necessary for scaling the business. Each of those stakeholders contributes to the holistic success and marketability of SolarAgrotech.

9 Risk Assessment and Mitigation

Risk	Impact	Likelihood (High/Medium/Low)	Risk Mitigation Technique
Economic Fluctuations	Affects farmers' ability to invest	Medium	Flexible payment options
Technology Reliability	Disruptions in service	Medium	Regular maintenance, robust design, and quick response
Regulatory Challenges	Delays in approvals, changes to tariffs and policy	Medium	Engage with regulators early, ensure compliance, and adapt to policy changes
Supply Chain Disruptions	Delays in component availability	High	Develop multiple supplier relationships and maintain buffer inventory
Competition	Loss of market share	Medium	Continuous innovation and differentiation through advanced features
Adoption Resistance	Slow market penetration	Medium	Demonstration projects, education, and partnerships with agricultural cooperatives
Climate Variability	Impact on solar energy generation	Low	Hybrid systems and backup power solutions
Data Security and Privacy	Breach of sensitive information	Low	Implement strong security measures and data protection protocols

Based on the findings of this high-level study, several general recommendations can be made to ensure the successful launch and sustainable growth of SolarAgrotech. It is critical to prioritize risk mitigation techniques to address potential challenges identified in the risk assessment. Specifically, flexible payment options to mitigate economic fluctuations that could affect farmers' ability to invest in new technology. To ensure reliability, regular maintenance schedules and robust design protocols should be implemented, supported by a quick response support team to address any operational disruptions promptly. Additionally, engaging with regulatory bodies early in the project and ensuring compliance with all relevant policies will help navigate potential regulatory challenges effectively.

Furthermore, the sensitivity analysis conducted indicates that a 10% drop in revenues results in unfavorable outcomes, namely a negative Net Present Value (NPV) and a profitability index of less than 1. This highlights the importance of maintaining a strong market presence and implementing effective marketing to drive demand. Developing multiple supplier relationships and maintaining buffer inventory can be essential to manage supply chain disruptions, while strategic partnerships with agricultural cooperatives and NGOs can help increase market penetration and adoption of SolarAgrotech's solutions. '

It is also recommended to continuously invest in research and development (R&D) to enhance the AI capabilities and integrate additional features into the product, thereby maintaining a competitive edge. By focusing on these risk mitigation strategies and emphasizing continuous improvement and market adaptation, SolarAgrotech can better navigate potential challenges and capitalize on opportunities to achieve long term success.

10 Conclusion

In conclusion, the project demonstrates promising feasibility indicators under very restrictive assumptions. Nonetheless, investors are advised to conduct additional analysis on projected demand, initial costs, and operational expenses to mitigate potential risks associated with adverse market conditions that could jeopardize its viability.