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# A CONCEPTUAL AGROSMARTX BUSINESS MODEL: ENHANCING FOOD SECURITY THROUGH AN INTEGRATED AGRICULTURAL ECOSYSTEM AND PLATFORM

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***Abstract:*** **This study aims to develop a conceptual business model named AgroSmartX, a Smart Agriculture Technology company that integrates digital platforms and mobile applications to address key challenges faced by multiple customer segments, including smallholder farmers, agricultural suppliers, and agricultural retailers. Key challenges include low crop productivity, inefficient resource management, lack of real-time data, and unstable market access. The methodology adopts Design Thinking, involving a literature review, benchmarking existing AgriTech companies using the Business Model Canvas (BMC), and conducting surveys to understand user needs. The paper then develops an initial business model using the Empathy Map (EM), BMC, and Value Proposition Canvas (VPC), alongside a high-fidelity prototype of a digital platform. Validation is conducted through feedback from stakeholders, followed by refinement into a validated business model. A Strategy Canvas is also developed to compare AgroSmartX with existing market solutions. Key findings indicate that AgroSmartX provides innovative solutions such as AI-driven crop monitoring, IoT-based smart sensors, and a digital marketplace that act as pain relievers and gain creators. The paper contributes to a conceptual business model that enhances agricultural productivity and sustainability. Future work includes developing a comprehensive business plan based on the validated model.**

***Keywords:*** **Food security, Smart Agriculture, AgriTech, IoT, Digital Platform, Business Model, Agro-Ecosystem.**

## I. INTRODUCTION

The agricultural sector is undergoing a significant transformation driven by rapid technological advancements, environmental pressures, and evolving consumer expectations. Smart agriculture integrating artificial intelligence (AI), Internet of Things (IoT), drones, and data analytics is increasingly adopted to enhance productivity, sustainability, and efficiency [1]–[3]. Despite this progress, key customer segments such as smallholder farmers, large-scale farms, and agri-business companies continue to face critical challenges. Their primary job-to-be-done is to optimize crop yield while minimizing costs and resource usage, including water, fertilizers, and labor, while also ensuring timely, data-driven decision-making and supply chain transparency. However, several persistent pains remain, including high adoption costs, limited rural internet connectivity, low digital literacy, fragmented and non-integrated solutions, labor shortages, and increasing regulatory pressures related to sustainability [4]–[6].

While current agri-tech solutions such as precision farming tools, drone monitoring systems, and cloud-based farm management software attempt to address these issues by enabling data-driven decisions, automating processes, and improving efficiency, they often fall short. Many existing solutions are expensive, complex, and inaccessible to smaller farmers, and frequently lack integration across the agricultural value chain [7], [8]. As a result, they fail to fully address the evolving needs, pains, and desired gains of diverse users, such as increased productivity, reduced costs, real-time insights, and improved sustainability [9], [10].

Therefore, there is a clear need for a more innovative, inclusive, and integrated solution. In response, this study proposes AgroSmartX, a conceptual smart agriculture platform that combines AI-driven analytics, IoT-based monitoring, and user-friendly digital applications to deliver affordable, scalable, and sustainable solutions for modern agriculture.

## II. PROBLEM STATEMENT/OBJECTIVES

The agricultural sector faces several persistent and interconnected problems across different customer segments. For smallholder farmers, the primary job-to-be-done is to maximise crop yield with limited resources. However, they face extreme pains such as high technology costs, lack of technical knowledge, and poor internet access [6], [4], [11]. Their essential gains include affordability, ease of use, and access to reliable farming insights [12], [13].

For large-scale farms, the job-to-be-done focuses on optimising operations and improving efficiency at scale. Their pains include managing large volumes of data, integrating multiple technologies, and ensuring compliance with environmental regulations [5], [1]. Their desired gains include automation, predictive analytics, and improved operational efficiency [2], [10].

For agribusiness companies, the job-to-be-done involves ensuring supply chain efficiency and sustainability. Their pains include lack of transparency, inconsistent data, and difficulty in monitoring upstream farming activities [8], [14]. Their essential gains include traceability, data-driven decision-making, and compliance with sustainability standards [9], [12].

In addressing these problems, the main objective of this paper is to develop a conceptual business model for AgroSmartX, including a digital platform and mobile application that provides integrated smart agriculture solutions. Specifically, the platform aims to:

- Deliver affordable, user-friendly smart farming tools that act as pain relievers by reducing costs, simplifying technology adoption, and enabling real-time monitoring.
- Provide data-driven insights and integrated farm management features that act as gain creators by improving productivity, sustainability, and decision-making across the agricultural value chain.

## III. METHODOLOGY

This study adopts the Design Thinking (DT) approach to ensure a user-centred and solution-orientated development process. First, a literature review (LR) is conducted to understand current trends, challenges, and technological advancements in smart agriculture. This is complemented by benchmarking analysis of existing agri-tech companies using the Business Model Canvas (BMC) framework to identify industry practices, value propositions, and business strategies. Next, interviews and surveys are carried out with various customer segments, including farmers and agri-business stakeholders, to gain deeper insights into their job-to-be-done, extreme pains, and essential gains.

Based on these findings, an initial business model (BM) for AgroSmartX is developed using business modelling tools, i.e., Empathy Map (EM), Business Model Canvas (BMC), and Value Proposition Canvas (VPC).

A digital platform and mobile application prototype are also designed to visualise the proposed solution. The initial model is then subjected to testing and validation through further interviews and surveys with target users. Feedback is analysed to identify strengths, weaknesses, and areas for improvement. Following this, key findings are discussed, and the business model is refined and finalised into a validated conceptual model. Lastly, a strategy canvas is developed to compare the relevance and sustainability of AgroSmartX against existing solutions in the market, highlighting its competitive advantages from the perspectives of different customer segments.

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## IV. LITERATURE REVIEW

**[A]** Fourth Industrial Revolution (4IR), MyDIGITAL, National 4IR Policy and 13th Malaysia Plan (13MP)

This study examines agriculture as a sector that is rapidly evolving through technology and innovation. Agriculture today is no longer viewed only as traditional farming but also as a technology-driven industry that supports food security, economic growth, and sustainable development. With the increasing global population, modern agriculture now integrates technologies such as automation, artificial intelligence (AI), the Internet of Things (IoT), and data analytics to improve farming efficiency, reduce waste, and increase crop productivity [1], [2], [4].

The transformation of agriculture is closely related to Sustainable Development Goal 9 (SDG 9), which focuses on industry, innovation, and infrastructure. Agriculture also contributes to SDG 2 (Zero Hunger) and SDG 8 (Decent Work and Economic Growth) because it supports food production, employment, and economic sustainability.

In Malaysia, the agricultural sector remains important under the 13th Malaysia Plan (13MP). The government emphasises strengthening food security, reducing dependence on imported agricultural products, and increasing high-value agricultural production. One of the key concepts highlighted in the 13MP is to "raise the floor and raise the ceiling," which refers to improving the living standards of lower-income groups while transforming Malaysia into a high-growth and high-value economy [16].

In agriculture, this concept is reflected through High Value, High Income (HVHI) agricultural activities that utilise innovation and technology to improve productivity and farmers' income. The 13MP also highlights improvements in irrigation systems, large-scale farming, and public-private partnerships to modernise the agricultural sector.

Furthermore, MyDIGITAL and the National 4IR Policy support digital transformation across industries, including agriculture. Technologies such as smart sensors, drones, cloud systems, and AI-based monitoring systems allow farmers to practise precision agriculture, where crops and environmental conditions can be monitored in real time. According to Klaus Schwab, the Fourth Industrial Revolution is transforming industries through the integration of digital and physical technologies [15].

**[B]** Demand and Supply in the Agro-Technology Industry

Globally, the demand for agricultural products continues to increase due to population growth, urbanisation, and changing consumer lifestyles. According to the Food and Agriculture Organization (FAO), agricultural production must increase significantly in the future to ensure a sufficient food supply for the global population [12].

In Malaysia, there is still a gap between local agricultural production and domestic demand, causing dependence on imported agricultural products. This situation highlights the need to strengthen local agricultural productivity and improve farming efficiency through digital technologies and innovation.

As a result, many agro-tech companies have started adopting digital platforms and smart farming systems to improve agricultural productivity and supply chain management. These companies use technologies such as IoT sensors, automation systems, hydroponics, and AI-driven monitoring tools to improve crop quality and operational efficiency.

To ensure sustainability, agro-tech companies must achieve the break-even point where revenue is equal to cost structure:

Revenue=Cost Structure

**[C]** Benchmark of Similar Agro-Tech Business Models Using BMC Framework

There are two similar companies that are found locally. The first one is from Johor which is FarmByte. FarmByte was created to enhance Johor and Malaysia's food security agenda. Adopting a digital-first strategy, FarmByte aims to transform the agrofood sector by integrating the ecosystem and elevating the livelihoods of farmers with the production of high-quality produce. Secondly is BoomGrow, where the company produces pesticide-free produce grown in a controlled hydroponic environment – the roots of the plants are not grown in soil but in a water-based nutrient-enriched solution – monitoring inputs, light, water, and humidity to optimize growing conditions and outputs. Below is the business model canvas of the company FarmByte (Figure 1) and BoomGrow (Figure 2).

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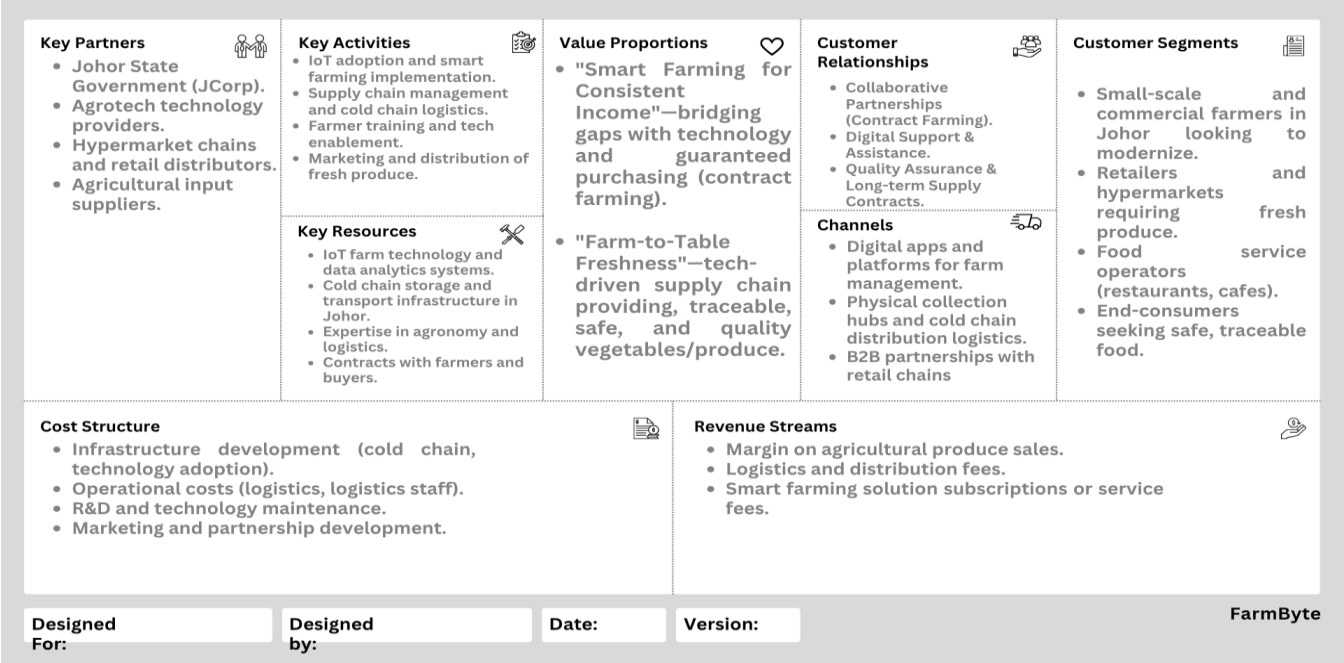


**Figure 1: FarmByte Model using BMC Framework**

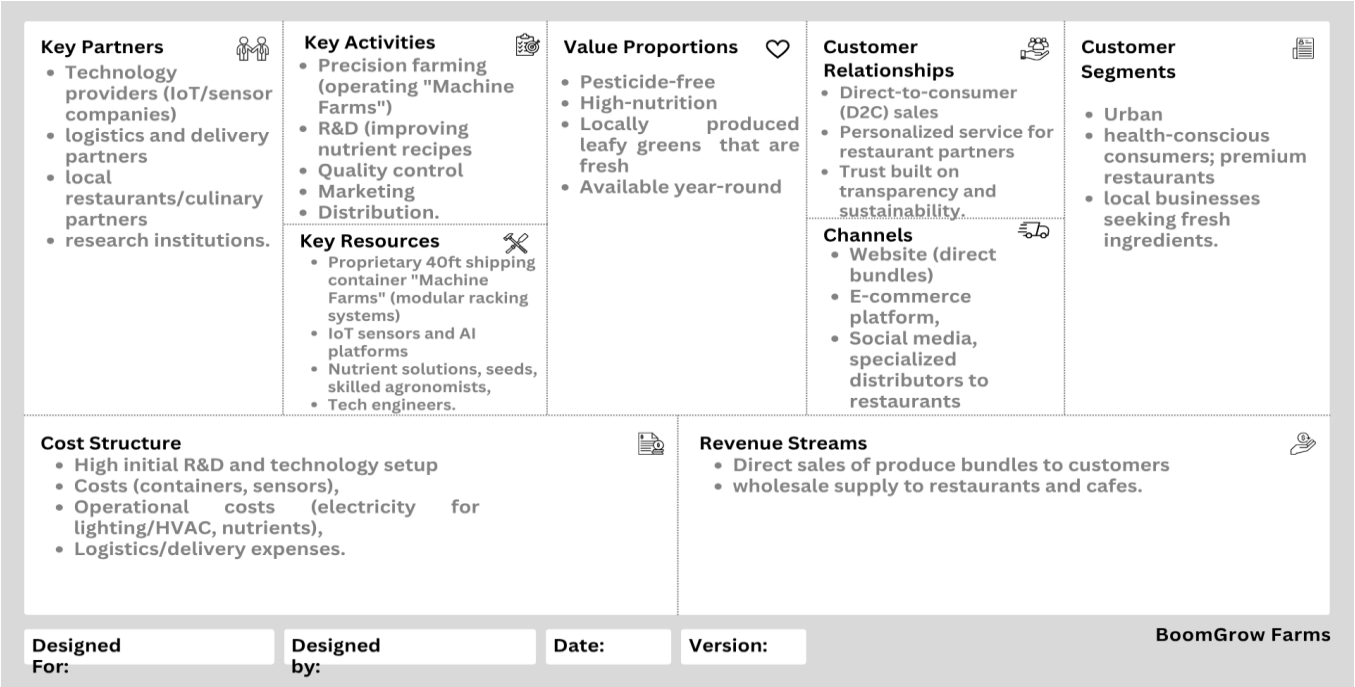


**Figure 2: BoomGrow Business Model using BMC Framework**

**[D]** Reskilling and Upskilling of B40 Communities and Agricultural Workforce

As agriculture becomes increasingly technology-based, workers are required to develop new technical and digital skills. However, many individuals from the B40 income group still face unemployment, underemployment, and mismatches between their existing skills and industry needs.

This issue is closely related to:

- SDG 4: Quality Education
- SDG 8: Decent Work and Economic Growth

To address these challenges, the Malaysian government has introduced reskilling and upskilling initiatives under the 13MP, TVET programmes, and MyDIGITAL initiatives. These programmes aim to equip workers with skills related to Industry 4.0 and smart agriculture.

Examples of important skills in modern agriculture include:

- IoT and smart sensor management
- Data analytics
- Drone technology
- Smart irrigation systems
- AI-based agricultural monitoring

Government incentives and training programmes help B40 communities and retrenched workers participate in High Growth High Value (HGHV) sectors. Through digital agriculture and agro-tech entrepreneurship, modern agriculture can create employment opportunities, improve income levels, and contribute to inclusive economic growth.

**[E]** Global Agro-Digital Ecosystem: India and Taiwan Benchmark

A strong global benchmark for agro-digital transformation can be seen through the collaboration between India and Taiwan. Both countries demonstrate how digital ecosystems and smart farming technologies can modernise agriculture and improve efficiency.

India has introduced AgriStack, a digital agricultural ecosystem that integrates farmer databases, land records, and agricultural services into one system. This platform improves farm management, digital accessibility, and government support distribution for farmers.

Meanwhile, Taiwan is recognised for its advanced IoT sensor hardware and precision agriculture technologies used in high-end horticulture. Smart sensors help farmers monitor environmental conditions such as humidity, temperature, soil quality, and crop growth in real time.

An important trend is that Indian startups are adopting Taiwan's IoT sensor technologies for precision farming and advanced horticulture, while Taiwan is studying India's AgriStack model to improve digital land management and farmer identity systems for younger technology-orientated farmers.

This collaboration reflects the impact of the Fourth Industrial Revolution (4IR), where countries combine strengths in the following:

- IoT and smart farming systems
- Digital agricultural databases
- Precision agriculture
- Data analytics and automation
- Technology-based agricultural ecosystems

The India–Taiwan benchmark provides valuable insights for Malaysia in strengthening its agro-digital ecosystem through initiatives such as MyDIGITAL and the National 4IR Policy.

Overall, key ideas such as food security, digital transformation, sustainability, and innovation are closely connected in this study. These elements show that agriculture is no longer just about producing food but also about using technology, improving systems, and creating opportunities for economic growth.

In conclusion, agriculture today is a sector full of potential. With the support of government policies, new technologies, and innovative business models, it can contribute not only to economic development but also to social well-being and sustainability. By aligning with national plans like the 13MP and global goals set by the United Nations, agro-based businesses can play an important role in shaping a better and more sustainable future.

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## V. INITIAL BUSINESS MODEL (BM) – USING BMC & VPC

1) Business Model Canvas

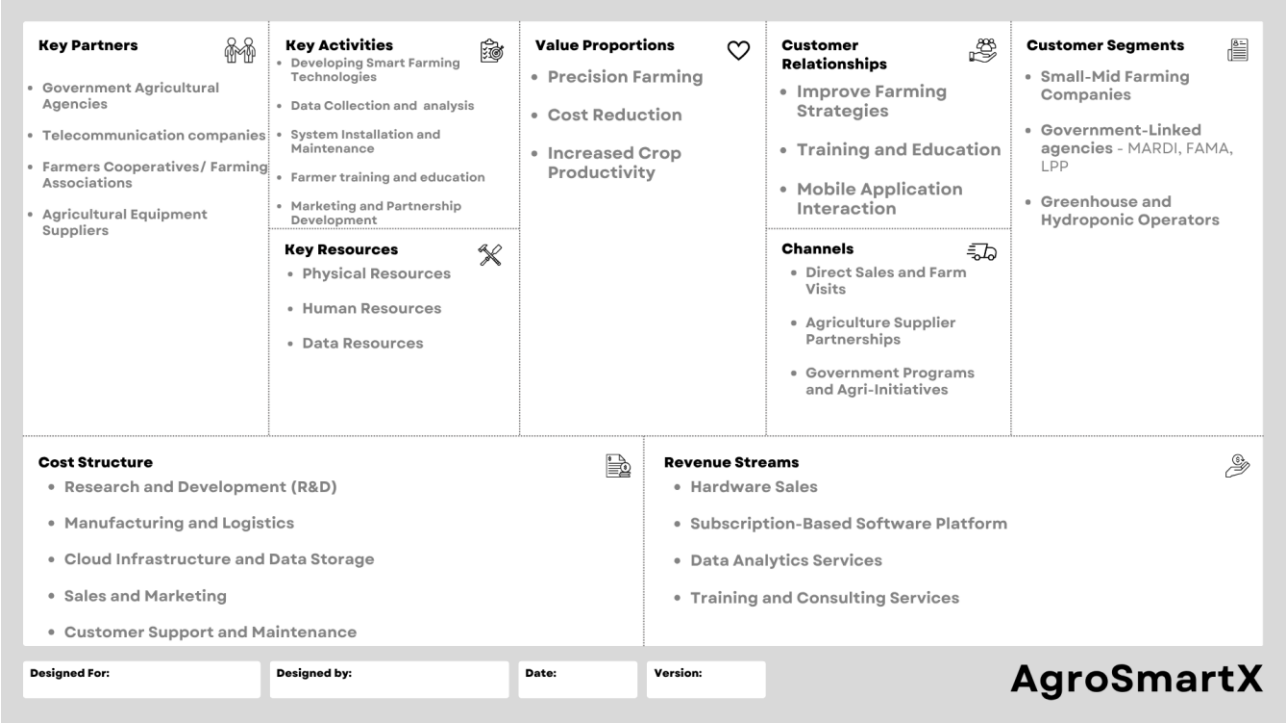
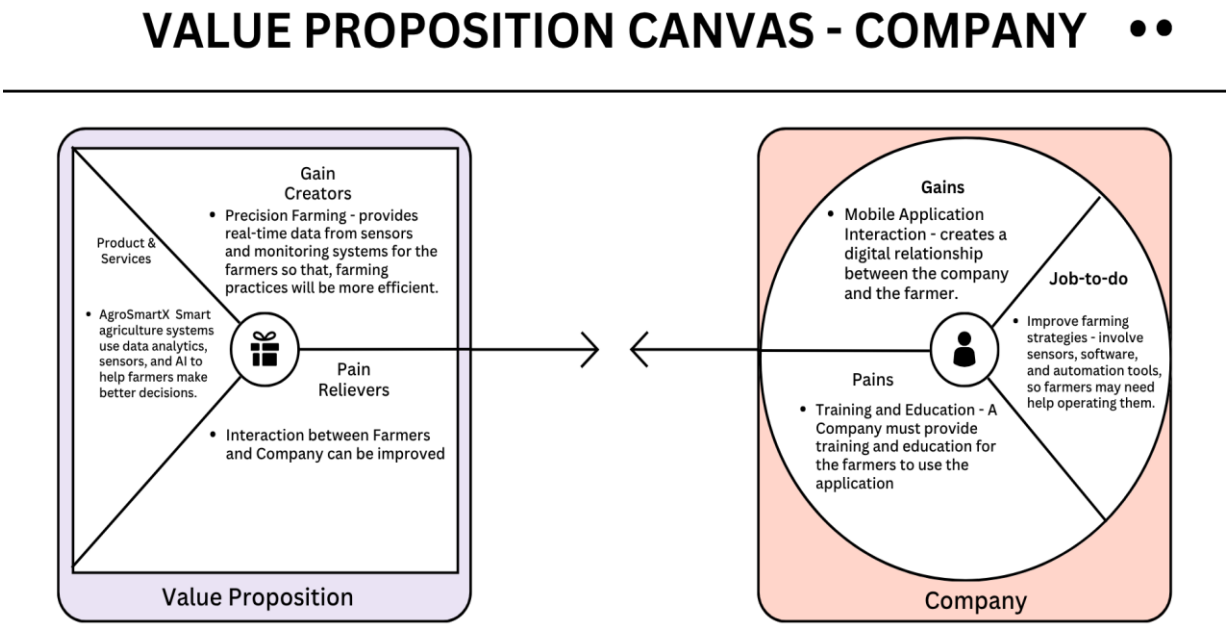



**Figure 3: Initial Business Model for AgrosmartX using BMC Framework**

2) Value Proposition Canvas

Value Proposition canvas for AgroSmartX

a) VPC for Company



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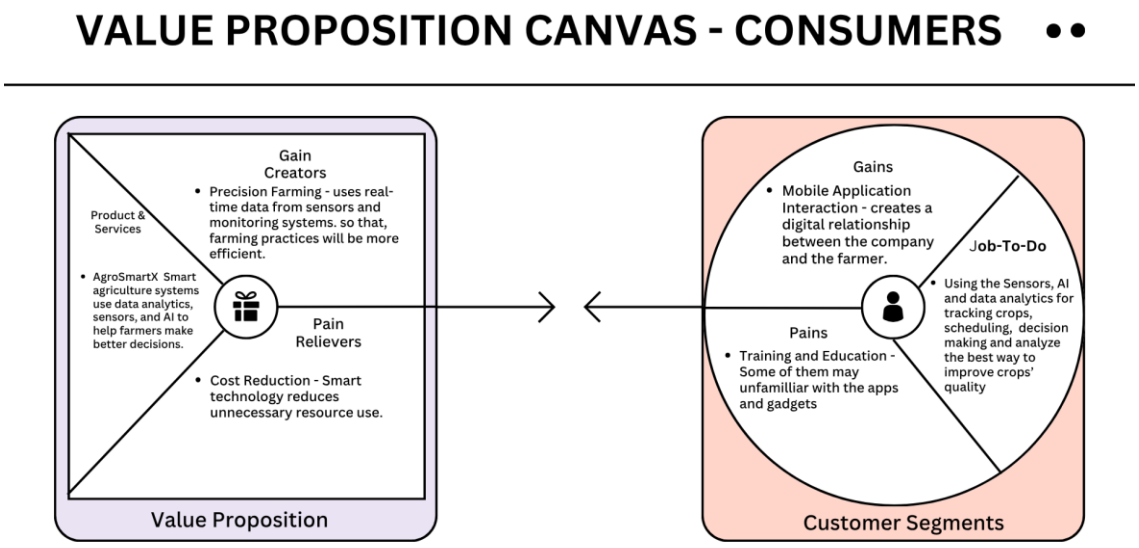
b) VPC for Consumers




3) High-Fidelity Wireframe / Mockup

a) Home

- Landing page for application users

b) Schedule

- Page for the users to check their farm and garden maintaining activities
- This page also provides data about the crop at the user's farm based on data and analytics from AI

c) Subscription and payment

- Page for users to pay their subscription to use the application

d) Contact us

- Page for users to contact the HQ for any problems

e) FAQ

- Page for users to find any answer to their doubt on how to use the application

f) "Let's get started" button

- A button to go directly to the schedule
-

4) The "Purple Cow" value proposition

- The "Purple Cow" in this project is the involvement of AI in agriculture that is changing the way crops are managed in fields and gardens, Real-time AI-powered insights for better decision-making.

## VI. CONDUCT VALIDATION OF INITIAL BM & KEY FINDINGS

Initial validation of the AgroSmartX business model was conducted through a comprehensive survey process involving 50 key stakeholders to ensure strong solutions to the problems. This group of respondents was strategically divided between three key customer segments including smallholder farmers (25 respondents), who primarily focus on traditional cash crops and exhibit moderate digital literacy, agricultural suppliers (10 respondents), representing distributors of irrigation and fertilization technologies, and agricultural retailers (15 respondents), including supermarket procurement officers and exporters interested in supply chain transparency. By testing a high-fidelity prototype with this group, the study aimed to validate whether the proposed AI and IoT integration effectively addressed the high costs and market fragmentation identified during the empathy phase.

Key findings from the validation process revealed that while 84% of respondents saw significant value in the integrated ecosystem, specific improvements were needed to meet consumer expectations. Smallholder farmers expressed concerns about the high initial capital required for IoT hardware, leading to improvements in revenue models to include Subscription-as-a-Service (SaaS) options to reduce barriers to entry. Meanwhile, agricultural buyers highlighted the high demand for traceability, which is driving the addition of digital logging features in the market to track crop history from seedling to harvest. Additionally, feedback on the user's strong preference for local language support (Malay) and simplified icon-based navigation to accommodate varying levels of digital literacy.

Finally, validation confirmed that AgroSmartX's "Purple Cow", a seamless integration of farm monitoring and a live digital marketplace provides a competitive advantage over existing fragmented solutions. Suppliers highlighted that access to Predictive Demand Analytics will allow them to optimize inventory levels, while farmers prioritized real-time pest and disease alerts as the most anticipated profit creators. This insight played a key role in transforming the initial conceptual model into a validated business framework, ensuring that the ultimate AgroSmartX platform is not only technologically advanced but also commercially viable and user-centric in the Malaysian agricultural context.

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Summary of Key Findings from the Validation:

| Category | Customer Segment | Key Findings | Insights / Actions Taken |
|---|---|---|---|
| **Value Perception** | All Segments | 84% of respondents see strong value in an integrated AI + IoT ecosystem | Confirms the relevance of AgroSmartX solutions and the viability of the overall concept |
| **Cost Concern** | Smallholder Farmers | High initial cost of IoT hardware is a major barrier | Introducing Subscription-as-a-Service (SaaS) model to reduce upfront costs |
| **Market Need** | Agricultural Buyers / Retailers | Strong demand for supply chain traceability | Adding digital logging features to track crop lifecycle (seed to harvest) |
| **Usability** | All Segments (especially farmers) | Preference for local language (Malay) and easy navigation | Enhanced UI with Bahasa Malaysia support and icon-based interface |
| **Technology Adoption** | Smallholder Farmers | Moderate digital literacy influences usability | Simplified design and reduced complexity for better accessibility |
| **Supply Chain Efficiency** | Agricultural Suppliers | Need for better demand forecasting and inventory planning | Integrated Predictive Demand Analytics feature |
| **Farm Productivity** | Smallholder Farmers | High interest in real-time pest and disease alerts | AI-based alert system prioritized as a key feature |
| **Competitive Advantage** | All Segments | Integrated platform (monitoring + marketplace) seen as unique ("Purple Cow") | Strengthened position as an all-in-one ecosystem vs. fragmented solutions |
| **Business Model Validation** | All Segments | Model is practical, relevant, and needed in the Malaysian context | Refined into validated, user-centric, and commercially viable BM |

## VII. VALIDATED BM – BMC FRAMEWORK

### *1) Validated Business Model (BMC)*

The AgroSmartX business model is built using the Business Model Canvas (BMC), covering all nine key components in a more detailed and practical way.

First, the Customer Segments (CS) include three main groups: smallholder farmers (CS1), agricultural suppliers (CS2), and agri-buyers or retailers (CS3). Each group has different needs but shares the common goal of improving efficiency and profitability.

The Value Proposition (VP) focuses on solving real agricultural problems. AgroSmartX offers AI-driven crop monitoring, IoT-based smart sensors, and a digital marketplace. These features act as pain relievers by reducing uncertainty and costs, while also creating gains such as better yields, smarter decisions, and stable market access.

For Channels (CH), the platform is delivered through a mobile application and web-based system, making it accessible and easy to use, especially for farmers in rural areas.

The Customer Relationships (CR) are built through continuous engagement, including in-app support, personalized recommendations using AI, and community features that allow users to share insights and experiences.

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In terms of Revenue Streams (RS), AgroSmartX generates income through subscription plans, transaction fees from the digital marketplace, and potential partnerships or data services.

The Key Resources (KR) include the digital platform itself, AI algorithms, IoT infrastructure, and data analytics capabilities, as well as human expertise in agriculture and technology.

The Key Activities (KA) involve platform development, data analysis, system maintenance, and continuous innovation to improve features based on user feedback.

The Key Partnerships (KP) are crucial and include government agencies, agricultural organizations, IoT providers, and technology partners to support implementation and scaling.

Lastly, the Cost Structure (CS) consists of technology development, infrastructure costs, marketing, partnerships, and ongoing operational expenses.

***2) Business Environment Map (EM)***

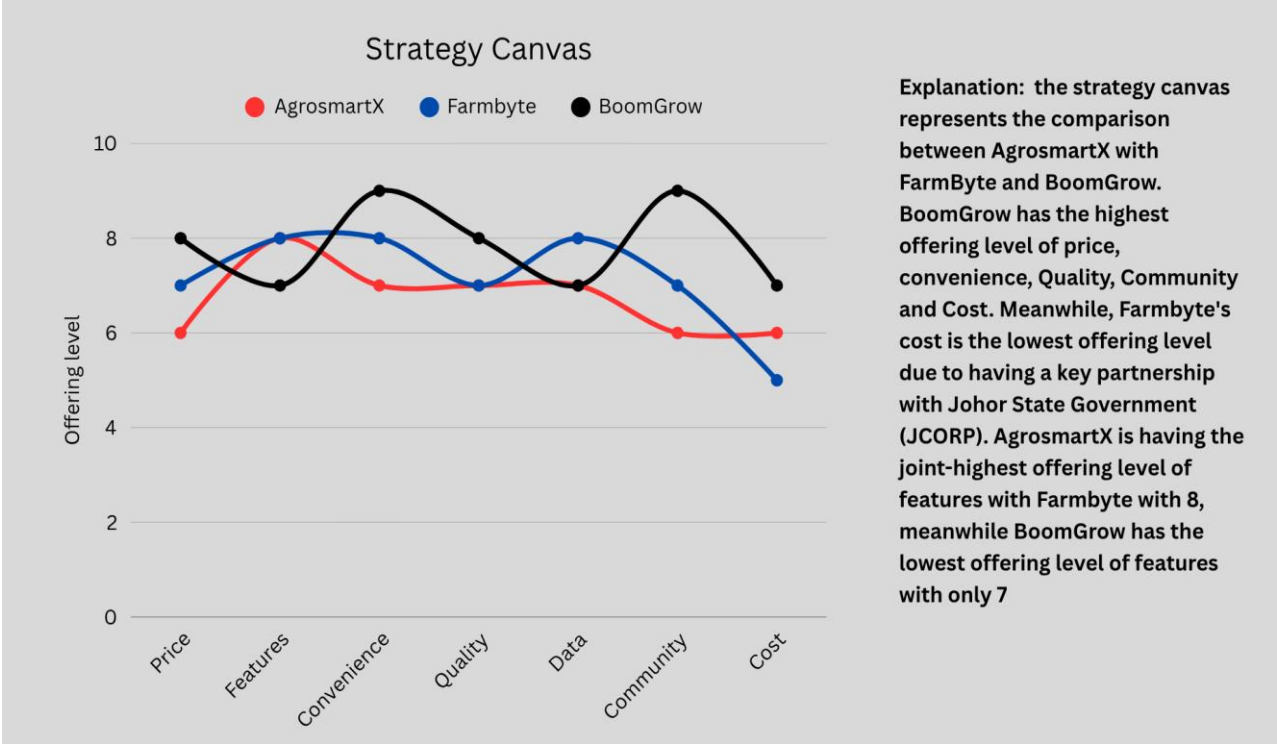
AgroSmartX operates within a rapidly changing environment influenced by several important trends and policies.

One major factor is the rise of megatrends, particularly digital transformation and smart farming, where technologies like AI, Big Data Analytics (BDA), and IoT are becoming essential in modern agriculture. These trends highlight the shift towards data-driven decision-making.

At the national level, Malaysia's 13th Malaysia Plan (13MP) emphasizes food security, sustainability, and digital adoption, all of which align strongly with AgroSmartX's objectives. Similarly, the MyDigital initiative promotes the growth of a digital economy, encouraging the use of advanced technologies in traditional sectors like agriculture.

The Fourth Industrial Revolution (4IR) Policy further supports the integration of smart technologies, reinforcing the relevance of AgroSmartX's AI and IoT solutions. In addition, NEP 2030 focuses on inclusive economic growth, which supports smallholder farmers—one of the key customer segments of this model. From a geopolitical perspective, global issues such as supply chain disruptions, climate change, and food security concerns make smart agriculture solutions even more important. These external pressures increase the need for efficient, resilient, and technology-driven agricultural systems like AgroSmartX.

***3) Strategy Canvas (Purple Cow & Blue Ocean Strategy)***



AgroSmartX stands out in the market by applying the concept of a "purple cow," meaning it is designed to be unique and remarkable compared to existing solutions.

Traditional agriculture systems often rely on manual processes, limited data, and fragmented market access. In contrast, AgroSmartX offers a fully integrated ecosystem that combines smart farming technologies with a digital marketplace.

From a Blue Ocean Strategy (BOS) perspective, AgroSmartX does not just compete with existing AgriTech players but creates a new market space by integrating multiple services into one platform. While other solutions may focus only on farm monitoring or supply chain, AgroSmartX connects all stakeholders in a single system.

Key differentiators include:

- Real-time AI-powered insights for better decision-making
- IoT sensors for accurate and continuous farm monitoring
- Direct digital marketplace linking farmers, suppliers, and buyers
- User-friendly platform tailored for different customer segments

These differentiators make AgroSmartX highly relevant and valuable, especially for users who need a complete, all-in-one solution rather than separate tools.

***4) High Fidelity Wireframe / Prototype (Digital Platform)***

The AgroSmartX digital platform is designed as a high-fidelity prototype that integrates advanced technologies while remaining simple and user-friendly.

The platform includes key features such as:

- AI-powered dashboard that provides crop health analysis, yield predictions, and personalized recommendations
- IoT integration for real-time monitoring of soil conditions, temperature, and humidity
- Digital marketplace where farmers can sell produce directly to buyers and connect with suppliers
- Data analytics (BDA) to track performance, forecast demand, and support better planning

The mobile application is designed with a clean interface to ensure accessibility, even for users with limited technical knowledge. AI capabilities allow the system to learn from user data and continuously improve recommendations, while analytics tools help users make informed decisions.

Overall, the prototype demonstrates how AgroSmartX can function as a smart, connected, and scalable platform that brings real value to all customer segments.

## VIII. CONCLUSION AND FUTURE WORKS

In conclusion, this study introduces AgroSmartX as a practical and user-focused solution to the real problems faced by key agricultural players: smallholder farmers (CS1), agricultural suppliers (CS2), and agri-buyers or retailers (CS3). Farmers struggle with low productivity, unpredictable yields, and lack of timely information. Suppliers face difficulties in demand forecasting and inventory planning, while buyers often deal with inconsistent supply and quality. At the core, all these groups are trying to achieve similar goals: improve efficiency, reduce uncertainty, and create more stable and profitable outcomes. However, their biggest pains, such as high costs, poor data access, and disconnected market systems, often prevent them from reaching these goals. AgroSmartX responds to these needs by offering meaningful gains like better crop monitoring, smarter resource usage, and more reliable market connections. What makes AgroSmartX stand out is how it brings everything together into one ecosystem, using AI for smarter farming decisions, IoT sensors for real-time insights, and a digital marketplace to connect all players directly. This approach not only solves immediate problems but also supports Malaysia's national priorities under the 13th Malaysia Plan (13MP), especially in terms of digital transformation, food security, and sustainable agriculture. Overall, AgroSmartX shows strong potential as a relevant and impactful solution for modern agriculture.

Moving forward, the next step is to turn this conceptual model into a fully detailed business plan. This will include clearer financial planning, revenue strategies, and cost analysis to ensure the idea is not just innovative but also viable in the real world. Further improvements to the prototype will also be important, especially in making the platform more user-friendly and scalable. Testing the system through pilot projects with real users, such as farmers and suppliers, will help identify what works well and what needs improvement. In addition, building partnerships with government bodies, agricultural agencies, and technology providers can support wider adoption and long-term success. These future efforts will be crucial in transforming AgroSmartX from a concept into a working solution that can truly benefit the agricultural industry.

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