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Business Model Canvas for Internet of Things Application on Hydroponic in Tangerang

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Abstract

Internet of Thing (IoT) in hydroponics was developed to monitor and control the hydroponic environment for efficiency and effectiveness with maximum results purpose. Many papers expose about IoT application on hydroponic, this article completed it with business model so it will sustain as valuable business especially in Tangerang Banten Indonesia. It is interesting and necessary to analyze the business model, so that this valuable system of the solution can sustain and growth, also proper for the big picture purpose. Of seventeen (17) goals SDGs, hydroponic using IoT application is related to solving point number two (2) about zero hunger and point number thirteen (13) about climate action. This paper uses qualitative descriptive methodology which analyzes and provides points of BMC for IoT application on hydroponic. The result of this paper found that BMC is proper tool to analyze and describe business model for IoT of hydroponic. Then this paper also finds there are several points of revenue streams with some different customer segments, support from hydroponic community, and some collaboration with key partners is needed, which means the business cannot stand alone. This paper has limitations which could be further interesting topics for the next paper.

I. INTRODUCTION

With a tropical climate, Indonesia is very conducive to agriculture, coupled with the demographic bonus of its productive age population, making Indonesia a very potential country as a food granary and guardian of the world's climate. With 278.8 million people in 2023 and 69.13% are aged 15-64 [1], Indonesia has big resources to do something to solving hunger and climate change related to SDGs [2].

In fact, farmers in Indonesia as of 2023 are 28,194,295 means 10% from total resident. Young farmers aged 19-39 years in Indonesia as of 2023 are 6,183,009 people or around 21.93% of farmers in Indonesia [3]. Majority Indonesian farmers are not millennials or Gen Z [4]. Typically, young farmer millennial and Gen Z in Indonesia prefer to do agriculture as their passion and used high technology on urban farming to makes fun farming with big impact on profit margin, rather than traditional way [5]. So that, Indonesia has huge potential resource to increase young farmers.

In Tangerang City which total population 2022 is 954.847, age 15 – 44 years old is 466.501, 49% from total population in Tangerang city (Publikasi Kota Tangerang, 2022). Survey does to fifty-three (53) respondents in March 2023 at Kota Tangerang Banten, Indonesia. From 53 respondents, 1 respondent Baby Boomers (born between 1946-1964), 3 respondents Gen X (born between 1965-1980), 7 respondents Gen Y or Millennials (born

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between 1981-1996), 39 respondents Gen Z (born between 1997-2012), and 3 respondents Alpha Generation (born between 2010-2022). Focus on Gen Y or Millennials, Gen Z, and Alpha Generation, with a total of 49 respondents (92% from total respondents). Of 49 respondents total for Gen Y or Millennials, Gen Z, and Alpha Generation, 11 respondents live in village, and 78% means 38 respondents live in city. 24 respondents are working people and 23 respondents as student and college students. Of 49 respondents, 34 respondents have planting experience, with various obstacles and bad experiences. 90% of respondents interested in application IoT on hydroponic. Of 49 respondents 100% have at least one account on social media. From the survey, most young age born between 1981 – 2022 live in city, they are working and students, and interest to use application IoT on hydroponic, and they all have at least one social media account.

Hydroponic technic as one of urban farming, match with young farmers preference for type of farming [7]. Hydroponic farming continues to develop with high technology. Internet of things for hydroponic applications has been presented by several researchers. The implementation of IoT on hydroponics has proven successful in increasing plant yields because it can monitor and control the environmental factors that are more conducive for plants to growth. Internet of things applications for hydroponics have a very good impact and are the best solution to implement, especially for people who want to do farming, but do not have much time [8]. So, implementation of IoT on hydroponics is proper for young farmers.

Tunas Farm, one of the IoT Hydroponic farms in Tangerang, doing their business with new concept “from farm to table” [7]. It brings new perspectives to do business with hydroponic farms. Paradigm that IoT implementation will bring unreasonable cost for farmers to implement [9]will be reduce and make it reasonable to farmer if we have proper business model.

Business model innovation is about replacing outdated models. Business model innovation appears to respond to emerging user needs and pressing environmental concerns. However, the new business model should create value for companies, customers, and society, assuming business model canvas is proper to describe it [10].

Below are research objectives for this paper:

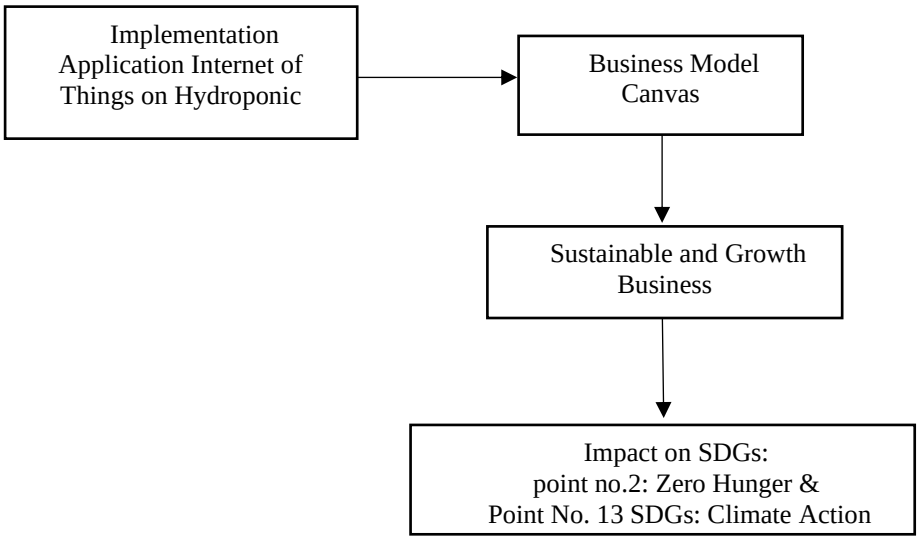

Fig. 1 Research Objectives

Figure 1 above explains this paper expose business model canvas, implementation IoT applications on hydroponic in Tangerang. This paper will elaborate the proper strategies suggesting how to run the business of applications hydroponic using IoT, so that in the future the business can sustain and growth. The Business Model Canvas on implementing IoT applications on hydroponics can drive sustainable business and meet long-term advantages related to SDGs, especially point SDG number two (2) about zero hunger and point number thirteen (13) climate action.

II. Related Works / Literature Review

A. *Review from Previous Studies of IoT Hydroponic*

Based on record per 2019 to 2024 there are 88 papers Scopus index which expose applications IoT on Hydroponic.

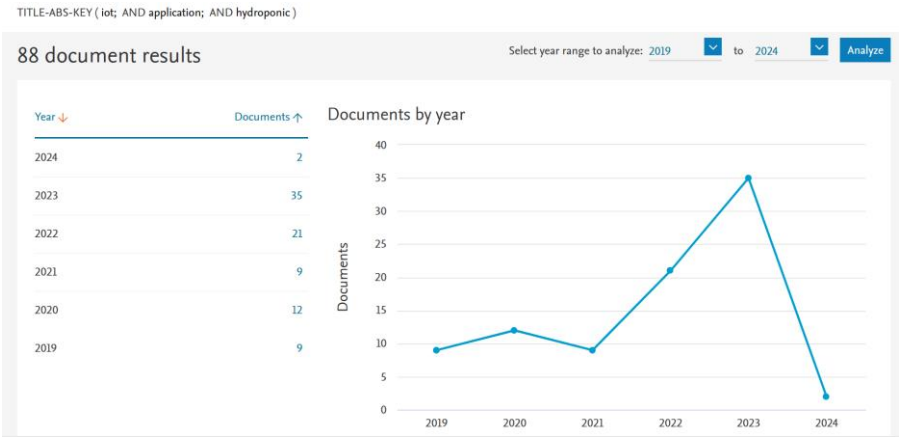

Fig. 2 Analize Search Paper Scopus 2019 – 2024 IoT applications on Hydroponic (Scopus)

Mostly the papers expose the implementation of IoT on hydroponic, not much paper discuss more about the scheme of business and how it can be sustained and growth. The most published is in 2023, which is 35 (thirty-five) publications expose IoT applications on hydroponics.

Abu Sneineh, Anees & Shabaneh, Arafat A.A. 2023 successfully built and implemented a hydroponics monitoring system that can collect parameters, such as temperature, water limit, pH level, and nutrient levels connect to smartphone application. The application, if necessary, can run the pumps for water, fertilizers, or salt using smartphone [11].

Smart farming with hydroponic techniques connected with portable hydroponic devices could be turned into a possible business in the future which can evade the crisis [12]. In India, IoT-based application has been proposed for monitoring and control hydroponic. It can provide an ideal solution to the insufficiency of traditional farming, and how the implementation practices boost crop yield and income for India farmers [13].

After review more than ten literatures related to IoT application on Hydroponic, Pooja Thakur, Manisha Malhotra, and R.M. Bhagat conclude that, the application of the IoT approach in hydroponic systems appears to have a promising future, and this is an exciting time for the sector [14].

Hiroshi Kubo & Kazuki Okoso Japanese researcher, 2019 published Business Ecosystem Strategy using New Hydroponic Culture Method. They are using IoT to collect, analyzed, and control the growth situation of crops related data, such as temperature, humidity, dissolved oxygen, et cetera to control the water volume, released harvest time notification, and control the environmental condition. Besides that, they used big data & Artificial Intelligence, block chain, robot & drone, biotechnology, and Mobility as a Service (MaaS). These hydroponic characteristics are high productivity, high profitability, low initial investment, low labor load, low environmental load, and no need for expertise [15].

In 2020, Mulyati, Hamidin and Fauzan describe the feasibility of IoT for Hydroponic Horticultural Gardens in Pasundan Natural Plantation, West Java. They calculate that operation hydroponic using IoT will be more profitable when the number of plant populations increases by more than 51.1% of the plant population at the time of the test and the Internal Rate of Return (IRR) will increase if the plant population is increased by 698.85% of the total plant population at the time of the test [16]. In logic, if the yield is the only one revenue stream, then it's difficult to get more profit when we use IoT applications on hydroponic. So that needs proper business model to describe and analyze for IoT applications on hydroponic.

B. Review from Previous Studies of Business Model Canvas in Urban Agriculture and Urban Farm

In 2020 until 2021 depth interviews and participant observation were conducted to two European economies in Eastern and Western Europe, Poland and Italy, with different Urban Agriculture relevance and functionality, to better identify potential Urban Farm business models. The new value proposition is a powerful way to create a broader customer base and develop innovative product and service solutions to deliver unique value. This study led to the conceptualization of the cross-cultural business meta-model, Business Model Canvas of Urban Farm [17].

Business Model Canvas (BMC) was adopted as a research framework to compare Urban Agriculture (UA) in Roma and Buenos Aires. Using the business model helps to move beyond the description of potential benefits and add explanations of how values are captured at the operational level. The analysis demonstrates that UA is differently adjusted to specific social and environmental urban conditions, and that BMC is useful for analyzing urban farming [18].

A literature survey and the creation of a business model canvas allowed to compile a SWOT analysis that supported the definition of optimal features for sustainable food production and the requalification of the abandoned building in Orzes village Belluno were surrounded by the rural areas in Italy. This research identified strengths, a strong cohesion within the territory and the active involvement of local (and non-local) actors allowed for generating new job opportunities, including consultancy services specialized for agricultural businesses and possible partnerships with research institutions and universities [19].

The identification of the nine elements of BMC is very useful in understanding, analyzing, and planning activities that need to be evaluated and improved by Women Farmers Group in Tangerang City, Banten Indonesia [20]. WFG in Tangerang City doing agribusiness with hydroponic implementation.

III. METHODS

This paper uses a qualitative descriptive methodology [21]. The framework of this paper is shown in figure 3.

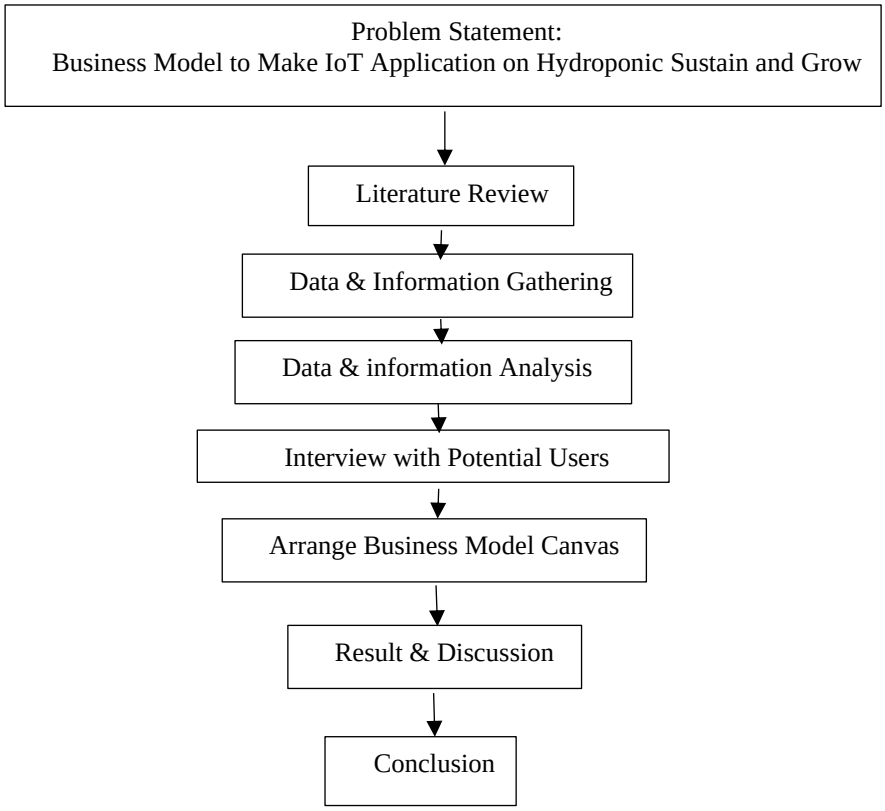

Fig. 3 Paper Framework

The data we got then analyzed to compare with some literature such as books, theory, or research before. Descriptive Research conducted on this research uses an approach explains the business model using Business

Model Canvas [10]. The location of this research is Tangerang Banten Indonesia. Data Collection Methods in this research are using the method interviews, documentation, and observations in 2023 – 2024, especially to young farmers born between 1981 – 2021 in Tangerang city.

Value Proposition Canvas (VPC)

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Value Proposition Canvas is a simple process of designing and testing value propositions, that perfectly match customers' needs and desires. VPC is proper tools to describe new feature product or services and analyze how it fulfilled customer / user needs [22].

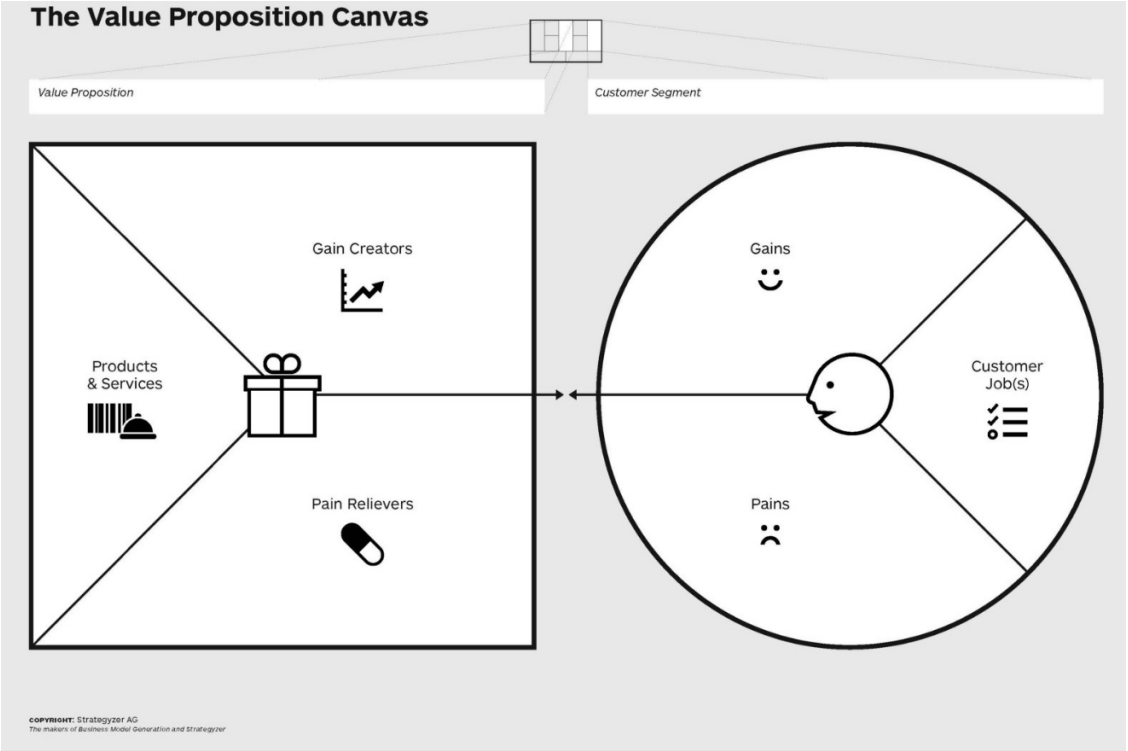

Fig. 4 Value Proposition Canvas

Customer Job(s). How customers do their activities to reach their goal.
Pains. Points that customers face with situations and conditions they don't expect and can be obstacle for their goal.
Gain. Points that customers are happy with the situations and conditions they prefer and help them to get what they want.
Pain Relievers. Point that product or services can reduce customer pain when they reach their goal.
Gain Creator. Point that products or services beyond mandatory or basic customers' needs.
Product & Services. The package features pain relievers and gain creator as solutions for customer.

3

Business Model Canvas

Osterwalder's original canvas includes nine elements, they represent vital aspects of business survival. Below is the template:

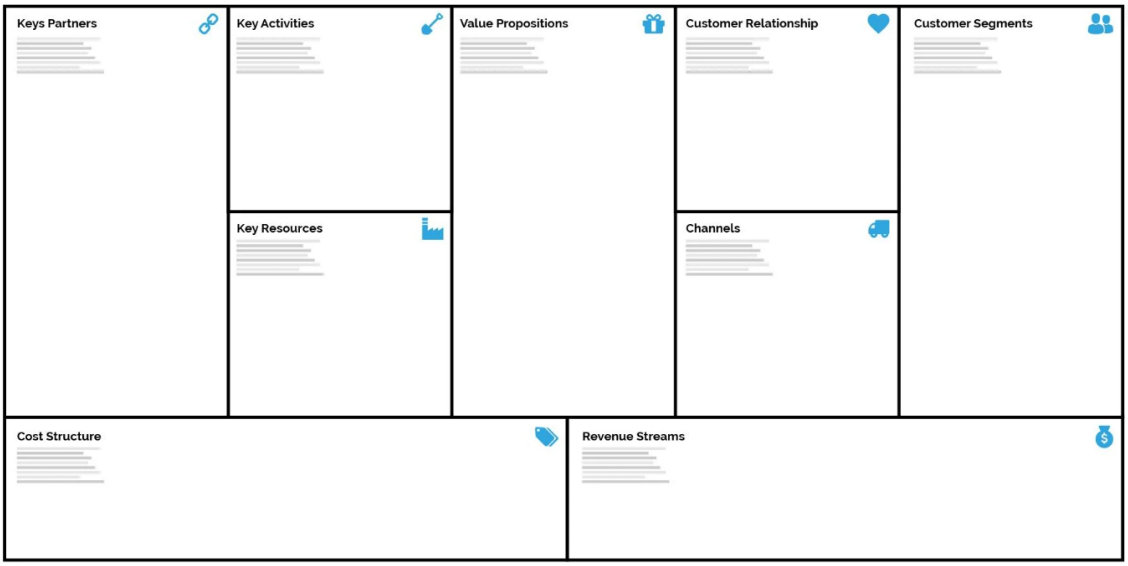

Fig. 5 Business Model Canvas Template Blocks [10].

The first element is Customer Segment, then the second element is value proposition. This block is the uniqueness of the product or services. Why should customer buy from you? Ideally, it solves a problem or drives additional value for an end-client. The third block is Distribution Channels**.** The channel to deliver products or services. Next block is Customer Relationship, how we choose strategy to interact with the target customer. How the image is built and how we treat the customer to get positioning and good brand image from customer. The fifth block is revenue stream, is about determining where the revenue comes from. The Key Resources block describes all the critical resources needed to run the business well. Next block is key activities. The business activities vital for work that we should do in the daily process of the business to get the target and our purpose. To run the business well, we have partner to do some work together, block Key partners are listed parties like suppliers who are vital to flawless business operations. In other words, we can't survive without them. All the mentioned above blocks of the Business Model Canvas aren't implemented for free. We spend money on production and accompanying services. To set realistic revenue goals, we need to estimate the costs first. The cost structure block shows how much money is spent to run the business.

IV. Results & Discussion

Value Proposition Canvas (VPC) for IoT Application on Hydroponic

Internet of Things of hydroponic is one of development feature to boost the yields of hydroponic with effective and cost efficient. To describe new value of hydroponic using IoT, below is the VPC:

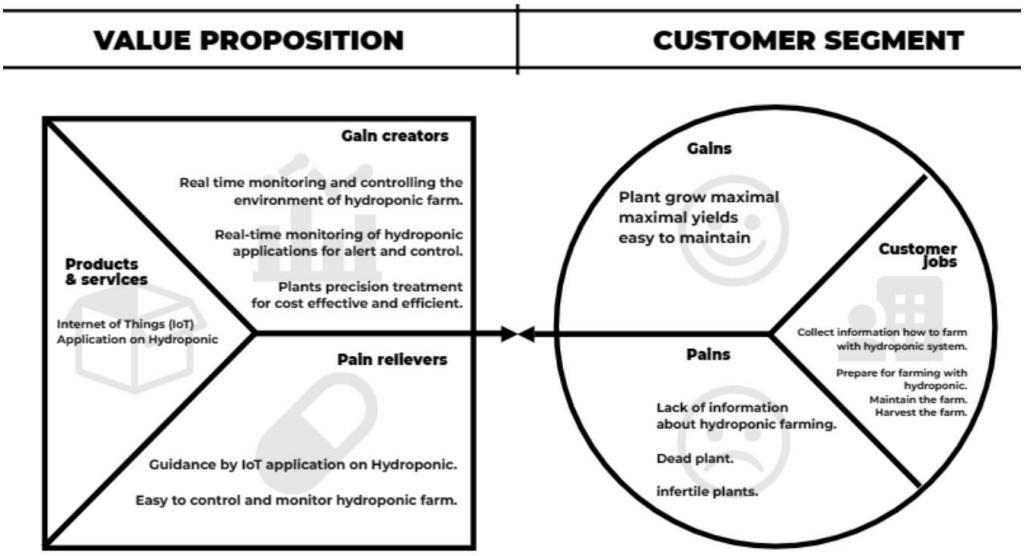

Fig. 6 Value Proposition Canvas for IoT Application on Hydroponic [22].

Customer Jobs. When customers decide to start their hydroponic, they must collect information how to create hydroponic system in their farm. Information can be from any resources, from books, video, social-media, or information from expert or someone who have experience about hydroponic. Then customers will prepare the equipment and all they need to start the hydroponic farm. Customers maintain hydroponic farm, checking if the environment is conducive for the plants? If not, customers will act to taking care the hydroponic farm, such as added some fertilizer, adjust pH water, and keep the light intensity ideal for the plants. When the plants ready for harvesting, customers will pick and harvesting it.

Pains. Sometimes customers lack information about how to create hydroponic farm. Some dead plant and infertile will be bad experience for customers / farmers.

Gain. Lucky if customers or farmers have maximal yields, their plants grow very good, and easy to maintain.

Products & Services. IoT application on Hydroponic, hopefully can fulfilled farmers or customers expectation how to do good hydroponic farm.

Pain Reliever. With IoT application on Hydroponic farmers or customers have more information and guidance how to be farming with hydroponic system. IoT application on Hydroponic also make hydroponic farm easily to control and monitor.

Gain Creator. IoT application on Hydroponic real time monitoring system makes hydroponic farm easy to maintain and control. Real time monitoring system IoT application on Hydroponic will give alert to customers or farmers if there are some environment conditions of hydroponic farm need to be adjusted. With IoT application on Hydroponic, farmers can get advantages how to makes their farmer effective and efficient, fertilizer and pH adjust just when the plants need it. Farmers also can predict when the time to harvest the plants, this will be economical advantages for farmers.

Business Model Canvas (BMC) for IoT Application on Hydroponic

Business model canvas can be used to describe business model for application IoT application on hydroponic, below is the BMC:

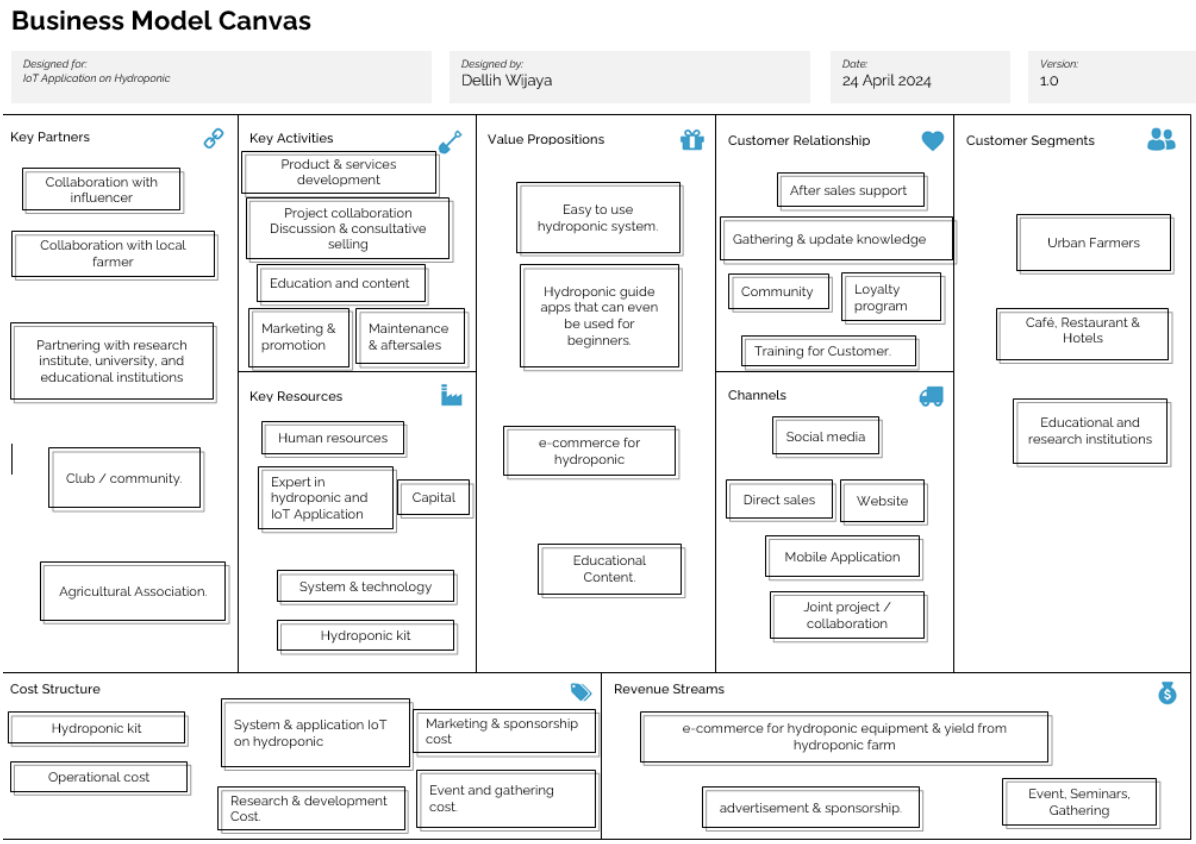

Fig. 5 Business Model Canvas for IoT Application on Hydroponic

Figure 5 describes business model for IoT Application on Hydroponic.

Customer Segment. Customer segment mostly are urban farmers [23], cafe and restaurant create hydroponic environment as their theme to attract customer[24]. Students using hydroponic as application of gamification

models with virtual reality for learning plant cultivation techniques [25]. We can also foster children's interest in learning about plants with hydroponics [26] and use IoT applications to further interest them.

Value Proposition. With IoT application on hydroponic, user can easily monitor and control hydroponic remotely, even for beginners. We can use the application for e-commerce hydroponic, to get the kit and equipment of hydroponic easily to find and sell the yield to another customer. IoT application on hydroponic is very helpful for research and educational purposes, the collection data gathered by the sensor can be easy to analyze.

Channel. To campaign for the application we can use social media platforms, website will be base information about the application beside the mobile application itself. To reach customers or users for the application we can directly inform and educate them, collaborate with some organizations, institutions, and others community will be effective to get more users.

Customer Relationship. Users who are interested and install the application to plant hydroponic kit will be get guidance from the application. Discussion and consultation will be provided as after-sales service. Gathering users to update knowledge and enlivening hydroponic harvest competitions will be something that attracts the community to be more active and enthusiastic. We can create some loyalty programs for loyal users to attract new users and keep maintaining the existing users.

Revenue Stream. To run the business well, we can earn from events, seminars, and gatherings tickets, while subscription for the application is for free. Then the application can be a marketplace for hydroponic kits and yields from users. These activities can attract other businesses such as fertilizer provider, hydroponic kit provider, community of urban farmers, café and restaurant which have hydroponic concept as their theme, and others to spend money to advertise on the application.

Key Resources. The key resources to this business are human resources to run the business, with some expert to create and develop the application. Start-up capital used at the first to create and develop the applications, doing campaigns to potential users, and provide hydroponic kit completed with the sensors. Then of course the system and technology to support this application and the business.

Key Activities. Day-to-day activities should be done to run this business. First, we must develop the products and services, then for marketing and promotion we can frequently upload to social media content of education about hydroponics and how fun and useful it is to grow crops, using this IoT hydroponic application. For direct approach we can go to the community to discuss and doing consultative selling with some project collaboration.

Key Partner. This business will need more collaboration with some key partners to make it sustain and grow. To provide all we need above we need to do some collaborations with social media influencers, local farmers, research institutions, universities, and any other education institution. Club or community of smart farming also will be key partner to collaborate beside agriculture association.

Cost Structure. The things mentioned above need cost. For fixed cost consist of operational cost such as salary and other operational costs and depreciation of all the assets, tools, equipment, and devices uses to run the business. First costs to create and develop the application, then to provide IoT hydroponic kit to sell to the users. Marketing and sponsorship to campaign the application, also event and gathering will be cost of the business.

Below are comparison with the previous research using BMC on hydroponic:

TABLE 1
COMPARISON PROS & CONTRAS BMC FOR IOT ON HYDROPONIC

No.	Tittle	Author	Year	Location	Point of Research	Pro	Contra	Conclusion
1.	Hydroponic Green House Business Development Strategy Using Business Model Canvas (BMC)	Yudi Nur Supriyadi, Neni Rosmawarni, Iwan Kresna Setiadi, Ramadhani Mahendra Kusuma, Guntur Syahputra Saragih	2023	Tangerang Banten Indonesia	Analyze hydroponic farm case on WFG (Woman Farmers Group) using BMC combine with SWOT and QSPM (Quantitative Strategic Planning Matrix)	BMC tools use for hydroponic farm in Tangerang	The paper does not discuss it uses IoT or not.	Identification of the nine-elements of BMC is very useful in understanding, analyzing, and planning activities that need to be evaluated and improved by WFG in Tangerang City [20].
2.	Innovation Report: 10	Daniel Pereira	2023	Canada	All BMC implementation	Completed BMC	Indonesia is not one of	Implementation BMC on

	Innovative Business Models for Agriculture and Farming. Section 5. Aquaponics and Hydroponics Systems				with various agriculture and farming	describes with five success stories in other countries.	the examples for the success story. Online platform and e-commerce website mention in the report, but not discuss whether it uses IoT or not.	hydroponic system has success in several countries [27].
3.	Meraih Sukses dengan Bisnis Hidroponik: Mengenal Bisnis Model Canvas	Farras Hazim	2024	Indonesia	Hydroponic, start the business, maintenance, and how to be success in hydroponic business	BMC purpose and benefit for hydroponic	The weakness of hydroponic systems is because they have not discussed IoT applications.	BMC is the proper tools to describes hydroponic business model[28]

V. CONCLUSIONS

Business Model Canvas (BMC) is proper tools to describe hydroponic farm. New BMC hydroponic with IoT application have opportunity to be implement. With IoT aplication BMC hydroponic have novelty of customer segment, cost structure, key partner, and other blocks. For Tangerang Banten Indonesia, IoT application on hydroponic can develop as added value and spesific theme for hotel, restaurants, and cafe to attract their customers.

There are added cost to create IoT system on hydroponic compare with traditional hydroponic. To make the business grow and sustain, we need more than one revenue stream added on business model IoT applications on hydroponic. Even though IoT helps hydroponic farm to boost the quality and quantitas hydroponic yield with efective and eficient.

Comunity and IoT hydroponic enthusiast should be create and build to support the business. Then seminars, gathering, or training can be add as revenue stream on business model IoT application on hydroponic.

Social media can be one of channel to deliver as 100% respondents at least have one social media account. E-commerce as marketplace for hydroponic kit, maintenance and yield can be interesting business and can add as revenue stream. For big purpose, hydroponic business which sustain can impact to solve zero hunger and climate action in SDGs.

This paper has several limitations which do not show the result of BMC implementation related to value proposition and revenue stream. What factor most affects sustaining and growth the IoT application on hydroponic? How about the feedback and impact of strategy implementation on hydroponic farmers? What is the success factor affecting the implementation of the strategy on hydroponic farm? Can be the next step paper to continue.

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