

Growing More with Less: A Food Production Methodology in Land Scarce Singapore

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Changing landscapes of Singapore's Agriculture Industry

The narrative around agriculture in Singapore has been evolving over the past few decades.

The post-war period in the 1940s saw a rapid increase in Singapore's food production. The total amount of food produced then was more than sufficient for its population then of about 1 million – excess was exported to neighbouring countries as well for a few years after the war. With rapid urbanization, the total amount of land available for farming started to decrease from approximately 20% in the 1940s to the current 1%. As such, food production in Singapore has been seen as a huge challenge due to its land constraints and the very same challenge served as the impetus for the rise of a variety of innovative farming models, to contribute toward Singapore's food supply.

Citiponics, a contemporary urban farming venture, believes in turning underutilised areas into valuable places for food production. It sees the first commercial urban farm built on an underutilised multi-storey carpark rooftop (MSCP) in Singapore, growing pesticide-free leafy greens through their proprietary vertical growing technology. Their urban vertical farm is situated in the heart of Ang Mo Kio, connecting the neighbouring residents to the freshest harvests in town. Residents from towering residential blocks next to the MSCP also get to have an understanding of Citiponics' farming

process through an aerial view of the urban vertical farm. Their view of a grey parking space has been transformed into a "sea of varying greens" with the introduction of the vegetable production plant. Currently, the urban vertical farm at Ang Mo Kio is able to grow up to 3 to 4 tonnes of pesticide-free vegetables on a monthly basis, supplying to local supermarkets and restaurants.

Impact of Frugal Innovations

Established in 2015, Citiponics believe that sustainable high-tech farming process should be simple to operate and widely accessible, even for those who do not have a background in agriculture. Prior to starting the commercial urban vertical farm in Ang Mo Kio, Citiponics introduced the concept of vertical farming through the form of a community farm at a MSCP rooftop in Taman Jurong as a form of pilot testing in 2016. Through the experiences it gained from years of researching and prototyping at Taman Jurong, it worked on improving its farming technology to ensure that it is able to grow safe produce productively and efficiently, without any forms of disturbance to the neighbouring communities.

They developed their vertical growing technology, Aqua Organic System (AOS) with frugal innovation in mind. Frugal innovations are known to be innovations which are created with reduced complexity and costs. They have simplified farming

1. Citiponics currently specializes in growing pesticide-free Georgina Lettuce, its unique in-house crossbred lettuce mix.

2. Citiponics Urban Vertical Farm @ Ang Mo Kio officially launched in April 2019. It is the first commercial farm to be built on an underutilised multi-storey carpark rooftop. Currently, it grows pesticide-free produce using its proprietary zero-waste farming technology - Aqua Organic System.



When designing a farming system around frugal innovation concept, it means developing a system which allows farmers to grow more with less laborious work.

to three simple steps - seeding, transplanting and harvesting. By introducing commercial urban farming in the neighbourhoods and reducing the complexity of farming, they are able to provide job opportunities and involve nearby residents in local food production. One of the ways they are doing so is through the employment of senior citizens from nearby community homes to help them with their farm maintenance, allowing them to contribute to the food production ecosystem as well. This urban vertical farm in their community has, in addition, provided them the opportunity to earn a living. Mr. Ho, one of the senior citizens employed by Citiponics, commented that he sees working at the farm as a form of exercise, allowing him to maintain his health as he tends to the plants at the farm.

At the core of frugal innovation is the concept of doing more with less. When designing a farming system around this concept, it also means developing a system which allows farmers to grow more with less laborious work. With such development, it can result in a switch of people's impression of the farming industry in general - from one that is backbreaking, strenuous and dirty, to one that is less arduous, simple and clean. With

the help of automation and precision farming methodologies, Citiponics' urban farmers no longer have to work under the hot sun for extended hours. In fact, farmers get to choose their working hours. This is a great benefit for the senior citizens as they can choose to farm in the evening, when the weather is more pleasant. The urban farmers also no longer need to spend long hours at the farm as they get to work in short periods of two to three hours window. Even with the shortened working hours, the urban vertical farm still gets to grow between three to four tonnes of pesticide-free vegetables every month. When farming is kept simple, easy-to-operate and clean, they greatly reduce the onset of agriculture occupational-related health issues such as lung and skin illnesses which are associated to prolonged exposure to dust, chemical use and sun.


Apart from increased productivity and simplified operations, growing more with less is also about reducing the resources required for food production. The world's population is expected to increase by 2 billion people in the next 30 years, from 7.7 billion to 9.7 billion in 2050. With such a rapid growth of population, the agriculture industry needs to relook and rethink the way food is produced. Traditional farming methods, usually done without controlled usage of soil, water and pesticides, have resulted in several negative impacts on the environment such as soil degradation, water pollution and creation of agriculture wastes. Farming companies can no longer afford to grow more with more, as more food production results in more damages to our environment. More sustainable methods of food

production have to be in place to reduce the environmental impact of agriculture – to grow more healthy produce with less resources. One way in which Citiponics is enhancing its sustainable farming process is through growing pesticide-free leafy greens with minimal electricity and water consumption. As its AOS vertical growing technology is a close-looped system, it is able to reduce water consumption through harvesting of rainwater and control the water usage without any unnecessary wastages brought about by water runoff. By growing vegetables on underutilised-rooftop and strict adherence to a zero-pesticide growing method, this also means that the water and soil will not be affected by chemical-related pollution. Due to the staggered nature of growing tubings, the system is also able to enhance the efficiency of electricity consumption with the help of gravity. The total monthly electricity and water consumption for the approximately 1800m² plot is comparable to the total monthly consumption of five five-roomed housing flats.

Importance of Sustainable Farming for Our Future Generations

To tackle the issue of agriculture wastages, Citiponics adopts a zero-waste farming method. Every component in the AOS vertical farming system is reusable and recyclable. It currently grows pesticide-free vegetables using soilless culture method, the growing medium is made up of fire-clay pebbles which are specifically customized to meet the system's growing requirements. Upon every harvest, the pebbles are removed and washed before being reused for the next cycle of vegetable production. As such, it results in a circular process where zero waste is generated even though its production yield is four to seven times higher than traditional farming methods per square meter. Through such sustainable farming process, Citiponics hopes to grow more to contribute to the enhancement of global food resilience without compromising on the health of our planet for future generations.

The vision of a self-sufficient nation is not that distant, when more industry players work together to turn agricultural challenges in

Singapore into opportunities for alternative farming methods. Moving forward, it hopes to continuously keep sustainability and accessibility at the core of its farming processes, reinforcing its ethos of growing more with less. Future plans will be spent on possible expansion to other underutilized rooftop areas, continuous research and design on production of other crop varieties as well as development of agritech education for educational institutions. With the concept of creating farms which are near residential areas, it has shown to raise the awareness on agricultural topics such as food safety, food security, waste elimination through the concept of circular economy and climate change reversal - promoting intergenerational bonding for the nearby residents through the use of urban farming as a conversational starter. This is the benefit of growing vegetables right in the heart of the community - residents are able to eat safe and healthy produce that are grown by the community, for the community. 



3-5. Apart from Georgina Lettuces, Citiponics has been growing other varieties of vegetable species such as Crunchy Cai Xin and Sweet Basil as well.