

AVA VISION

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FUTURE OF FARMING

Singapore's agriculture sector needs to embrace technologies or innovations that can help to achieve quantum leaps in productivity.



■ Dr Koh at a hi-tech indoor farm in Japan. He led a study trip there in July 2016, where Singapore farmers and officials learned the various factors that make indoor farming commercially viable.

With land and labour constraints, and imminent climate change, the approach to food production needs to transform and be more creative. Farmers need to leverage on technology and innovation. Our future in food security lies in a modern and technologically-savvy farm sector that is fuelled by agricultural professionals, or 'agri-technologists' and 'agri-specialists'.

"We should envision 'Three National Food Baskets'," said Dr Koh Poh Koon, Minister of State for National Development and Trade & Industry, said in his Parliament Budget Speech on 7 March 2017. These three baskets refer to (1) our diversified sources of import, (2) internationalisation – helping local farms and food companies venture abroad to seek opportunities, and (3) local production.

On local production, we must recognise that farming today is no longer just toiling on a field under the hot sun. Modern farming should use technology, science, engineering and R&D to improve yields and operations. "We envision farms of the future will make use of integrated vertical and indoor systems, automation and robotics. They will be highly intensive and productive, and operate on minimal manpower," Dr Koh said in an earlier Parliament Committee of Supply Debate Speech in 2016.

In recent years, a new breed of progressive farmers has emerged. Through them, we can see our envisioned future taking shape.

"We envision farms will make use of integrated vertical and indoor systems, automation and robots."

Dr Koh Poh Koon
Minister of State for
National Development
and Trade & Industry



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■ At Panasonic, indoor vertical farming makes climate control possible. Output is multiplied as the space and essential conditions for plant growth can be optimised. (Photo: Panasonic)

Sky Greens

Sky Greens, for example, has become the poster child for innovative farming.

Sky Greens' vertical vegetable farming system is engineered to produce at least five times more leafy greens than conventional farms, with the ability to support farming on non-arable land. The system features tall aluminium frames that contain planting troughs, which are rotated by a water-pulley system. This technology was the result of a successful R&D collaboration with the Agri-Food & Veterinary Authority (AVA) of Singapore, a partnership that led to the realisation of Singapore's first commercial vertical farm.

Sky Greens has also internationalised by setting up operations in China. Work is underway to deploy their vertical farming towers on more than 20 hectares of land on Hainan Island.

Panasonic Factory Solutions Asia Pacific

Panasonic, an unconventional addition to the local agriculture scene, takes vertical farming indoors. The Japanese electrical appliance maker now owns the first indoor farm licensed by AVA.

Panasonic uses artificial lighting to cultivate vegetables in a multi-tiered system that is housed in climate-controlled environments. This space-saving and weatherproof method naturally keeps pests out and allows temperate plants to be cultivated. AVA worked closely with Panasonic and supported them through co-funding, providing consultations on the import of fertilisers, seeds and soil, as well as sharing technical expertise on indoor cultivation systems.

“Our modern farmers should be more appropriately called ‘agri-technologists’ or ‘agri-specialists’. We will need a generation of ‘agri-specialists’ with multi-disciplinary expertise... (Farming) will no longer just be about toiling in the sun doing manual labour but also about engineering, info-communications technology, entrepreneurship, and R&D.”

Dr Koh Poh Koon
Parliament Budget Speech
(7 March 2017)

Swee Chioh Fishery

The indoor farming concept and technology can also be extended to fish farming. Swee Chioh Fishery is one farm that has started indoor farming using the recirculating aquaculture system (RAS). AVA worked with the hatchery to set up the RAS and develop accompanying culture protocols for large-scale indoor seabass larviculture. As a result, a high level of bio-security can be maintained by reusing treated water. This is an improvement over traditional flow-through systems or outdoor pond cultures, which are susceptible to disease outbreaks and the vagaries of the weather. As a result, Swee Chioh Fishery was able to achieve consistent hatchery production with good farm management practices.

Metropolitan Fishery Group

Another example of a progressive farm is Metropolitan Fishery Group (MFG), which has incorporated cost-effective technology in its coastal fish farms. Equipped with a real-time water quality monitoring system powered by solar energy, MFG has seen a reduction in operation costs and increased productivity gains. In the event of impending poor water conditions, the system will automatically send out SMS alerts so that early precautions can be taken to safeguard fish stocks. Supported by AVA, MFG also embarked on an R&D project that successfully raised farming intensity by developing optimal feeding protocols, improving fish stocking density, and increasing fish survival rate.

Seng Choon Farm

Chicken egg producer Seng Choon also transformed and automated its processes to raise productivity. With AVA’s support, Seng Choon introduced a robot cleaner to automatically clean the chicken layer houses, which resulted in manpower savings. Seng Choon continued to employ mechanisation over the years. Now, even the egg collection and manure removal processes are automated with the help of conveyor belt systems. Automatic nipple drinkers also ensure adequate water supply at all times. Within a year, Seng Choon’s production rose by 10 per cent to 450,000 eggs per day.



■ *With the robot cleaner, workers who were previously required to clean up manually can now be despatched to work in other areas of the farm.*

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■ At Sky Greens, leafy vegetables are grown vertically in 9-metre-tall towers.

AVA Will Walk the Transformation Journey with Farmers

These ‘agri-technologists’ are forerunners in Singapore’s agri-food production but it takes a concerted effort to bolster a nation’s food security. The industry needs to collectively embrace technology and break new grounds.

With the government and industry’s strong commitment to agricultural R&D, Singapore can carve a niche in urban food solutions by establishing itself as a living lab for food production technologies. AVA is committed to partnering farmers in adopting modern practices and embracing technology as a multiplier to do more with less. A few new initiatives have been rolled out.

AVA strongly urges farmers to tap into the Agriculture Productivity Fund (APF) to modernise, and invest in innovative technologies and advanced farming systems. From April 2017, the APF will disburse up to 30 percent of the approved funding quantum upfront, to facilitate

the adoption of technology. This will complement our move to increase the tenure of farm lands to 20 year leases, from the previous 10 plus 10, based on industry feedback.

To enable our local farmers to play an active role in transforming our farming sector, we formed an Industry Consultation Panel (ICP) early this year. Practitioners, researchers, academics, and policy makers will work together to innovate, co-create, and transform our farming sector through technology.

Through discussions involving the ICP and farmers, we developed a Farm Transformation Map, to guide the transformation of our farming sector in four areas — physical space, innovation, people development, and the larger broad ecosystem.

AVA will also adopt a new ‘account management’ approach for our farms. Each farm will now have a dedicated account manager to advise them on business development, technology adoption, and financial assistance. AVA wants to help our farmers succeed. For farmers that are willing and able to transform, AVA will walk this journey with them.

While AVA works with local farmers to boost production and capability, we also encourage consumers to support the local farming industry by buying local produce. Doing so will support the business of our local farmers and spur them to raise their production levels to meet increased demand, thereby strengthening our food security.



Scan to read more about the Farm Transformation Map that Dr Koh introduced in his Parliament Budget Speech on 7 March 2017.

MARRYING HERITAGE AND TECHNOLOGY

With close to 50 years' experience in rearing ornamental fish, Apollo Aquaculture Group continues to reinvent itself. With the help of technology, it has diversified into cultivating food fish and recently entered a joint venture to set up a farm in Brunei.



■ At the ground-breaking ceremony in Brunei: (L-R) Chairman of KR Apollo Sdn Bhd, Minister of State for National Development and Trade & Industry, Bruneian Minister of Primary Resources and Tourism, and Apollo Aquaculture Group CEO.

Apollo Aquaculture Group started its ornamental fish business in 1969, a decade in Singapore's history when the ornamental/aquarium fish industry was beginning to thrive. Today, Singapore is the world's top exporting country of ornamental fish, with exports amounting to almost \$76 million in 2013. Among the 300-odd farms devoted to the breeding of aquarium fish in the 1960s, Apollo Aquaculture Group is among the few that still stands strong, exporting millions of dollars' worth of ornamental fish yearly.

Besides continuing to play a part in putting Singapore on the world map of ornamental fish export, Apollo Aquaculture Group has also diversified into farming food-fish and crustaceans. Group CEO Mr Eric Ng inherited the business from his father in 2009. Under his stewardship, Apollo Aquaculture Group currently produces groupers and shrimps, contributing to Singapore's food security.

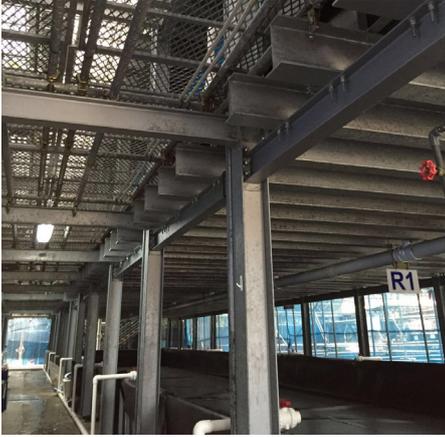
Mr Ng said, "The fundamentals for farming freshwater and marine fish

are similar. It's about good water quality, nutrition, and husbandry practices".

Despite having strong fundamentals in aquaculture, the transition from farming ornamental fish to food-fish was not an easy one. Not only did Mr Ng have to bear with naysayers, he also had to be patient and industrious in conducting experiments and pilots. For more than eight years, Mr Ng and his team conducted research on aquaculture technologies, studied the compatibility of the aquatic organisms, and collected trial data.

To Mr Ng, technology is clearly the way to go in the "blue revolution" of aquaculture. "Although Singapore is a small nation and land space is a major constraint for aquaculture activities, we have turned to technologies to improve our manpower and production productivity. Innovation is key for us to stay relevant in the industry and it is this drive that keeps us moving forward."

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■ Level 1 of the multi-tier recirculating aquaculture system, which currently stacks up to 3 levels at Apollo Aquaculture Group's farm in Lim Chu Kang.



■ The water filtration and monitoring system, part of the multi-tier recirculating aquaculture system.

Vertical Fish Farming: 'AquaDeck'

A signature of Apollo Aquaculture Group innovation, the 'AquaDeck' technology was conceptualised for the vertical stacking of ornamental fish tanks indoors, on land. AquaDeck's innovation uses Japanese and German technologies and was designed to suit our tropical climate.

AquaDeck features three overlaying tiers of aquaculture tanks, water recirculation systems, and automatic underwater sensors that allow the remote control of measure parameters like temperature and pH, among others. Now, this technology is further expanded to support the farming of food fish, even beyond Singapore's shores.

Beyond our Shores

Apollo Aquaculture Group will be setting up an indoor vertical fish farm in Brunei, in a joint venture with a Bruneian partner. The farm will produce grouper fish, shrimps, and ornamental fish using the AquaDeck and multi-tier recirculating aquaculture system.

Farming operations are expected to begin in mid-2017. The 12-hectare site is slated to be fully developed by 2022. By that time, the yield will reach 5,000 tonnes per year, of which 95 per cent will be food fish.

A ground-breaking ceremony was held on 13 February 2017, graced by Bruneian Minister of Primary Resources and Tourism Dato Seri Setia Awang Haji Ali bin Haji Apong and the Minister of State for National Development & Trade and Industry Dr Koh Poh Koon.

This new farm is in line with Mr Ng's vision for the future of aquaculture. "Fish farming in the 21st century is very modernised, and technological advances will bring the aquaculture industry to new heights. Technologies should be implemented to ease daily routines such as feeding, water change and harvesting. With technology, farming can be done with a smaller water footprint."

He added, "Most importantly, the fish we produce must be free from antibiotics and hormones, and be safe for consumption."



Scan to watch a video of the ground-breaking ceremony in Brunei.

Features of Apollo's Multi-tier Recirculating Aquaculture System

- **High efficiency in recycling water:** Recirculation system uses less water, maintains consistent water quality, and reduces the discharge of waste water.
- **Optimised for high stocking density and biological loading:** Multi-tier tanks are energy efficient and cost effective.
- **Compartmentalised system:** Can contain and isolate disease outbreak and reduce losses.
- **Use of microbes, ozone, and nano-technology in fish health management:** Reduces dependency on antibiotics and use of chemicals.
- **Barcode tracking system:** Enables fish health traceability and inventory control.

NEW DOG LICENSING RULES TO ENHANCE TRACEABILITY

Pet dogs are to be licensed before sale, with effect from 1 March 2017. This is a step towards enhancing animal welfare and safeguarding animal health in Singapore.

Revisions have been made to the Animals and Birds (Dog Licensing and Control) Rules. From 1 March 2017, all dogs intended for sale by pet businesses must be licensed before they are sold.

When a dog is sold, pet businesses are required to transfer the ownership of the dog to the new owner. This can be done via AVA's online licensing platform – Pet Animal Licensing System (PALS) at <https://pals.ava.gov.sg>.

Individual dog licensees who sell or give away their dogs are to inform AVA that they are no longer keeping the animals. They are required to provide AVA with the particulars of the dog's new owner. This can also be done via PALS.

These revisions will improve the traceability of pet dogs in Singapore, especially in the event of a disease outbreak such as rabies. The revisions will also discourage pet abandonment and help AVA to reunite lost dogs with their owners.

To make it more convenient for pet businesses to observe the new licensing requirements, AVA will allow multiple dogs intended for sale to be registered under a single 'Group' license. The licensing fees will be tiered according to the maximum number of dogs intended for sale.

Working with the Industry

These revisions took into consideration feedback from the pet businesses and will improve traceability of all pet dogs, starting from the source of the dogs.

Since November 2016, AVA has been working with pet businesses to prepare them for the revision.

"Our stakeholders are receptive to and are ready for the revisions. Some of the businesses have said that the revision will help to reduce paper work and help them to keep track of their sources, which is important for disease control," said Ms Jessica Kwok, Group Director for Animal Management, AVA.



■ From 1 March 2017, all dogs intended for sale by pet businesses must be licensed before they are sold. (Photo: annaspyrka)



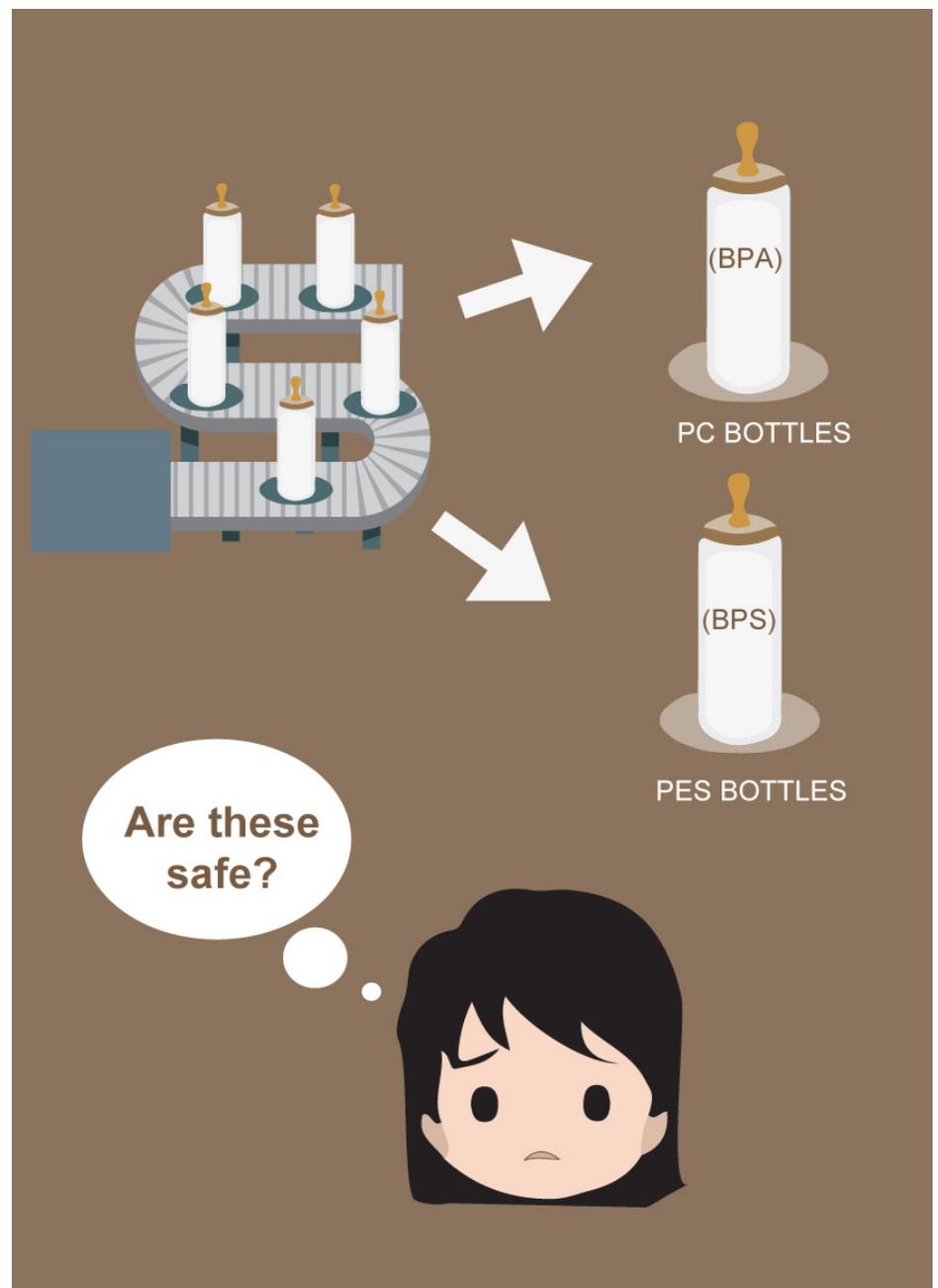
Scan to read full press release.

SAFETY OF PLASTIC BABY BOTTLES

As part of AVA's food safety programme, laboratory assessments are conducted on various food-contact materials. Among the many materials we test on is the plastic baby feeding bottle.

In the past, baby feeding bottles were made from Polycarbonate (PC) plastic due to its tough and transparent properties. PC plastic contains bisphenol-A (BPA), a compound which some researches claim is detrimental to human health. Concerns were raised over the migration of BPA from PC plastic to the milk in the bottles.

Today, instead of PC plastic, baby feeding bottles are made using Polyethersulfone (PES) plastic, which does not contain BPA. However, another compound, bisphenol-S (BPS), is present in PES plastic and some have concerns over the safety of BPS as well.



■ BPA and BPS are used in the manufacturing of PC and PES plastic bottles, respectively.

PES PLASTIC BOTTLES ARE TESTED TO BE SAFE



AVA tested PES baby feeding bottle samples to analyse whether there is any migration of BPS from the bottles. The results showed that there was no migration of BPS, indicating that to-date, there are **no health concerns, even from repetitive use of these bottles.**



Manufacturers and traders of food-contact articles are responsible for ensuring that the articles they buy or sell are safe. There should be no migration of any harmful substances into the food stored in these food-contact articles. All food-contact materials must meet the requirements of Singapore's Food Regulations.

ADVICE TO CONSUMERS



Do not heat PES baby feeding bottles in microwave ovens (unless the bottles are labelled as 'microwave-safe').



Cool boiling water until lukewarm in a non-PES container before transferring water into PES baby feeding bottles.



Do not pour hot boiling water into PES baby feeding bottles.



Parents who are still concerned about using PES baby feeding bottles can consider alternatives such as glass bottles.



DOCTOR FOR FARM ANIMALS

Dr Han Zi Yang is among AVA's veterinarians who are at the forefront of detecting animal diseases and ensuring that food from our farms is safe for consumption.



Q. What do you do at work?

Dr Han Zi Yang: I am a veterinarian with the Surveillance and Inspection Department of the Agri Establishment Regulation Group.

My team plans surveillance programmes for Singapore's animal farms. This involves going to farms on land and sea to check on the health of animals, and collecting samples for laboratory testing. These could be faecal, rectal, or blood samples, among others.

Even when we are not carrying out inspection work, we can still be found in farms. When farmers find that their animals are not in the best of health, they will enlist our help to check on the livestock. Occasionally, I will also assist my colleagues in the Veterinary Pathology Section in conducting post-mortem examinations in AVA's Animal Health Laboratory.

How does the work you do contribute to the well-being and interests of AVA and/or Singapore?

Updated and effective policies, coupled with regular monitoring, can help us to detect diseases early. This is important as it prevents the spread of diseases and safeguards the health of our animals. In turn, this also means that the food produced by our farms is safe for consumption.

Share some lesser-known facts about your work.

Many people may not know that we have quite a variety of animal and plant farms in Singapore and these are a crucial component in our local food supply. Besides cattle farms and chicken egg farms, there are quail farms, a goat farm, and even a crocodile farm. We also have ornamental fish farms and more than a hundred coastal fish farms.

What do you find enjoyable/satisfying about your work?

I feel I am doing something meaningful, knowing that my team and I are at the forefront of detecting animal diseases and ensuring that food from our farms is safe for consumption. Being a young veterinarian, gaining the recognition of the farmers for my knowledge and competency is also satisfying to me.



■ Carrying out checks at a bullfrog farm.

What is the most memorable experience you have had in this job?

As a result of the fish mortality crisis in 2015, many coastal fish farmers lost their fish stock overnight. My team spent part of our Chinese New Year out on the fish farms together with our colleagues from the Technology & Industry Development Group and the Laboratory Group. We dedicated ourselves to the task and helped our farmers to dispose of the carcasses as quickly as we could.

It was a gesture much appreciated by the farmers, as we lifted some burden off their shoulders during the ordeal. We had to forego our Chinese New Year holidays but the gratitude received from the farmers was well-worth it.

What are the main challenges you face at work and how do you overcome them?

Sometimes, our farmers do not follow rules and regulations in their farming practices and I will need to carry out enforcement work.

An example of incorrect farming practices could be the illegal storage of non-farming items (e.g. construction equipment) on the farm. It's pretty challenging trying to strike a balance between building relationships with the farmers and doing what is right.

Instead of merely faulting them, it is also important to educate our farmers the reasons behind enforcing these rules and regulations. Ultimately, our job is to facilitate agri-trade and to ensure the health and well-being of the animals.



■ Dr Han (right) helping out in disease investigation during a post-mortem examination.



RESPONSIBLE PET OWNERSHIP EVENT: HAPPY PETS HAPPY 'HOOD



A happy neighbourhood is one where residents and pets share public spaces and get along amicably. Pet owners and non-owners alike have a part to play in creating a harmonious living environment. To encourage pet owners to be responsible and considerate, and to educate non-animal lovers on how to manage their encounters with pets, AVA organised the *Happy Pets Happy 'Hood* event between 5 and 11 December 2016.

This was the first week-long responsible pet ownership event hosted by AVA. Compared to two- or three-day events, the longer duration allowed residents to explore various segments of the event on different days, or to return to the event with more questions after their first visit.



More than 12,000 visitors experienced the event's stage programmes (such as dog obedience demonstrations and ventriloquist performances), interactive pet care gallery and handicraft workshop activities. At the same time, AVA invited vet volunteers to provide free pet health checks on 10 and 11 December 2016. Animal welfare groups*, Pet Lovers Centre, and Clubpets magazine also participated as exhibitors.



Scan to watch a video of the educational moments captured at the event.



Scan to watch vet volunteers and adorable pets in action during the free pet health check.

In conjunction with *Happy Pets Happy 'Hood*, Cat Welfare Society organised a movie screening to raise funds for its causes.

**Action for Singapore Dogs, Animal Lovers League, Cat Welfare Society, Causes for Animals Singapore, Mercylight, Noah's Ark CARES, Purely Adoptions, SOSD Singapore, Society for the Prevention of Cruelty to Animals Singapore*

LOCAL PRODUCE MEETS LOCAL TALENTS

Farms in Singapore produce a measure of leafy vegetables, chicken eggs, and fish that supplements our food supply. These fresh and safe local ingredients were recently featured in one of Singapore's movies, *Take 2*.

To showcase our home-grown vegetables, eggs, and fish, Culinary & Catering Management students from Temasek Polytechnic specially created a dish, *Three Treasures Stew*, for this movie. Download this famous recipe now (in English and Chinese) from <http://bit.ly/3treasurestew>.



Scan to view a photo montage of Dr Koh Poh Koon and local farmers at the gala premiere of the movie on 25 January 2017.



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