

BIOTECH

Plants, pathogens and perseverance

BY JENNIFER JACOBS

When Ivan Hoh and Yap Soon Joo graduated from university in the mid-2000s, having bought into the government's avowed interest in biotechnology, they realised that it had been a lot of hot air.

"When we took up biotech at university, there was the promise of BioValley, exciting technologies, exciting science and wonderful careers. Little did we know that when we graduated, there would be no jobs," says Hoh, CEO of Codon Genomics Sdn Bhd, in an interview at its headquarters in Balakong, Selangor.

He and Yap, the company's executive director for science and technology, graduated with a bachelor's degree in molecular bioscience from Universiti Kebangsaan Malaysia in 2008. "The country was not ready for this new technology. At that point, there was no ecosystem for biotech," says Hoh.

When there is nothing available in your area of expertise, the conventional wisdom is to do something else. But they decided to start a biotech company, and one that leveraged data in a more intelligent way.

"We were part of Malaysia's first genome project, in collaboration with the UK, and realised that data would be the next currency driving the world. That is why we started a company dealing in data. Today, we call ourselves a biological data company," says Hoh.

The company actually started with three people,

but the third partner has since exited the business.

As with every start-up story, especially one in a difficult and little-known sector, their path was not strewn with roses. "We started with RM30,000 of our own money. I sold my car and this was as much money as we could put together," says Hoh.

The company's first purchase was a server and its first office was in Puchong. "The rent for the office was only RM800 a month because it was above a pub and near a South African church. Every morning at 10am, the people in the church would sing, dance and bang on the drums. And at 7pm, the whole place would go boom, boom, boom with music from the pub. But it was the cheapest place we could find," Hoh chuckles.

Things were not easy. They started the business with the idea of analysing people's DNA, but the market was not ready for this. So, they pivoted to agriculture and pathogens.

"We realised that the future was not about generating data but analysing it. So, we concentrated on analytics," says Hoh.

"We have worked on such interesting things, from an organism that is smaller than a virus that devastated the Australian coconut industry in the 1970s to discovering extensive drug-resistant tuberculosis in Malaysia to working with collaborators to detect Brucella in non-pasteurised milk."

The company works on highly classified projects behind the scenes so he cannot talk about them. "These are some of the milder ones. Our collaborators are asking us to help them work on everything from viruses and

pathogens to healthcare and now agriculture," he says.

Codon Genomics business development and marketing executive Minn Yap says, "We have been around for nine years and have very experienced people here — molecular biologists, bio-informaticians, software engineers ... you have to be very experienced to do what we are doing."

The company is now evolving towards applications, she adds. "We do not only deliver solutions to Malaysia. Our market is global. We deliver solutions to countries such as the US, the UK, Saudi Arabia and recently, Sweden."

"We have already worked on more than 150 research projects with research institutes, universities and others. We have conducted more than 30 scientific seminars and workshops and published 35 papers in really good journals in the past seven years."

Codon Genomics has started building its own applications and fungal databases such as Ark Gene and Circle Plus. "We have built software that is now being used by industry leaders," says Minn.

Hoh cuts in, "In oil palm, one of the biggest pathogens is ganoderma [boninense]. Our database tracks all the new emergence of this so we can tackle it. Not only that, we can use the DNA information to detect what strain of ganoderma this is. The Malaysian Palm Oil Board is using this to monitor diseases."

BUILDING KNOWLEDGE

Minn says that after this, the company started building what she calls "knowledge". "We have genomics for oil



palm breeding. So, we got to learn more about this crop. And then, we developed the GanoID post-pathogen interaction that Ivan [Hoh] was talking about. Now, in 2019, we are reading for a solution for oil palm because we know there is an ongoing crisis with the crop and we want a solution for that."

Hoh says, "The crisis is multi-faceted. I think it is a reputation crisis. That is why the sustainability factor comes in. The palm oil industry is actually thriving. By 2050, the demand for palm oil will quadruple from what it is today. With the world's population set to increase to nine billion by that time, there is no doubt that the demand will grow."

"The only problem is the branding. The [anti-palm oil] lobbyists are advocating for other oil-producing crops such as soybean and rapeseed because a lot of these are planted in the US and Europe while 85% of the world's palm oil comes from Malaysia and Indonesia. So, they are using marketing and branding to halt the influence of palm oil. That is the biggest problem."

But despite the fierce smear campaign, he does not think the palm oil industry will be badly affected. "It will continue to thrive, but we cannot do things the way we did 10 years ago. We have to tackle this using the heart and mind through the word 'sustainability,'" he says.

"People need to know that oil palm is grown sustainably and we think this can be achieved through science and the intelligent use of data. This is where we come in."

Codon Genomics' senior application scientist Dr Lee Wei Kang then delivers a short presentation, talking about the company's newly developed platform, the oil palm crop improvement Agrinome. Oil palm is the most efficient and productive oil crop because it produces more oil per hectare, compared with sunflower, soybean and canola oil, and it can remain productive

for 25 to 30 years, he points out.

It has been widely used in food, cosmetics, biofuels and pharmaceuticals. And each person consumes up to 8kg of palm oil a year, he adds. In Malaysia, some 5.8 million hectares have been planted with 780 million oil palm trees, which works out to about 25 trees for every person in the country.

"It takes 8ha of soybean to give you the equivalent of 1ha of palm oil. If you replaced palm oil with soybean, you would need to plant 160 million acres. Which would be more sustainable?" says Hoh.

But oil palm is a much embattled crop. First, there has been controversy about forest land being cleared to make way for plantations. Now, the government has committed to limiting the land available for palm oil cultivation. In the meantime, the demand continues to grow, which means that plantations will have to produce more with less land, says Lee.

If this were not enough, climate change and what is known as abiotic stress (stress to the plant that occurs naturally as a result of climate change such as less rainfall and changes in soil chemistry and nutrients) and biotic stress (caused by animals, insects and other pests) affect fresh fruit bunch production and the trees. Finally, there are the wild price fluctuations of the commodity.

How does Codon Genomics help with this? "Using data, we can come up with a new breed that requires less water. In the future, we will be able to tailor-make the trees to suit different situations, soil conditions and weather. We could improve yields by 10% through better genetic materials. This industry is worth more than RM60 million. The extra money can be reinvested in marketing, creating better forests and fostering sustainable management for life," says Lee.

The company can also help in seed production. "The world produces up to 200 million seeds a year because there is a lot of demand for planting and the replanting programme is up 10% to 20% of the crops every year. We need high quality oil palm seeds to sustain the industry. We can contribute our knowledge, data and technology to create some really useful applications," he says.

USING TECH FOR AGRICULTURAL RESEARCH
That is why Codon Genomics came up with Agrinome — a new cloud-based platform that takes IT into agricultural research — to help achieve a more sustainable oil palm industry that can produce more with less, says Lee. "Our mission is to provide a solution to enable oil palm plantations achieve higher efficiency and scalability and provide them with a level of automation in their practices."

It begins with the basics. "Our strategy starts with improving the very core of the plant, which is the breeding materials. This crop can stay up for 5 to 30 years, so it is very important to have good starting material with better resistance to pests and biotic stress which can, at the same time, produce a maximum yield," he says.

The seed production market is worth RM500 million a year and the market needs 100 million to 200 million seeds per year, says Hoh. "We do not need everybody to buy our software. We deploy it to the seed producers, such as research institutes and the downstream, smallholders can actually benefit from these seeds."

Lee says Codon Genomics applies its knowledge, data and technology to improve the seeds at the genetics selection level. It focuses on two parts — first, it does DNA sequencing to find out why some oil palm trees have high yields while others have lower yields.

"Our R&D objective is to develop good traits. Let's say the father tree has high yields and the mother tree is resistant to pathogens. We breed the two so that the child has both traits," he says.

"We have the seed production step as well as tissue culture cloning. These two procedures help propagate good starting material and we amplify and produce the seeds in large quantities."

"Our software helps plantations produce high-quality seeds that can be planted in the field. It also helps the plantations monitor their field performance, that is, what you need to do so that your planting material grows well."

There is not much automation in the palm oil industry at the moment, says Hoh. "We want to revolutionise this and put automation and digitisation in every step. So, we have to start with the basics and work

with plantations to optimise workflow and digitise what they can use technology — such as the Internet of Things (IoT), artificial intelligence (AI), big data and software — to automate their processes. That is what Agrinome does."

Lee elaborates, "You can divide it into three main components. The first is big data collection and how we standardise workflow and the use of a mobile application, together with a sensor, barcode or RFID, to help them collect data easily."

With breeding, for example, there is genomic data as well as field performance data. Then, there is the labourers' workflow data. "Right now, you manually gather data such as how much trees grow every year and the oil content every season," he says.

For instance when a plantation is experimenting with a new cross-breed, it will involve 180 palms in multiple replicates. If more than 100 of these show the positive traits that they have been selected for, the attempted cross-breeding is considered successful.

The problem is that to get to this point, you need to plant 20,000 to 30,000 of these crosses and monitor all of them on 30 different parameters, including things like height, frond length and oil extraction rate, says Hoh. All this is incredibly tedious and labour-intensive. The only way to do this efficiently is with the use of software, he adds.

Basically, with Agrinome, the plantation workers tag the plants with IoT devices so that all the parameters can be tracked automatically. Then they pass a sensor over the tag and the data is uploaded to the cloud.

"With this, you can gather the data consistently and easily and sifting through it will tell you which trees are the best, with the traits you want. This is only one of the features of our software," says Hoh.

He adds that before, a plantation may have needed to hire 10 people to do the tracking. But now, they can make do with two. With the information, the CEO or manager of the plantation can have an insight into what is actually happening on the ground, for example, in terms of seed production or how many workers are deployed at any one time, says Lee. "This will help them manage their operations better because previously, if they wanted to know how many seeds were produced or how many people were working and their respective productivity levels, they would need to go through a few steps before they could get the statistics — especially for large plantations with 500 or 1,000 employees."

"This can help smallholders with things like getting the Malaysian Sustainable Palm Oil (MSPO) certification because the digital platform can increase transparency and flexibility by tracking every step and workflow. So, they can track every plant, know their origin, their parents and the seedling production process. It is 100% fully transparent for future certification."

Hoh says the company's total addressable market for oil palm seed and planting material production is at least RM500 million in Malaysia and Indonesia alone while the global bioinformatics market is about US\$10 billion.

Where will Codon Genomics go from here? "We will expand regionally. We are looking at Thailand and Indonesia and I already have dealers in the Philippines," says Hoh.

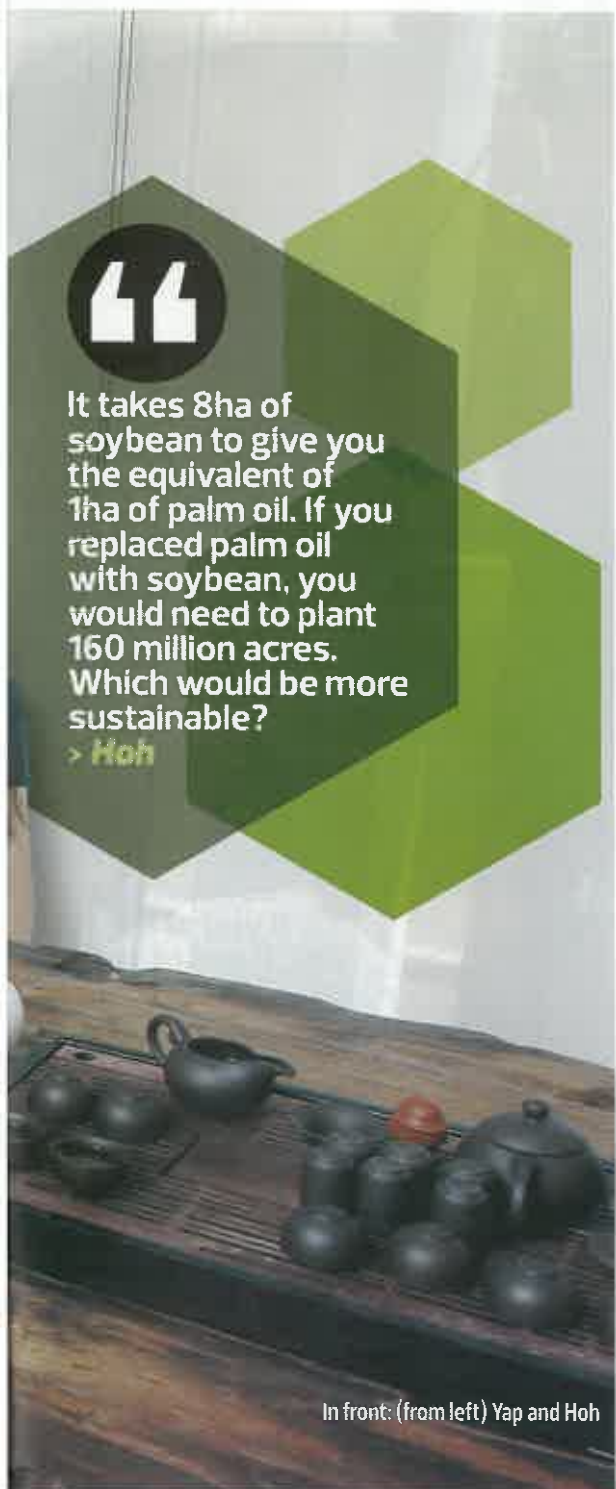
The company is now nine years old and it has been a long, arduous trek to profitability. Today, its revenue runs into the seven figures. "In five years, we are projecting about RM30 million," says Hoh.

The company is looking to hire more bio-informaticians and experts in disciplines such as AI, not to mention data scientists. It also plans to expand its sales team to help it grow its regional footprint.

Hoh says that before Codon Genomics started, those who graduated with biotechnology degrees had few places to go to in Malaysia. If they did not want to work with a research institute, they had to leave the country or go into another discipline.

"We wanted to create our own technology and do the country proud. When we started out, people thought we were crazy because nobody was willing to do what we were doing. Things were tough and the banks would not lend us money. We had to get by on our own," he says.

"We were not geniuses, we are merely hard workers who were on the ground and tried to understand the pain points of our potential market and address these through technology." ■



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> Hoh

In front: (from left) Yap and Hoh