



Strengthening Oh' Farms Capabilities

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For approval by the Management of Oh Chin Huat Hydroponics (Pte) Ltd

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The following report is a proposal to enhance capabilities of Oh Chin Huat Hydroponic Farm Pte Ltd (Oh' Farms) through the application of SPRING Singapore's Capability Development Grant (CDG). The report includes analysis of current position and strategy of the company, analysis of macro and micro environment, analysis of key issues that Oh' Farms faces and our recommendations on how Oh' Farms can leverage on CDG to improve its business capabilities. The research methodology involves an interview with our colleague (Ms Ore Hui Ying, Sales Executive of Oh' Farms), farm tour and literature review from websites and journals.

Current Position

Oh' Farms is a leading hi-tech hydroponics farm with 220 greenhouses that produces approximately 1000 kg of vegetables daily. By investing and utilising advanced agriculture technologies such as Dynamic Root Floating technique and decentralised irrigation systems, Oh' Farms is able to grow high quality and pesticide-free vegetables for its customers. Oh' Farms also provides a multitude of product and service offerings to diversify its business. With the heightening interest in local products from activists groups and growing support from the government, Oh' Farms has immense growth potential. However, it faces risks of lease expiry every decade, rising costs of land and labour and intense product competition.

Key Issues

Based on our situational analysis, we have identified 2 key issues that Oh' Farms need to address: **labour and land-intensive nature of business**.

Recommendations

To manage the key issues faced and further strengthen Oh' Farms competitive advantage, we propose three strategies to raise the farm's productivity and drive growth:

Recommendation	CDG Business Area	Objective
1 Vertical Farming	Productivity Improvement	To increase number of crops grown per unit of land
2 Precision Farming	Technology Innovation	To monitor and capture real-time data of crop conditions
3 Aquaponics	Technology Innovation	To reduce inputs costs via closed loop agricultural system

Conclusion

Moving forward, Oh Farms' can apply for the CDG to obtain financial support to adopt agricultural technologies that complement its existing capabilities. Oh' Farms' competitive position can be strengthened with improvements in productivity and technological innovation. Successful implementation will also enable Oh' Farms to extend consultation services within the agritech industry in Singapore and the region.

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1. INTRODUCTION

The following report is a proposal to improve Oh Chin Huat Hydroponic Farms Pte Ltd (Oh' Farms) business capabilities through the application of SPRING Singapore's Capability Development Grant (CDG) in two key areas, namely "Productivity Improvement" and "Technology Innovation". (Appendix B - About SPRING and CDG) A brief summary of Oh' Farms current position is provided, followed by an analysis of its business, its competitors and Singapore's agricultural industry. From the analysis, we identified key issues and proposed solutions to address these issues.

Our research methodology includes a literature review on Singapore's hi-tech agriculture industry based on websites and research journals, with inputs from our colleague, Ms Ore Huiying [Sales and Marketing Executive, Oh' Farms] (Appendix C). We have consulted her to ensure feasibility and relevance of our recommendations. Also, we toured the farm with our visitors from Singapore Heart Foundation to gain a better understanding of how farm tours are conducted and facilities in the farm (Appendix I).



2. CURRENT POSITION

As one of the pioneer and most successful hydroponics farm in Singapore, Oh' Farms is positioned as a one-stop supplier for its hydroponics vegetables and culinary herbs, and imported exotic vegetables, herbs and fruits. It is recognised by its consumers for its premium-grade hydroponics produce that are pesticide-free and of high nutritional value. As a forerunner in hydroponics technology, it continues to innovate and provide assistance in the implementation of hydroponics technology to organisations and educational institutions worldwide. (Appendix D - Company Background)

In this section, we will evaluate the effectiveness of Oh' Farms current positioning strategy by analysing its micro- and macro-environment with the SWOT (Appendix E) and PESTLE (Appendix F) Frameworks.

Certified by Agri-Food & Veterinary Authority of Singapore (AVA) for Good Agricultural Practice for Vegetable Farming (AVA, 2015), Oh' Farms produces over 109.5 tonnes of leafy vegetables and culinary herbs annually, which approximates to 1% of local vegetables produced for the domestic market (AVA2, 2016). Its commitment to high-quality produce, education, community, and responsiveness have been recognised by its customers who range from local Singaporeans to businesses (e.g. Resorts World Sentosa).

2.1 Strengths and Key Success Factors

2.1.1 Hydroponics: Dynamic Root Floating (DRF) Technique

Oh' Farms has perfected its hydroponics DRF Technique (Figure 1) for agriculture in Singapore's tropical climate over the past 15 years. It overcomes the build-up of heat in a greenhouse and shortage of dissolved oxygen in the nutrient solution by inducing plants to develop an air root system in the highly humid space between the surface of the nutrient solution and the underside of the culture boards (PHG, 2000). Benefits of hydroponics include no pesticide, weeds and soil-borne diseases which reduce costs and improve efficiency (BBC, 2016).



Figure 1: DRF Technique
http://www.fftcc.agnet.org/htmlarea_file/library/20110801154442/eb330.pdf

2.1.2. Diversified Business Model

Oh' Farms has expanded its business to beyond the production of leafy vegetables. It is also engaged in the production of culinary herbs, contract farming, knowledge transfer, wholesale distribution of imported produce and horticulture hobbies (OhFarms, 2016). Its diversified business model provides more areas of organic growth and risk diversification.

2.1.3. Dedication towards Innovation

Oh' Farms invests heavily in innovation to drive productivity. Its DRF technique is the result of its continuous research and experimentation over the years in adapting Hydroponics Technology to suit the tropical climate. Other recent projects include investment in an automated Horizontal Pillow Packaging Machine (Figure 2) to improve efficiency of its packaging process (OhFarms, 2016).



Figure 2: Horizontal Pillow Packaging Machine
<http://www.ohfarms.com.sg/> 6

2.2. Industry Analysis

Oh' Farms is one of the many farms in the high-technology agricultural industry in Singapore. As an island with limited land and natural resources, Singapore's agricultural industry is virtually non-existent (EconomyWatch, 2016), with approximately 1% of its land being allocated for agriculture over the past five years (WorldBank, 2016). This landscape presents opportunities and threats for Oh' Farms. Several key opportunities and threats are highlighted below (Appendix C - SWOT, Appendix D - PESTLE).

2.2.1 Opportunities

2.2.1.1 Political: Increasing Government Support

In 2013, AVA announced the Food Security Roadmap (Figure 3), which includes a key strategy of diversifying Singapore's sources of import through industry development and local production. AVA, Ministry of National Development (MND) and National Parks Board (NParks) introduced a slew of initiatives to create greater awareness, promote the demand of key local food items, and provide greater support for this industry. These initiatives include new subsidies and policies (MND, 2014) and a local-produce task force (ST, 2015). The government aims to increase local production to 10% of total vegetable consumption (MND2, 2011), up from the current 8% (Figure 4, AVA3, 2015). Local production can provide a buffer in times of supply disruptions and serve as a platform to test-bed agricultural innovations (MND3, 2014).

The government is also keen to promote agri-tourism, as seen from the execution of pilot projects to develop vacant State land at Lim Chu Kang area for agri-tainment projects besides traditional agricultural uses in 2006 (SLA, 2006).



Figure 3: 2013 Food Security Roadmap for Singapore
http://www.ava.gov.sg/files/avavision/issues3-4_2013/images/roadmap-03.jpg

Food Supply Origination (%)

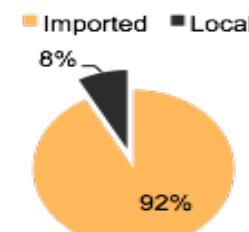


Figure 4: Food Supply Origination
<http://www.ava.gov.sg/explore-by-sections/food/singapore-food-supply/the-food-we-eat>

2.2 Industry Analysis

2.2.1 Opportunities



Figure 5: NTUC FairPrice Made in Singapore Fair 2015 (<http://www.channelnewsasia.com/news/singapore/fairprice-extends-support/2017286.html>)

2.2.1.2 Social: Increasing awareness of local produce

Several local enterprises have kickstarted social groups to promote awareness of local produce amongst Singaporeans. Initiated by SPA Esprit Group, Open Farm Community (OFC) unites local farmers and creative chefs in a first-of-its-kind dining concept in Singapore (OFC, 2016). Oh' Farms has participated in OFC's first Social Market. Another activist group is the Kranji Countryside Association which collaborates with public and private partners to promote local agriculture, food security and sustainability, health, eco and agro tourism, education, conservation, recreation and community bonding (KCA, 2016). Furthermore, NTUC FairPrice has been organising "Made in Singapore Fair" (Figure 5) since 2012 and offers financial support to local enterprises (e.g. SME Suppliers Support and Development Programme) (CNA, 2015). School groups are also jumping on the bandwagon to encourage consumption of local produce (ST, 2015).

2.2.1.3 Environmental/Technological: Technological Advancements in Agriculture

With an estimated 9.7 billion people by 2050 (Figure 6, UN, 2015), and more than 99.7% of global food coming from land (Worldwatch, 2004), more efforts have been put into research and development (R&D) to find strategies to increase food production and yields per surface area in order to safeguard food security (Techcrunch, 2016). This trend is further spurred by the recent effects of global warming and climate change that have put a toll on traditional agriculture techniques (IMF, 2008). Oh' Farms can tap on these R&D efforts to increase its production yield.

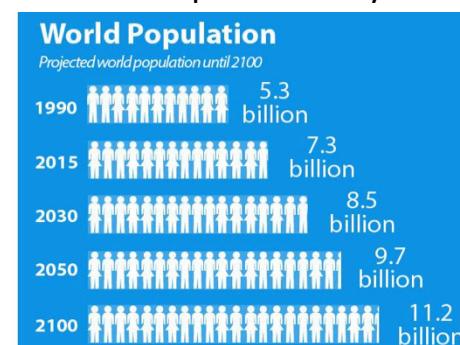


Figure 6: United Nations World Population Projection (<http://www.un.org/News/dh/photos/large/2015/July/Population-Infographic-01.jpg>)

2.2 Industry Analysis

2.2.2 Threats

2.2.2.1 Political: Inability to own farm-land in Singapore

As Singapore has limited land (Figure 7), farm-lands are leasehold with a 10-year tenure and are subjected to a 10-year lease renewal after the lease ends, provided that there are no redevelopment plans, and the farm is able to meet the criteria set by AVA, including:

- 1) At least 90% of the land for farm production; the remaining 10% may be used for ancillary purposes
- 2) Meet minimum production levels to qualify for new leases or lease extensions (AVA4, 2016)

While AVA and NParks have provided greater certainty to farmers with a sufficient payback period to recoup productivity investments (NParks, 2014), Oh' Farms still need to meet the lease criteria and is vulnerable to redevelopment of farm-land for other purposes (ST2, 2014).

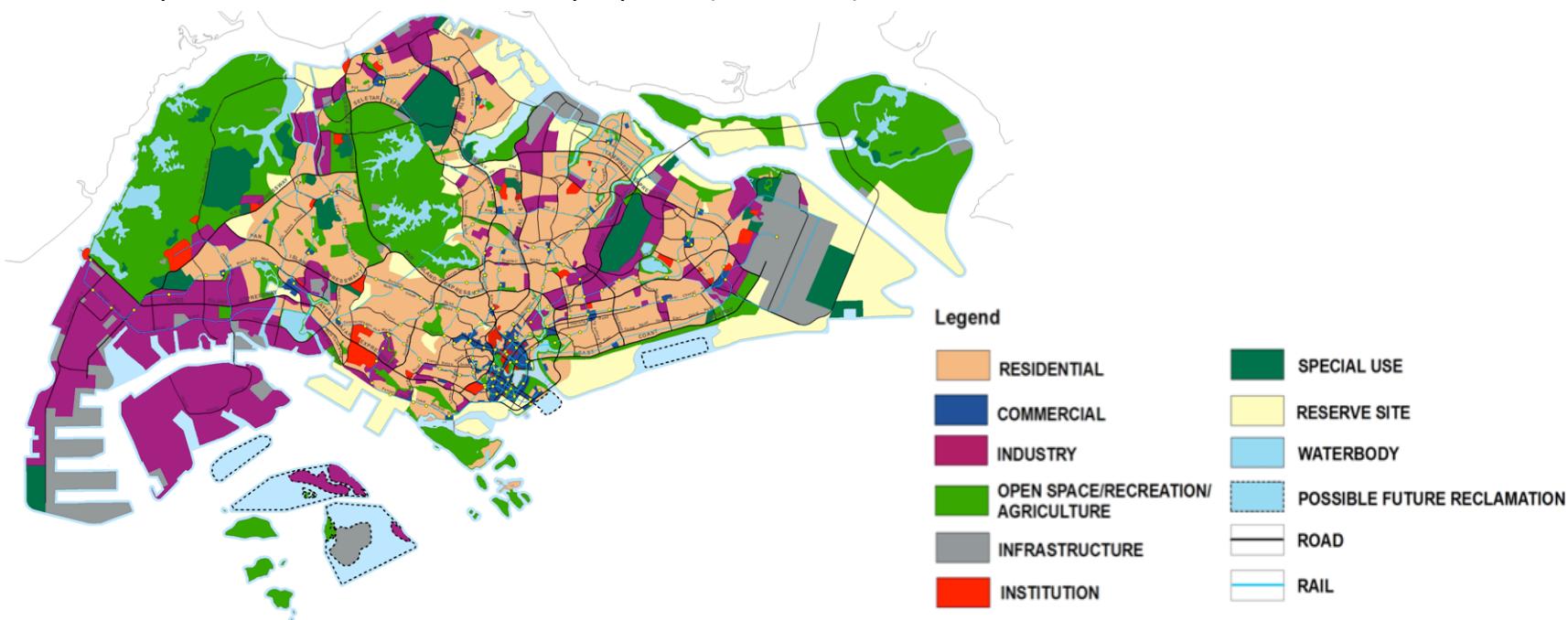


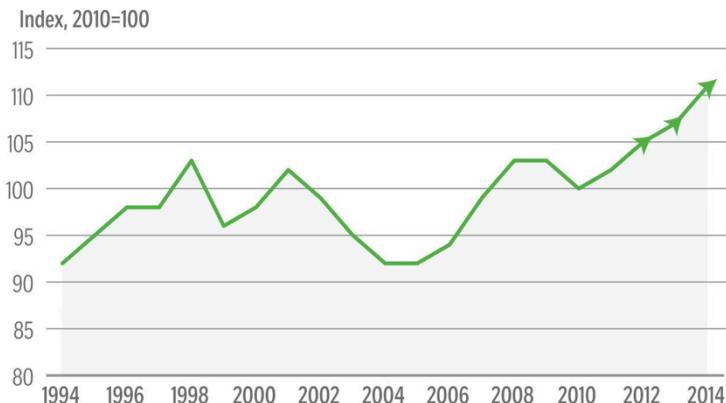
Figure 7: Profile of Possible Land Use Allocation in Singapore Beyond 2030

(<http://4.bp.blogspot.com/-6W6kEHEPCU0/UQ0thPPhXqI/AAAAAAAQy8/lFhLuWhUpPQ/s1600/Land+Use+plan.png>)

2.2 Industry Analysis

2.2.2 Threats

Rising unit labour costs



Source: MINISTRY OF TRADE AND INDUSTRY ST GRAPHICS

Figure 8: Rising Unit Labour Costs

(st_20151126_ymsidebar26_18684651.jpg)

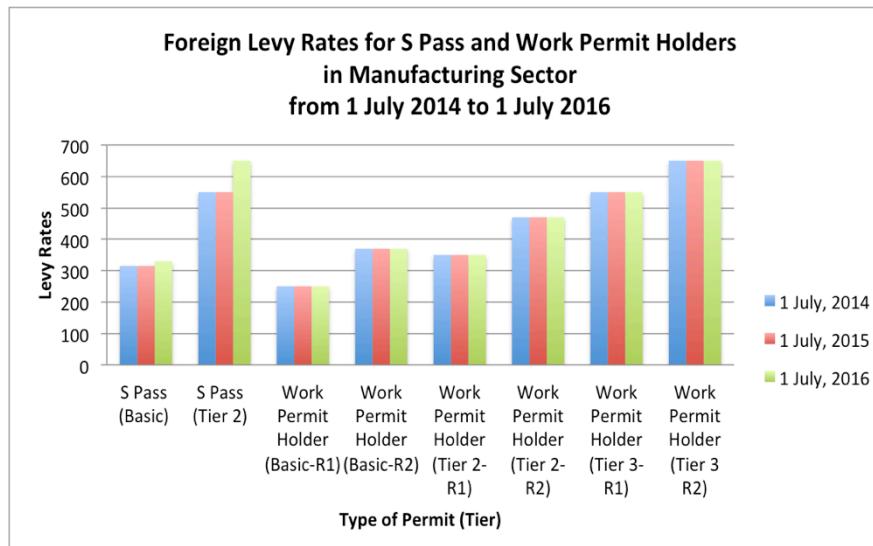


Figure 9: Foreign Levy Rates for S Pass and Work Permit Holders in Manufacturing Sector from 1 July 2014 to 1 July 2016

(http://www.singaporebudget.gov.sg/data/budget_2015/download/annexa5.pdf)

2.2.2.2 Political/Economic: Rising costs of land and foreign labour

Based on a study conducted by Ministry of Trade and Industry (MTI) in 2015, the overall unit labour costs rose an average of 1.9% per year from 2004 to 2014, compared with a 0.1% annual decline in the preceding decade (Figure 8). The bulk of the increase in unit labour costs was driven by a rise in remuneration per worker. (ST3, 2015). Moreover, foreign worker levies have been raised while dependency ratio ceilings have been gradually reduced as part of MTI's policies aimed to wean companies off cheap foreign labour (ST4, 2015). Particularly for the manufacturing sector that Oh' Farms is classified in, the S Pass foreign worker rates have increased by over 5-20% from 2014 to 2016 (Figure 9). The rising costs of land and foreign labour have significantly increased the costs of production for Oh' Farms. Furthermore, land prices have also increased, with the most recent bid for farm land at a hefty sum of \$1.73million for a five-hectare land, (about 115 basketball courts equivalent) at Lim Chu Kang. (Today, 2006) The rising costs of land and foreign labour have significantly increased the costs of production for Oh' Farms.

2.3 Competitors' Analysis

Oh' Farms faces numerous competitors both locally and overseas.

2.3.1 Local Farms

Currently, there are about 200 food farms in Singapore. Of these, about 50 are leafy vegetable farms. A major local competitor of Oh Farms' is Kok Fah Technology Farm, which produces 3,000kg of leafy vegetables daily in 2015 up from 2,000 kg in 2010 under the "Pasar" brand name (StraitsTimes, 2015).



Figure 10: Singapore's Food Source

(<http://www.ava.gov.sg/explore-by-sections/food/singapore-food-supply/the-food-we-eat>)

2.3.3 Multi-national Conglomerates

Oh' Farms faces fierce competition from global technological firms that are venturing into the local agricultural industry. An example is Panasonic (Figure 11), which aims to contribute 5% of Singapore's local production by 2017 under brand name Veggie Life (ST5, 2015). By leveraging on its technological know-how (e.g. hyperspectral imaging system), it creates a controlled environment that monitors the quality of the crops and reduces overall cultivation time by 50% (CNA2, 2015).

2.3.2 Overseas Farm

Singapore imports over 90% of the food consumed in the country while local vegetable farms only contribute to 8% of all the vegetables consumed. AVA aims to raise Singapore's self-sufficiency to 10% (Figure 10, AVA5, 2016). While there has been an increase in demand for local farms, consumers do consider price as one of the main factors in deciding which vegetables to purchase, and are generally not particular about where the vegetables are produced (SGFarming, 2014). Prices of local greens (e.g. Oh' Farms) are estimated to be 15 per cent higher than those of imported vegetables, owing to relatively higher labour costs and rents (StraitsTimes, 2015).



Figure 11: Panasonic's Indoor Farm in Singapore

(<http://www.japantimes.co.jp/news/2014/08/24/national/science-health/high-tech-vegetable-farms-grow-up/#.VtITppN96CQ>)



3. KEY ISSUES

Based on our situational analysis and interviews with Ms Ore, we have identified 2 main issues Oh' Farms currently face that can be addressed through the application of CDG.

- 1) Oh' Farms' **labour-intensive model**, which has intensified the rapid increase in labour costs due to the recent government policies to tighten the foreign labour pool; and
- 2) Oh' Farms' **heavily reliance on land**, which makes Oh Farms' vulnerable to rising land costs and re-development policies.

These challenges have been further aggravated by Oh' Farms' local competitors who leverage on technological know-hows to increase yields, and its overseas competitors who ride on the benefits of cheaper production costs overseas than in Singapore. These two key issues have resulted in a higher cost per unit production for Oh' Farms as compared to its competitors.



4. RECOMMENDATIONS

To tackle the key issues that Oh' Farms face that impede its productivity, we propose the following recommendations for Oh' Farms' application of CDG:

Recommendation	CDG Business Area	Objective	Timeline
1 Vertical Farming	Productivity Improvement	To increase number of crops grown per unit of land	2 months
2 Precision Farming	Technology Innovation	To monitor and capture real-time data of crop conditions	3 months
3 Aquaponics	Technology Innovation	To reduce inputs costs via closed loop agricultural system	8 months

We have taken into account Oh' Farms current capability in hydroponics to deliver recommendations that can leverage on its existing expertise to overcome the key issues highlighted. We have also consulted Ms Ore on the feasibility of our proposed solutions.

4.1 Vertical Farming

Leveraging on Oh' Farms' current hydroponics technology, Oh' Farms can adopt the use of vertical farming (Figure 12) technology to further increase the number of crops grown per area of horizontal growing space.

Listed as one of the 15 emerging agricultural technologies, vertical farming is the practice of producing food in vertically stacked layers that can be implemented through the utilisation of hydroponics (BusinessInsider, 2014). This approach works best for salad greens and herbs, which are part of Oh' Farms current crops, as they have higher margins and can be grown in larger quantities than other vegetables that require more space and longer grow cycles (CNBC, 2015).

4.1.1 Cost-benefit Analysis

Costs (The Economist, 2010; CNBC2, 2015; Agricultureguide, 2011)

- 1. Large capital outlay:** costs include construction of system, electrical bills
- 2. Limited varieties of vegetables and fruits**

Benefits (SkyGreens, 2014; The Economist, 2010; Agricultureguide, 2011)

- 1. Higher yields:** Vertical farming intensifies land use and can result in at least 10 times more yield per unit land area, which enables Oh' Farms to better meet productivity level requirements for lease renewal.
- 2. Higher flexibility:** Vertical towers are made of aluminium and steel, which can be customised and scaled to suit Oh' Farms' needs. Also, should AVA not grant the renewal of lease, these towers can allow for production in another landscape (e.g. factory).
- 3. Low water use:** Only 0.5 litres of water is required to rotate the structure. Also, unlike Oh' Farms' current greenhouses, there is no need for a sprinkler system as the plants are irrigated and fertilised using a flooding method.
- 4. Low energy use:** Each vertical tower requires only 40W electricity (equivalent to one light bulb) is needed to power the rotation of the troughs, which costs \$3 per month. Also, the tower harnesses natural sunlight and can be constructed in Oh' Farms' existing greenhouses.
- 5. Less manpower required:** Vertical towers and rotating troughs reduces manpower dependency.



Figure 12: Sky Green's Vertical Farm

(<http://permaculturenews.org/2014/07/25/vertical-farming-singapores-solution-feed-local-urban-population/>)

4.1.2 Implementation

Oh' Farms can collaborate with Sky Greens, which is a Singapore-incorporated company that patented the world's first low carbon hydraulic commercial farming system, through knowledge sharing and purchase a 3 9-meter vertical towers from them. The vertical tower consists of 38 tiers of growing troughs that rotates consistently to ensure plants receive uniform sunlight and nutrients (Figure 13; SkyGreens, 2014). Return on investment per rack is estimated to be 1-2 years.

Projected Implementation Cost: \$10,000 per rack (Krishnamurthy, 2014)

Overall, Oh' Farms can apply for the CDG to integrate vertical farming in their existing hydroponics greenhouses. Vertical farming intensifies land use per area and reduces the reliance on land for Oh' Farms (i.e. the same output of Oh' Farms can now be achieved on a smaller land area). Also, automated troughs reduce manpower required to cultivate the crops. Thus, Oh' Farms is less susceptible to the threat of increasing land lease costs and labour costs.



Figure 13: Sky Green's Vertical Farm System Illustration
http://innovatedevelopment.org/wp-content/uploads/2015/09/Vertical_Farming_VF_Illustration.jpg

4.2 Precision Farming

To reduce dependence on foreign labour for monitoring of crops, Oh' Farms can implement precision farming to complement its current hydroponics agricultural method which requires significant monitoring of crops under controlled environment. Precision farming is the use of agriculture wireless sensors systems for environment monitoring and control. (BusinessInsider, 2014).

4.2.1 Cost-benefit Analysis

Costs

1. **Large investment outlay:** costs include implementation costs
2. **Higher consumption of electricity**

Benefits

1. **Higher yields, higher quality crops and resource maximisation:** Sentrol Cloud (Figure 14) provides Oh' Farms employees with full autonomy of the greenhouse environment as compared to its existing manually automated greenhouse shields. Employees can calibrate optimal levels of temperature and humidity (Figure 15) and relay devices will automatically correct the imbalance by triggering fans, heaters or irrigation systems when deviations are detected. (NHR R&R, 2016) Automatic feedback loop allows crops to consistently grow under optimal conditions, thereby reducing the harvest period, increasing crop quality and minimising under/over utilisation of resources.
2. **Less manpower required:** Sensors enable employees to have real-time traceability and diagnosis of crops and farm machine states from anywhere via a web-enabled electronic device (e.g. computer). Thus, employees need not be physically present at the farm to monitor crops.

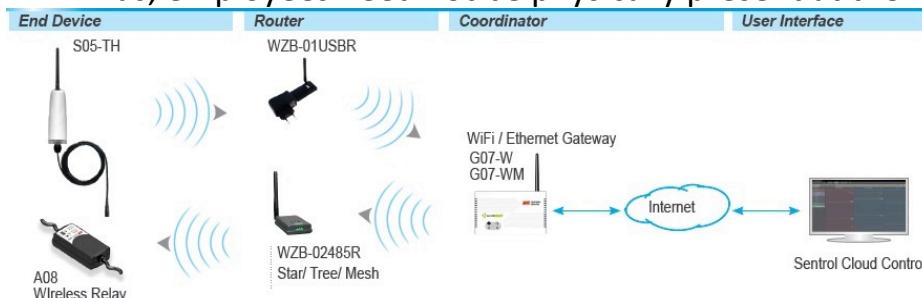


Figure 14: Sentrol Cloud System (25GB)

(<http://www.shop-wifi.com/sentrol-cloud---sophisticated-user>)



Figure 15: Trend Analysis on Web

(<http://www.shop-wifi.com/sentrol-cloud---sophisticated-user>) 16

4.2.2 Implementation

Oh' Farms can engage the services of NHR R&R Group Taiwan or Pepperl+Fuchs (Pepperl+Fuchs, 2016), which are specialists in agricultural sensors, to implement precision farming. High precision temperature and humidity sensors can be installed in Oh' Farms nursery, greenhouses and cold storages. Return on investment is estimated to be 1-2 years.

Projected Implementation Costs: \$13,000

1. \$6,000 for system implementation [Sensors and cloud application (ranges from \$165 for a STH-01ZBE ZigBee Wireless Temperature and Humidity Data Logger Sensor to \$799 for a Sentrol Cloud application (25GB, 25 Gateways)] (Figure 16)
2. \$7,000 for advisory services and training costs

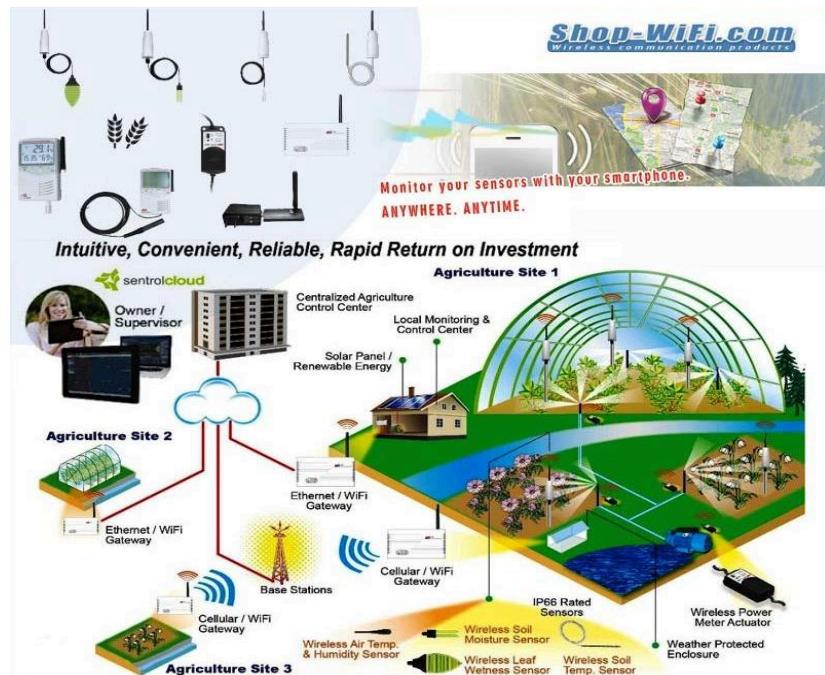


Figure 16: Cloud Computing System (<http://shop-wifi.com/image/data/neeeee/agro-sensors-800.jpg>)

Case Study

An effective user of smart-farming technologies is Fujitsu, which grows vegetables through hydroponics and has equipped its factory with more than 100 sensors that monitor temperature, moisture, CO₂, air current, lighting, fertilizer flow, and the pH of the soil. Readings are uploaded to the company's latest cloud platform, allowing the teams of engineers in their suits to monitor them on Fujitsu tablets (Fastcompany, 2014). Oh' Farms can emulate from this successful case study of Fujitsu to ride on internet of things to grow better vegetables through hydroponics.

Precision farming enables Oh' Farms to better monitor and control growing conditions, boasting higher and better quality yield and reducing manpower required.

4.3 Aquaponics

As a high-technology agricultural farm, Oh' Farms can further develop its agricultural capabilities by integrating aquaponics to its current hydroponics method and adapting aquaponics for use in Singapore's tropical climate. Aquaponics is a system that combines aquaculture with hydroponics in a symbiotic environment. Through the integration, nutrients from the fish waste assist plant growth while the plants provide filtered oxygenated water to keep the fish healthy in a self-contained and controlled eco-system.

4.3.1 Cost-benefit Analysis

Costs

1. **Large capital outlay:** costs include implementation, energy and training costs
2. **Develop expertise in Aquaculture**

Benefits (vs Hydroponics)

1. **Diversification:** An aquaponic system unit can yield 860 kg of tilapia and 40,000 leafy greens annually. In addition to vegetables, Oh' Farms can supply tilapia to its business clients, generating an alternative source of revenue (Nelson, 2016).
2. **High Yield:** In 2008 Nichols Research Study, aquaponics has a 30-40% higher yield as compared to hydroponics (Nichols, 2008).
3. **Low Manpower Dependency:** Manual water replacement operations are made redundant due to the closed-loop nature of the system that provides constant filtration of water and maintenance of water quality. The media-filled bed breaks down all waste, including the solids, within the plant bed. It uses the fewest components and no additional filtration, making it simple to operate.
4. **Low Resource Usage:** Reduced usage of chemical nutrients and water
5. **Floor Space Optimisation and High Quality Crops:** The raft system (Figure 17) allows plants to grow on polystyrene boards above the fish tank and the extra volume of water from the raft tank provides a buffer for the fish, reducing stress and potential water quality issues.



Figure 17: Raft System
(<http://aquaponics.com/aquaponic-systems/home-and-school-systems/>)

4.3.2. Implementation

Oh' Farms can engage with Nelson and Pade Inc.[®], a trusted brand-name in the aquaponics industry, to purchase their patented Clear Flow Aquaponic Systems[®] (Figure 18). This innovation won “Sustainable Product of the Year Award” in the 2014 Earth Day Awards in Milwaukee, WI (Nelson2, 2014) (Figure 19). Each unit of the model system has 4 – 200 gal fish tanks, filtration and ZDEP[®] , 2 Raft Tanks, 2 Living Filter Media Beds, Accelerated Plant Nurseries, Automated Germination System (Nelson, 2015). Detailed assembly and operation manuals are included in the system packages that facilitates easy independent installation of the aquaponics system by Oh' Farms. Return on Investment for this system is estimated to be 3-4 years (Nelson3, 2016).

Projected Implementation Costs: An aquaponics system unit is approximately \$55,426, excluding freight costs (Nelson, 2015).



Figure 18: Demonstration System at Nelson and Pade
http://www.agrview.com/news/crop/aquaponics-new-facet-of-agriculture-combines-fish-vegetables/article_de33cfa6-ea67-11e2-8a8a-0019bb2963f4.html

In all, Oh' Farms can reap more crops with aquaponics as compared to its current hydroponics method to reap more crops as compared to hydroponics better meet the growing demands for local products and alleviate the concerns of increased costs of land and labour resources. Oh' Farms can compete on a more level-playing field with overseas importers by offering cheaper, yet higher-quality crops. This innovation brings about synergistic and risk diversification benefits between fishes and crops while propelling Oh' Farms to further pursue its diversified business model.



Figure 19: Earth Day Award (<http://www.wisconsinsustainability.com/author/greenmastersprogram/>)



5. CONCLUSION

With its current expertise in hydroponics and an organizational culture that favours R&D, Oh' Farms is in a strategic position to leverage on new agricultural techniques and adapt them to suit its needs. Our three recommendations of Vertical Farming, Precision Farming and Aquaponics can allow Oh' Farms to alleviate the problems from the two key issues that we have identified: (i) foreign labour-intensive nature of business and (ii) heavy reliance on land. Subsequent to this proposal, further steps should be taken for the application of CDG. (Appendix G)

By applying for CDG, Oh' Farms can improve its processes and optimise resource allocation to maximise productivity, as well as strengthen its technology innovation capabilities to improve its products so as to compete effectively within the agricultural industry worldwide. Qian Hu's application of CDG to develop a multi-tier automated recirculation fish tank system is an example that we can learn from. (Appendix H)

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About SPRING Singapore

As an agency under the Ministry of Trade and Industry, SPRING Singapore (SPRING) is responsible for helping Singapore enterprises grow and building trust in Singapore products and services. SPRING works with partners to help enterprises in financing, capability and management development, technology and innovation, and access to markets.

SPRING's Mission: Help Singapore enterprises grow and build trust in Singapore products and services

SPRING's Vision: Global Singapore Enterprises

SPRING'S Strategic Outcomes: 1) Productive, innovative and resilient industries and enterprises,
2) Good jobs
3) Trusted products and services

About Capability Development Grant (CDG)

One of the comprehensive assistance programme to help businesses in their capability upgrading efforts and to seize growth opportunities that SPRING provides is the Capability Development Grant (CDG). CDG is a financial assistance programme that helps small and medium enterprises build capabilities across 10 key business areas: Brand & Marketing Strategy Development, Business Excellence, Business Strategy Innovation, Enhancing Quality and Standards, Financial Management, Intellectual Property and Franchising, Productivity Improvement, Service Excellence and Technology Innovation. It provides a grant support of S\$30,000 and defrays up to 70% of qualifying costs. To qualify for the grant, the enterprise has to be registered and operating in Singapore with at least 30% local shareholding and a group annual sales turnover of ≤ S\$100m or group employment of ≤200 employees. SPRING will assess the application based on the company's needs, the project scope and competency of the service provider in improving the company's business capabilities.

Interview with our colleague Ms Ore Huiying (Sales and Marketing Executive, Oh' Farms)

Date: 5 March 2016

Venue: Oh' Farms Meeting Room

Team: Good Morning Huiying, may we invite you to share with us more about Oh' Farms as well as the agriculture industry outlook in Singapore.

Ms Ore: Of course.

Team: What do you consider to be the key problem faced by Oh' Farms today?

Ms Ore: One of the biggest problems we are facing now is labour shortage and costs. The foreign worker quotas puts us in a difficult position since there are not many locals who want to work in this industry due to the low margins and our farm is labour-intensive, especially in the packaging and food processing department. Also, our 10-year lease is expiring in 3 to 4 years' time which makes it more challenging for us to invest a significant amount of capital into new technology due to the higher risks involved.

Team: What do you think of our proposed strategies that includes Vertical Farming, Precision Farming and Aquaponics?

Ms Ore: I think they are great. We do have a mini, non-commercial Vertical Farm model and a small Aquaponics tank here for educational purposes when we host our farm tours to the visitors. We definitely support the use of new technologies, especially since they help to reduce the need for manpower and labour costs. However, cost is a great concern for us since the return on investment for agriculture farms is usually 10 years.

Established in 1991, Oh' Farms is a family-run agriculture business with a current worth of \$2.5 million in 2015 and boasts a headcount of 50 employees. It comprises of 220 greenhouses built on 2.44 hectares of land, which approximates to the size of 56 basketball courts, and produces over 109.5 tonnes of leafy vegetables and culinary herbs annually (i.e. 1% of the local vegetables produced for the domestic market). Oh Farms' invests heavily in research and development, which have achieved significant results in adapting the Hydroponics Technology to better suit the tropical climate in Singapore, improve agricultural quality and productivity, and improve the range of produce.

Oh' Farms' mission:

1. To bring to their consumers premium-grade hydroponics produce that are pesticide-free and of high nutritional value so as to maximize its benefits towards healthy living
2. To promote public awareness by providing assistance in advancing the knowledge of hydroponics technology to organizations and educational institutions around the world.

Oh' Farms' business model

1. B2C (direct-to-consumers and wholesale distribution): Oh' Farms' customers can purchase directly from the farm or at supermarkets
2. B2B (direct-to-business): Oh' Farm supplies to local corporations, including restaurants, hotels and hospitals (E.g. Four Seasons Hotel, Resort World Sentosa)

Oh' Farms' key business activities

1. Vegetable Farming: Cultivates a wide variety of pesticide-free local vegetables e.g. chinese cabbage
2. Contract Farming: Undertakes contract farming of high-value tropical vegetables and herbs for overseas importer
3. Knowledge Transfer: Assists clients in setting up a complete unit of a hydroponics farm, irrespective of size
4. Wholesale Distribution: Handles vegetables and herbal plants of foreign origins
5. Horticulture Hobbies: Assists community centres, social clubs, etc to promote hydroponics farming as a leisure and past-time hobby; Retails hydroponically-cultivated plants and flowers and gardening tools
6. Educational Farm Visits: Collaborates with schools to conduct educational tours to its farm

<u>Strengths</u>	<u>Weaknesses</u>
<ol style="list-style-type: none"> 1. Hydroponics (use of Dynamic Root Floating Technique): no pesticide and weeds, no soil-borne diseases, small quantities of fertilisers used, uniform distribution of nutrients 2. Diversified (e.g. import, knowledge transfer expertise) 3. High Quality: AVA's Good Agricultural Practice for Vegetable Farming (GAP-VF) Certification 4. Invest in research and development (e.g. automated irrigation systems, automated packaging systems) 	<ol style="list-style-type: none"> 1. Labour-intensive 2. Heavily dependent on land
<u>Opportunities</u>	<u>Threats</u>
<ol style="list-style-type: none"> 1. Initiatives by government to support and promote local produce 2. Need for urban food security in Singapore 3. Rising costs of imports 4. Initiatives by social groups to increase awareness amongst Singaporeans to purchase local produce 5. Technological advancement in agricultural methods 6. Increasing population in the world / Singapore 	<ol style="list-style-type: none"> 1. Many local and overseas competitors e.g. cheaper foreign-imported produce 2. Inability to own farmland in Singapore and vulnerability to redevelopment of farm-land for other purposes (e.g. housing) 3. Limited land space in Singapore 4. Rising costs of foreign labour in Singapore

Political

1. Increasing government support for local agricultural produce (e.g. AVA agricultural productivity fund, AVA's local-produce taskforce set up to create greater awareness and promote demand of key food items that have been grown, harvested or reared)

Economic

1. Rising costs in low-cost countries where Singapore imports produce from
2. Possibility of Agri-tourism

Social

1. Increasing awareness of benefits of hydroponics/local produce through e.g. social communities
2. "Locavorism", Increasing popularity of "grow your own produce"
3. Increasing population in the world including Singapore

Technological

1. More innovations to increase productivity of agriculture

Legal

1. Inability to own land in Singapore; leasing agreements

Environmental

1. Global warming/drastic weather climates which make it unfavourable for agriculture, resulting in food shortage
2. Limited land space in Singapore

The following table describes the implementation timeline for application for CDG:

Phase	Time	Implementation Plans	People In-charge
Phase 1 (Pre-application)	Week 1-3	<ol style="list-style-type: none"> 1. Confirmation of supportable area relevant to project (ensure that project has not commenced before application of CDG) 2. Finalise project proposal (not required for grant support of S\$30,000 or less), relevant proof of quotation for project cost items and consultant's proposal (if consultant is engaged) information 	Mr Yeok Keong (Executive Director)/ Ms Ai Ling (Project Manager)
	Week 3-5	<ol style="list-style-type: none"> 1. Prepare following documents required for submission of application: (1) Latest ACRA Search or Instant Information (\leq6 months old), (2) Latest Audited Financial Statements (\leq1 year old), (3) Project Proposal, (4) Relevant Proof of Quotation for project cost items, (4) Consultant's proposal if a consultant is engaged 2. Prepared quantitative impact and job creation indicators based on the last financial year and the projected 3-year figures from the year after the project is completed. 	Ms Ai Ling/ Ms Sally Tan (Accounts Executive)

The following table describes the implementation timeline for application for CDG:

Phase	Time	Implementation Plans	People In-charge
Phase 2 (Application)	Week 6	1. Submit application by logging on to the SPRING Grant Portal to submit online application (https://grantportal.spring.gov.sg/spring/pages/login.aspx)	Mr Yeok Keong
Phase 3 (Approval Process)	Week 7-10	1. Meet with SPRING Officer 2. Make adjustments to proposal (if any) 3. If approved, during project implementation period, to maintain proper project records 4. If not approved, appeal and make revisions to project proposal	Mr Yeok Keong/ Ms Ai Ling

The following table describes the implementation timeline for application for CDG:

Phase	Time	Implementation Plans	People In-charge
Phase 4A (Project Implementation: Procurement)	Week 11-12	1. Engage consultants/Capital purchases	Ms Ai Ling [oversee by: Mr Yeok Keong/ Mr Yao Teck (Financial Director)]
Phase 4B (Project Implementation: Pilot Testing)	Depends on project	1. Conduct Pilot Testing (2 greenhouses) <ul style="list-style-type: none"> •For Vertical Farming and Precision Farming : 1 month •For Aquaponics: 2 months 2. Collate Feedback and make adjustments (if necessary)	
Phase 4C (Project Implementation: Execution)	Depends on project	1. Implement project for subsequent greenhouses <ul style="list-style-type: none"> •For Vertical Farming: 2 month •For Precision Farming: 3 months •For Aquaponics: 8 months 	

The following table describes the implementation timeline for application for CDG:

Phase	Time	Implementation Plans	People Involved
Phase 5 (Claimant Process)	3 months or later (depends on date of completion)	<p>[Upon completion of project]</p> <ol style="list-style-type: none"> 1. Prepare required documents in Claim Submission Checklist (http://www.spring.gov.sg/Growing-Business/Grant/Documents/CDG_Claim_Submission_Checklist.pdf) for the Project Report template 2. Engage an auditor from SPRING's Pre-Qualified Panel to verify claim submission, unless expressly exempted by SPRING. 3. Log on to the SPRING Grant Portal and complete the claim submission online. 	Mr Yeok Keong/ Ms Ai Ling/ Ms Sally Tan

Feasibility Assessment

In assessing the level of success to attain technological innovations and productivity improvements, we can make reference to Qian Hu Fish Farm Trading. Qian Hu is Singapore's largest one-stop service provider ranging from farming, importing, exporting and distributing of ornamental fish. Last year, Qian Hu applied for SPRING CDG to develop a multi-tier automated recirculation fish tank system. Not only did the new system allow Qian Hu to double its farm fish holding capacity, the system also brought about significant cost savings as both the water consumption and manpower requirements were halved. In the face of economic uncertainty and consumer demand, these improvements have reduced Qian Hu's operating expenses, partially offsetting the fall in revenue from 2014. Given the extent of success in Qian Hu's automated system, there exists huge potential for Oh' Farms to reap significant cost-saving benefits by developing its business capabilities.



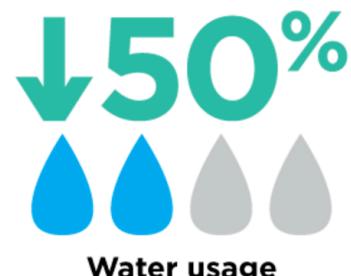
An Example of Successful Innovation: Qian Hu's Recirculation Fish Tank System



- Intensive
- Multi-tier
- Automated

x2

Fish-holding capacity within
the same land area



On 5 March 2016, as the interns of Oh' Farms, we had the opportunity to tour the farm with our visitors from Singapore Heart Foundation. The following slides show pictures taken during the visit



Figure A: Front gate of Oh Chin Huat Hydroponics Farm (Pte) Ltd

Stage 1: Germination

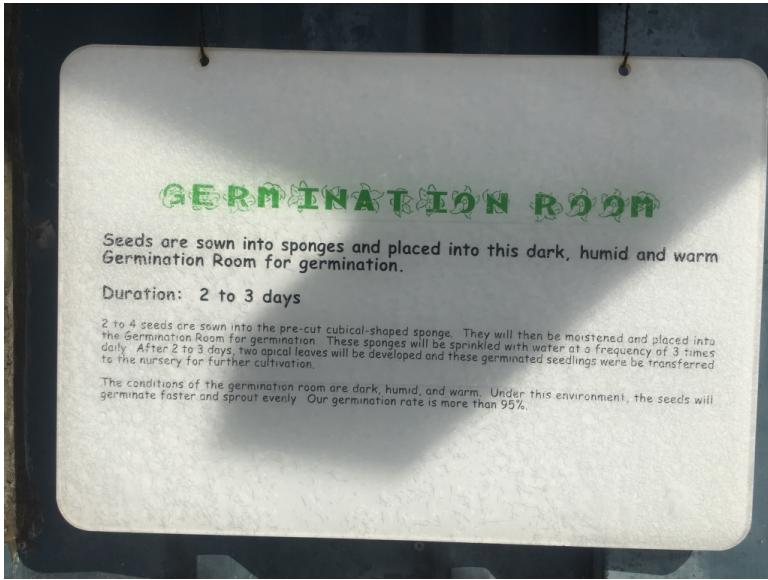


Figure B.1: Signage of Germination Room



Figure B.2: Germination Room

Stage 2: Nursery Greenhouse



Figure C.1: Irrigation Method



Figure C.2: Growth of seedlings

Stage 3: Transplanting

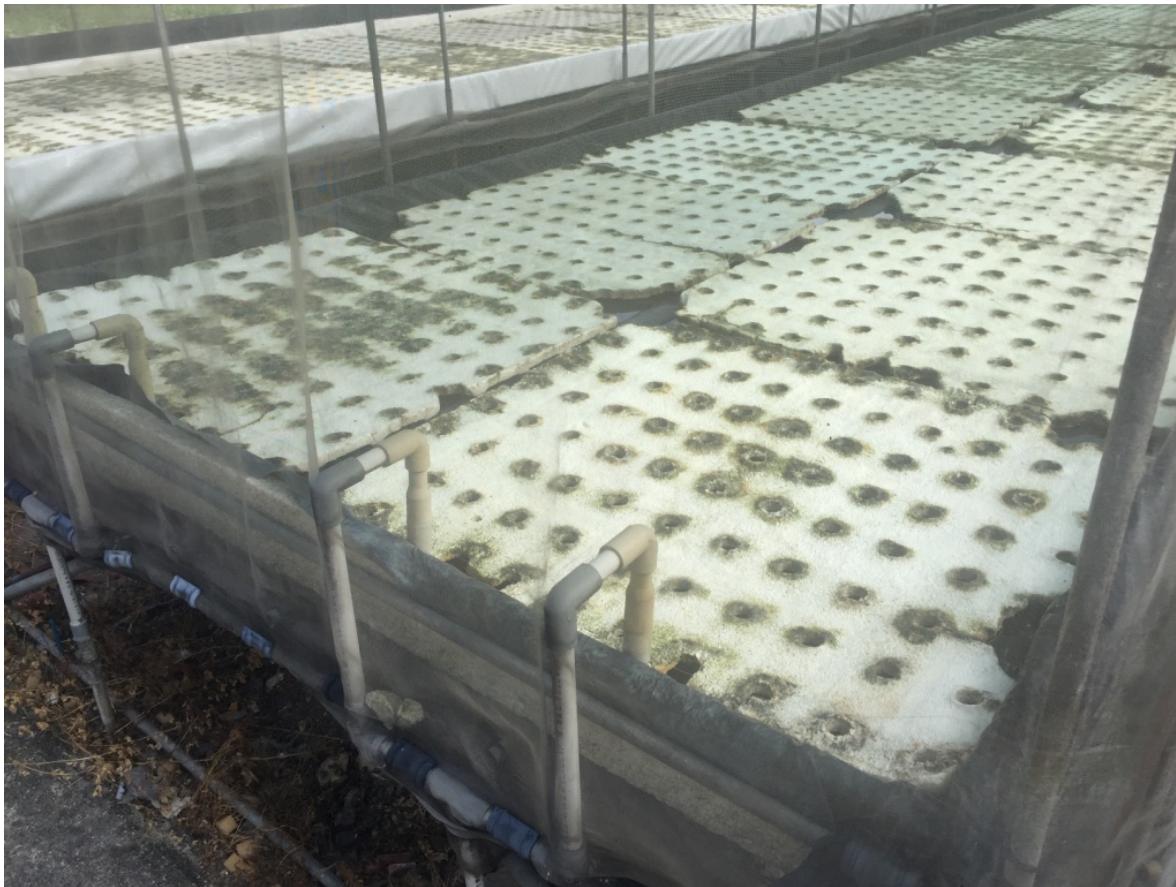


Figure D.1: Preparation of culture panel holes for transplant of seedlings

Stage 4: Growing



Figure E.1: Signage of Production Greenhouse



Figure E.2: Huangbin is observing the greenhouse



Figure E.3: Greenhouse

Stage 5: Harvesting and Packaging



Figure F.1 Cabbages that are ready for harvesting



Figure F.2 Packaging Counters



Figure F.3 Vegetables sorted

Hydroponics Herb Cultivation

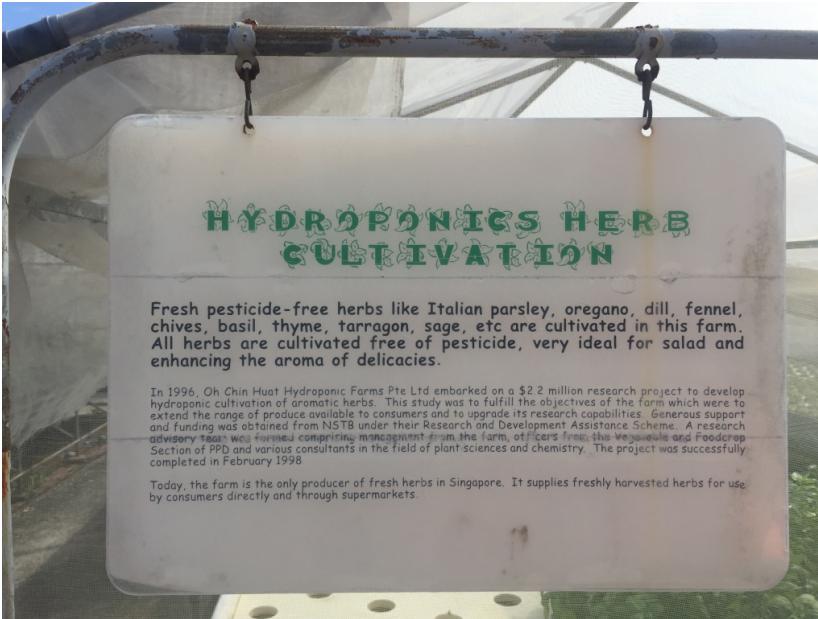


Figure G.1 Signage of Hydroponics Herb Cultivation



Figure G.2 Huangbin is smelling the herbs

Nutrient Mixing Centre and Plant Nutrient



Figure H.1: Signage 1 of Nutrient Mixing Centre and Plant Nutrient

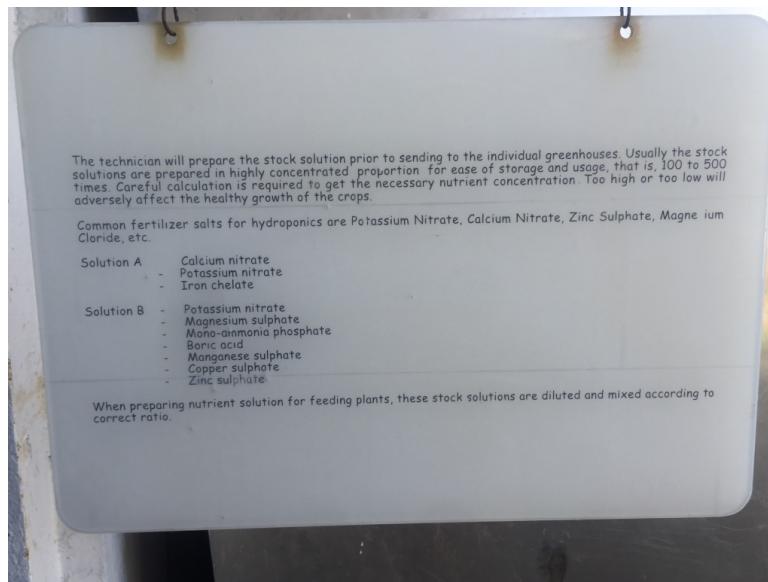


Figure H.2: Signage 2 of Nutrient Mixing Centre and Plant Nutrient



Figure H.3: Nutrient Mixing Centre

APPENDIX I: FARM TOUR

Tour Guide's Explanation



Figure I.1: Farm Tour



Figure I.2: Farm Tour at the Greenhouses



Figure I.3: Tour Guide Explaining at the Packaging Room

APPENDIX I: FARM TOUR

Other Farm Tour Pictures

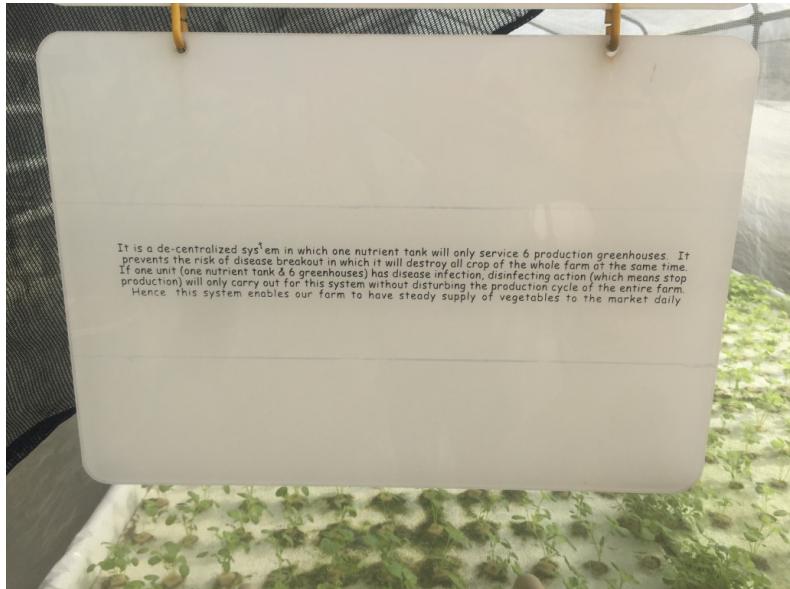


Figure G.1: Signage 3 of the Decentralisation of Nutrient Tank



Figure G.2: Chicken Coop



Figure G.3: Mini Aquaponics Model



Figure G.4: Rows of Greenhouses