



CIRCULAR ECONOMY

IN THE INDONESIAN AGRICULTURAL SECTOR **PART 2**



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A G R  D I T E

ABOUT OUR COMPANY

Agrodite is an Indonesian based enterprise with expertise in agriculture and circular economy. We support governments, private sector companies and other interested stakeholders with a strategy and a vision for a more circular business and future. Agrodite is committed to sustainable development and implements projects with impact for smallholder farmers, plantations or (state-owned) agri-businesses.

- **Vision:** A world of resilient and prosperous farmer communities with 21st century solutions to adapt to current challenges.
- **Mission:** Agrodite brings together different fields of expertise to maximize the positive impact of farmers and their communities in their living area.

INTRODUCTION

While still in the middle of the Covid-19 pandemic at the moment of this writing (December 2020), the Indonesian agriculture sector seems not to be hit hard during this period. Where the tourism, industry and property sectors are feeling the economic pain as a consequence of the Coronavirus, the Indonesian agricultural sector grew during the first quarter of 2020 with 9.46 percent. Online sales of agricultural products also grew by 24.89 percent during the first quarter of this year. The sector also managed to grow 2.19 percent year-on-year in the second quarter. Especially in the first period of the pandemic, one of the main problems faced during the outbreak is the lack of availability of agricultural labour resources at several parts of the value chain, like in the logistics and market. However, partly because exceptions were made in social restrictions in the agricultural logistics, growth in the sector could happen, because it was easier to transport agricultural goods domestically. Also, the export of Indonesian agricultural products has experienced a minimal decline only.

Although the Indonesian farmers show resiliency, there are still many farmers who used to produce and sell directly to restaurants and hotels. They feel the current low demand, often reducing the sales with 80 percent. It is not simple for every farmer to make the shift to online to find other markets for their products. With more people working from home, and therefore also cooking and eating from home, the market changed from Business to Business (B2B) to Business to Consumer (B2C) for some horticulture farmers. A strawberry farmer in Lembang explained that he normally produces for the horeca, but he had to move to selling directly to consumers. He has spent time and energy setting up an online presence and making use of Instagram to promote his strawberries. Many of the trends noticed during Covid-19, could become the “new normal”, like for instance at-home-cooking. Hopefully, another trend will be that companies and government will encourage people to work more from home. In Indonesia that will also lead to an increase in food e-commerce, with deliveries from both grocery stores (and the ones like Sayurbox and HappyFresh) and restaurants.

Besides, farmers have to become more innovative, the Indonesian government has made a great budget available, in response to the Covid-19 pandemic. Farmers need to see their farm as a business and make more use of online tools. A crisis like this has made it clear for many farmers not to rely on only one source of income.



Offline and online channels to sell their crops are a good start to diversify the selling market. With the budget from the government, there is a tremendous opportunity now to build a resilient and low-carbon society. Covid-19 has exposed how the linear “Take-Make-Waste” approach has failed in maintaining the world’s resources. A Circular Economy (CE) approach could support countries to recover financially and still heading towards the SDGs and net-zero carbon emissions.

Two Circular Agri Opportunities



1. CIRCULAR ECONOMY STRATEGY

Circular economy strategies could help develop a more sustainable agricultural sector in Indonesia. These strategies need to be further explored and planned for implementation in the coming years. Regenerative agriculture is one of such approach, in which food waste could be utilized as nutrients for the soil. Agri-waste can also be converted into biogas (through anaerobic digestion) or biodiesel.



2. CIRCULAR FOOD SYSTEM

Food waste is an increasing problem in Indonesia. An opportunity is to create a circular food system where food surplus gets redistributed and inedible by-products are collected and transformed into valuable products. In the current linear model, food is still thrown away at different stages from the production of crops till leftovers at the kitchen table. Already few Indonesian initiatives has started to work on this, like Surplus and Foodcycle.id.

In discussing circular economy in the agricultural sector, regenerative agriculture is mentioned to oppose the traditional industrial methods of crop cultivation. The extensive use of pesticides and artificial fertilizers is seen as the linear model. This model extracts more than it gives back to the soil and natural environment. The Indonesian farmers who go for the quick win and the quick cash using this model often reach a point where soil becomes unproductive. The circular model, however, embraces natural processes by closing nutrient cycles and enhancing soil conditions by returning organic waste to the farmlands. This model should not only be able to feed the growing Indonesian population, but also maintain ecosystems and tackle climate change. Not a small task. With regenerative agriculture, farms are part of a bigger eco-system and should balance the nutrients that it has taken by giving it back to the soil. High yield is not the primary goal, but a great topsoil and biodiversity are, with good income for the farmers on the long run. Turning degraded land into a flourish one takes time and it takes commitment to the vision of regeneration. Regenerative farming aligns with the ideas of agro-ecology, agro-forestry, zero budget – natural farming (ZBNF) and several other approaches.

In the previous edition with the same title (May 2020), the paper introduced the main concepts in Circular Economy and the difference with a linear model. It also discussed partly how CE can be integrated in the Indonesian agricultural sector. In this edition, the discussion continues how CE can support Indonesian farmers. More deeply, the strategy “Product As A Service (PAAS)” is explored. Instead of just selling products, that product can also be offered as a service. The customer makes use of the service and they pay for the time, long or short period of usage. Car rental is an example, but also an office printer, where people pay per printed page. Drones are discussed as a service to support plantations, but perhaps also smallholder farmers in the future.

Just as in the last edition, we have a case study section of circular agricultural initiatives in Indonesia. The case studies do not represent the PAAS only. The BLOPS case study is actually a good example of it, but they apply more strategies. The three fantastic new studies present a great combination of established companies and young/start-up companies. In the previous edition, the start-ups are actually taking off with a circular business model. The established companies on the other hand (Multi Bintang Indonesia and Danone) shift from being linear towards circular, with zero-waste policies as fundamental base. It is good to see that more Indonesian companies or Multinational Companies (MNCs) in Indonesia are taking steps and providing budgets towards circularity, carbon reduction and sustainable strategies. Agribusinesses and Food & Beverage (F&B) companies, with often smallholder farmers at the beginning of the supply chain, play an important role in setting up circular design strategies in the sector.

F&B companies with mills and production facilities produce different types of waste, not only solid or liquid, but also organic and inorganic. Often the organic solid or liquid waste can be perceived as by-products and can be converted into something useful. The best way to do that is in their own production cycle, but if that is not possible, it can also be utilized outside the cycle, for instance soy waste as cow feed. Many mills and facilities face similar problems, for instance with sludge waste. Through this edition, the presented case studies could be an inspiration for many other Indonesian companies to adopt similar approaches.

PRODUCTS AS SERVICES

The Circular Economy is not only about the avoidance of producing waste or pollution. It is a transformative approach in the way we do business, how we develop our products and services, and how we want to organize our communities. All of this, of course, in the best sustainable path possible. In Indonesia, the focus is primarily on plastics and waste management, as these issues still need to develop. However, besides waste management, Indonesia should also explore designing out waste in the system from the beginning of the supply chain. Waste management at the end of the cycle is already a hard-enough issue, so examining the design stage is a good starting point to avoid more waste at the end.

Sustainable Design and Life Cycle Assessment are tools to help companies improve their supply chains and look for value creation in different ways to deal with their waste. Every industry and product category will need a different combination of business and design approaches. For the agriculture sector and F&B businesses, organic waste is one of the core waste that preferably needs biological treatment.

The 5 most mentioned business models for circular economy are:



Figure 1: Circular Business Model



Circular Supplies: Products are part of the supply model, and consumers collaborate to share resources and ensure that circular products are available on the market. The circular resource flows represent the “re-” type flows of goods/materials/energy that are recycled, retained, reused, repaired, remanufactured, refurbished, recovered etc. They can actually also be viewed as separate business models.



Resource Recovery: This business model eliminates material leakage and extracts resources back from the economy to ensure that they are circulated back into the system. This could be a third party provided system.



Product Life Extension: This business model aims to extend the current lifecycle of a product by repairing, upgrading and reselling. In this way, resources/materials stay in the economy longer.



Sharing Platforms: Sharing platforms try to stimulate collaboration among consumers of products to maximize the reuse and shareability.



Product As A Service (PAAS): Products are used by one or many customers by a lease agreement or pay-for-use arrangement. In this way, the producer remains the owner of the product. It can also give the producer an opportunity to build long-term relationship with the customers. All five business models are interesting, but we will discuss this business strategy in more detail with a potential benefit for farmers.

Providing services to the customer instead of selling the product, is seen as a key strategy to create a circular economy. A product-service offering, or Product-as-a-Service, is one type of value proposition that can be used to enable circular value creation. As the name explains it already, it is a combination of product and service elements that are offered to the customer. A much used example is the photo copier. Customers are not interested in the copier, but more in the photocopies. Companies do not have to own a copier or take care of the maintenance, the producer will do that. In this way the producers can disassemble and reassemble machines to refurbish them. The providers and customers are only interested in performance and reliability, not in the question whether the product is new.

Another example mentioned in the first edition (the paper from May), was the use of lightbulbs. Customers do not pay for the lightbulb but for the service of light. In this way, the lightbulb producer can have better customer relationships and a higher return of lightbulbs and the critical materials. It is not a new model, look for instance at libraries, cable TV, car rental services, etc. However, with the use of digital technologies, it has become more interesting to use a PAAS strategy for a wider range of products. Start-ups like Spotify has changed the music industry entirely. CDs are much less produced and the PAAS strategy has been utilized to bring the value of listening to music to its customers. PAAS exists in many forms and variations, but for circularity, it is relevant to make the distinction between three types of PAAS: product oriented, use oriented, and result oriented PAAS:

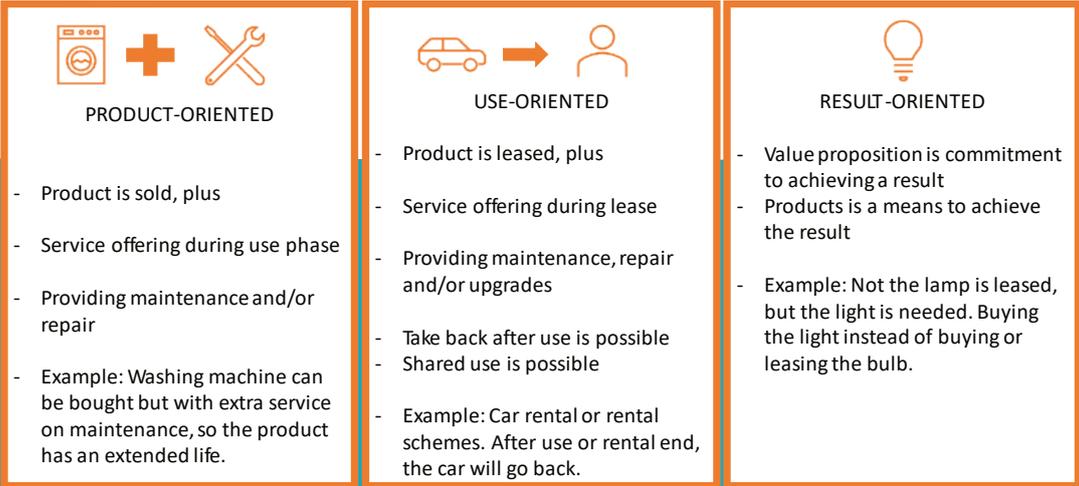


FIGURE 2: THREE TYPES PRODUCTS AS SERVICES

In the agricultural sector, a few of these examples can be found. Koppert, a crop protection company, asked themselves the question, do farmers want to buy pesticides or do they want pest free crops? With that in mind, they shift from only selling products to selling pest free crops. Their service is popular in greenhouses in The Netherlands. They take care of the spraying, but they also switch to organic pest controls. This is a win for the environment, a win for Koppert and the farmers, because it is more cost effective, and a win for the consumers, because the crops are pest free.

In Europe and the USA, there is also equipment lease and service, as an example for use-oriented PAAS. Why own a tractor, if you do not need it very often. A tractor can be leased for just the days that you as a farmer need it. Same counts for special farm equipment for seeding, harvesting or post-harvesting:



EQUIPMENT REPAIR AND PARTS

Fixes broken equipment, or sources parts for self-service.



EQUIPMENT SOURCING AND SALES

Provides farmers access to essential machinery.



EQUIPMENT RENTAL

Leases equipment for predetermined jobs or intervals.



EQUIPMENT SHARES

Splits ownership of common, but less-used equipment amongst a cooperative.



EQUIPMENT CONTRACTORS

Machinery owners perform tasks on a single job basis.

Drones as a service (DAAS) falls in that last category of equipment contractors. Information and communication technologies (ICTs) are playing an increasing role in addressing problems faced by agriculture. Smart agriculture in the Agriculture 4.0 revolution brings digitalization closer to the farmers with interconnected machines. The use of drones, also often mentioned as unmanned aerial vehicles (UAVs), and connected analytics has great potential to support and address some of the most serious problems faced by agriculture. Climate change, food security, soil degradation are just a few. Reliable data is required that is precise and up to date. Several reports claim that the agricultural drone market will be second largest drone market, after industry.

Drones are able to collect spatial data and can support evidence-based planning. More practical, it can be sent out over fields and plantations to spray the land with pesticides, herbicides and fertilizers. Drones, together with analytical software are able to locate the exact places where crop management products are needed. In this way, not a whole plantation needs to be sprayed, instead only some spots that require it. It can save costs on inputs, but it can also prevent spraying too many pesticides.



As often predicted, the next agricultural revolution is data driven. Some farmers and farmers on plantation level will be able to own the drone. A farmer who owns it, can often make use of data processing software in order to make farm decisions. But from a DAAS perspective, a farmer can also choose to have a drone contractor do it for him. The farmer does not have to worry about the maintenance of the drone or on how to operate it. The contractor can do it and offer more services to the farmer. The farmer can pay the service from the cost reduction on inputs, the avoided crop losses, and the savings of salary for the hired people to do spraying in the field. Many sellers of crop management products are looking into bringing their product as a service. Drones are high on the agenda of these companies as potential business opportunity.

How does this technology translate to the Indonesian reality of smallholder farmers? In general, Indonesian smallholder farmers are not benefitting enough from new technologies and innovation. Although probably still far in the future, but also smallholder farmers should be able to make use of drone technology. Product as a service gives actually the opportunity to reach the poorer farmers of Indonesia. If farmers are part of a large farmers group or a cooperative, on that level, they would be able to lease a drone. Instead of paying people to spray their field, or doing it themselves (often too much and inaccurate), they could bring in money to have a drone spray all their fields. Not only for a drone, but also for equipment, new business cases need to be developed to reach the majority of farmers in Indonesia. The Indonesian government has to make it easier, in relation to policies and regulations, to make these innovations available and in reach of farmers.



CASE ***STUDY***



Multi Bintang Indonesia's Circularities Journey

BACKGROUND

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We are Multi Bintang Indonesia, the producer of Indonesia's iconic beer, Bir Bintang, and the world's premium beer brand, Heineken®, with a proud history of nine decades in Indonesia. As part of the HEINEKEN Company, we put sustainability at the heart of business, which means looking at HEINEKEN's sustainability strategy 'Brewing a Better World' in all of our activities – from sourcing, producing, marketing and selling our products all the way to how they are consumed, and how we can reuse and recycle waste.

Achieving real and lasting change is only possible through the collective efforts of everyone who works at HEINEKEN®, our partners and suppliers, NGOs, governments, local communities and other stakeholders.

WHAT IS THE PROBLEM

Climate change is a serious issue, particularly regarding the effects of carbon emission to the environment. Climate Transparency (2018) reported that greenhouse gas emissions in Indonesia has tripled between 1990 and 2015 (+196%), and it is predicted to continue to increase until 2030. According to the report, sectors that use energy are the largest emitters of CO₂ from the total of Indonesia's greenhouse gas emissions, with the industry sector contributing 31% of it in 2017. Greenhouse gas emissions from activities related to energy consumption is indeed a threat to the environment, society, and the future generation.



As a company that produces beer, we are paying close attention on how to manage the waste from our production process, such as spent grains and spent yeast. They are rich in organic matters and have potential to still be useful. They should be handled properly, not left to merely decompose in landfills. The decomposition of organic matters in landfills will produce methane, a greenhouse gas 28 to 36 times more potent than CO₂ (United States Environmental Protection Agency, 2020).

Disposing organic matters to landfills is environmentally damaging and very far from being sustainable. The same goes with disposing inorganic matters to landfills, such as glass. Glass bottles, like the ones used for our Bir Bintang, should not be filling up landfills as they need millions of years to decompose, while still having economic value.

We realize that we have an important role in reducing environmental impacts of our activities, and we do have the power to actively pursue positive changes. The facts like the ones stated above are not just facts, but they are a call to action. We looked within ourselves to address our concerns – how can we, Multi Bintang Indonesia, make our business as part of the solution?

WHAT IS THE INNOVATION

Multi Bintang Indonesia's sustainability strategy is based on HEINEKEN's 'Brewing a Better World'. There are six focus areas, including reducing carbon emissions and growing with communities. Integrating the concept of economic circularity in our sustainability strategy is in line with our vision for a sustainable future, in which we can take actions to make things better for the environment while also benefiting the people around us.



Picture 1. Brewing a Better World

- **Using Rice Husks as a Renewable Energy Source in Our Biomass Plant**

We decided to change our use of fossil fuels with a renewable energy source, which is much more environmental-friendly and emits lower carbon emissions. In July 2018, we started the use of biomass in our Sampangagung Brewery, Mojokerto, where we partnered with PT Tasma Bioenergy (now known as BECIS Bioenergy), a company that focuses on providing renewable energy solutions to businesses.



Picture 2. Our Biomass Boiler in Sampangagung Brewery

Our biomass facility uses rice husks, sourced from local rice mills and collectors, to be converted into thermal energy. The burning of rice husks heats up the boilers used for brewing and other operational activities in our production process. Rice husks was previously perceived as waste by farmers, and as a way to help them manage their 'waste' sustainably, the rice mills could hand over their rice husks to be utilized as an energy source. It is usually free to take depending on the season, subjecting to transport cost.

Since the beginning of the biomass facility's operation until June 2020, a total of 12,153 tons of rice husks have been used to generate steam. Rice husks are the main feedstock for the boilers, but occasionally malt dust (by-product from malt milling) from the brewery is also used in very small quantities.

The burning of rice husks generates ash as its by-product, which amount to roughly a fifth of the weight of the rice husks used. For example, 116 tons of rice husks was used in April 2020, leaving out only 23.2 tons of rice husk ash. The rice husk ash did not go to waste as well. With its high silica content, the ash can be used as material for construction, brick-making, bedding for poultry, as well as a potent organic fertilizer, and through BECIS Bioenergy's CSR (Corporate Social Responsibility) initiative, the rice husk ash could be given to local communities, free of charge. For example, in February 2020, data provided by BECIS Bioenergy shows that out of the 88 tons of ash produced, 63.8 tons could be used for composting, 17.6 tons for brick-making, and 6.6 tons for construction material by communities in Trawas, Sudimoro, Mojoranu, and also in Sampangagung.



Picture 3. Rice husk from local mills stored in the biomass plant's storage facility

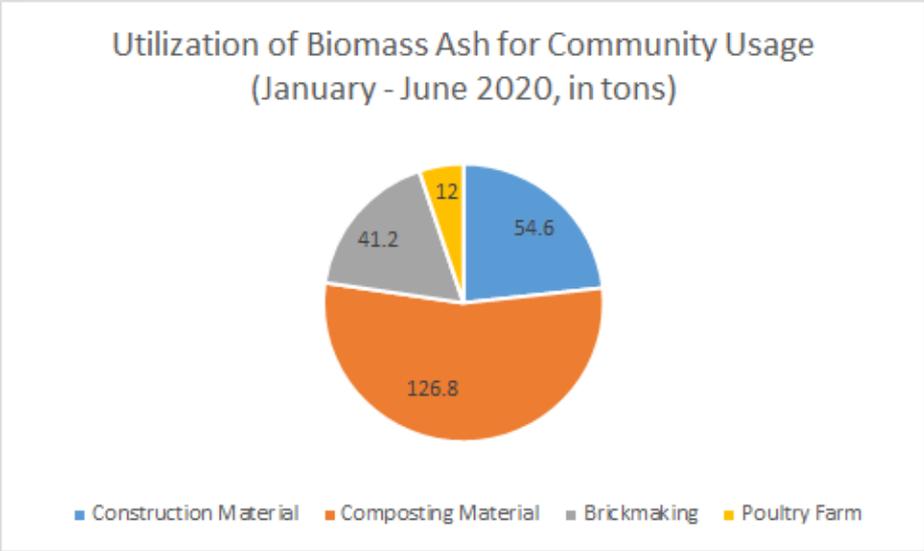


Chart 1. Biomass Ash Utilization (January - June 2020)

- **Zero Waste to Landfill**

Spent Yeast and Spent Grains to be Spent Well

When we brew beer, there are substances left over from the process: spent grains and spent yeast. Spent grains is a by-product from the wort filtration process, which contains valuable protein, fibers & carbohydrates. It accounts for 85% of by-products from the brewing process (Lima, 2010, as cited in dos Santhos Mathias et al., 2014) with the rest of it including spent yeast, which is yeast that is not reused for fermentation. We choose to see them as by-products because after they are used, they can still be utilized into something that is beneficial and valuable.

Economic circularity is about giving 'waste' a new value to conserve natural resources, and we try to do that so our spent grains and spent yeast can be spent well. Spent yeast is rich in proteins and saccharides (Kao, 2018) and according to Ikram, Huang, Zhang, Jing, & Meng (2017), the addition of spent grains to animal feed leads to an increase in milk yields and higher fat contents. They also found that spent grains is a good source of essential amino acids. Knowing that they are high in nutrients, we utilize the spent grains and spent yeast for farming needs through partnership with local co-ops and other companies.

For example, in Sampangagung Brewery we sold 445.31 tons of spent yeast and 8,839 tons of spent grains from the brewery in 2019. Local co-ops (CV Langgeng Dumadi, KUD Tritunggal, and KUD Budi Raharjo) bought the spent yeast and spent grains to be sold to local farmers around them, while a dairy company called PT Greenfields bought the spent grains to feed their cows. PT Maqpro Biotech Indonesia is another partner who buys only our spent yeast, processing it to make feed for fish and shrimps.



Picture 4. Feeding time: cows at KPSBU eating feed composed of our spent grains



Access our spent grain circularity story in KPSBU Lembang by scanning this QR code or visiting this link: bit.ly/mbispentgrains

● Making the Most Out of Returnable Bottles

We use a returnable bottle system, implementing the 3Rs – reducing the new bottles we need to make, reusing available bottles, and recycling what’s left, so our bottles will not merely end up in landfills. Bottles can still be reused 10 to 15 times if they are in good quality. In Java and Bali, there is an incentive mechanism to ensure the bottles are returned. Through the distributors, we charge a certain incentive fee to outlets. When the outlets return the bottles to us through the distributor, they will get the full incentive back because MBI absorbs the costs of transporting the bottles by utilizing return trucks. In their return journey, we fill the trucks with empty bottles, hence optimizing their movement. The bottles will be brought to the breweries to be sorted, the labels removed, washed, filled with new batches of beer, and pasteurized.

Product Name	2019	2018	2017	2016	Remark
Bintang Bremer 620 ml	85%	77%	83%	81%	% of returnable bottle In 2016, Heineken used one-way bottle
Bintang Pint 330 ml	92%	89%	98%	86%	
Heineken Quart 640 ml	69%	53%	8%	One-way bottle	
Heineken Pint 330 ml	74%	63%	17%	One-way bottle	

Table 1. Bottle return percentage at MBI

However, what happens to rejected bottles – bottles that come back to us in unideal conditions: stained, scuffed, or perhaps broken?

The good news is, they will not go to waste! The ‘rejected’ bottles that aren’t fit for production would be crushed and turned into shards of glass (*beling*) then sold to our partners to ensure that they will not mistakenly get into the production process. This partnership has been going for more than 10 years. With our current partner, PT Bening Citra Lestari (BCL), who has been partnering with us since November 2019, we have collected on average 445 tons of glass shards each month from our breweries in Tangerang and Sampangagung. The shards then go directly to BCL’s customers from the glassware industry – producers of glass plates, bowls, and bottles.

Despite having reused the bottles through the returnable bottle system, we also make new bottles to meet production demands. Interestingly, the shards mentioned are also sold to our supplier of glass bottles, who could make new bottles from the shards of glass bottles that once have come from them.

CHALLENGES

- Renewable energy in Indonesia requires a high financial investment, especially in the beginning.
- Finding the right partners who can commit with our circular economy principles are also crucial, for example in sourcing the feedstock for the biomass plant we source it locally from rice mills around us.
- Regarding the utilization of generated ash, it was initially quite hard for farmers to utilize ash to replace the existing chemical fertilizers, due to unfamiliarity. However, through socialization and trainings, we could offer them an alternative, more environmental-friendly fertilizers.
- Spent yeast has a semi-liquid form, which makes it difficult and costly for buyers to transport. Back then, we used the sun-drying method to dry the spent yeast in Sampangagung Brewery, so local co-ops could take the spent yeast in the dried form, cutting down transportation costs. The water from the container was removed until only the sediments are left to be dried. There were twelve yeast dryers in our sun-drying facility, and for each dryer, a container of spent yeast is poured into it and spread into an even layer. After a day or two, it would be tossed with a fork-like tool for it to dry quicker, and it took another five to seven days to dry completely. Each dryer generated about nine to ten sacks of dried spent yeast. However, as of 2020, all of the spent yeast from Sampangagung Brewery is in semi-liquid form, sold to PT Maqpro Biotech, a fish feed manufacturer, and CV Langgeng Dumadi, a local business that dries the spent yeast with wood chip burning.



Picture 7. Wet spent yeast to be dried



Picture 8. Mostly dried spent yeast being tossed



Picture 9. Sacks filled with dried spent yeast in our sun-drying facility

- Lastly, it is not as easy as it seems to collect our bottles. We have an incentive mechanism to ensure the outlets and distributors would return our bottles to us, yet the rate of bottle return is not 100% yet. We will keep innovating to have an even better collection system all around the country.

BUSINESS MODEL

Our commitment to put Zero Waste to Landfill proves that there is value in what seems to be 'waste'. The purchase of our spent yeast and spent grains could generate more than IDR 5 billion in revenue in 2019. It is indeed profitable to us and to the farmers who use the by-products for their livestock. With the returnable bottle system, we can cut down the cost of continuously producing new bottles, and prevent more glass bottles from being disposed to landfills. For example, in Sampangagung Brewery we used 6,033,060 new pint bottles (330 ml) in 2019, yet we could reuse ten times more of that amount – we used 61,957,049 'old bottles' collected from our distributors.

Our commitment in renewable energy is quite costly, but it is an investment we must make for the future of our planet. It is also in line with United Nation's Sustainable Goals: *Climate Action, Affordable and Clean Energy, Responsible Consumption and Production*, and lastly, *Industries, Innovation, and Infrastructure*. With the rising concern of climate change, the Indonesian government has urged to find an alternative energy source for its domestic consumption, with a target to achieve 23% renewable energy usage by 2025. Our initiative to use renewable energy in production is also in support of Peraturan Pemerintah No. 22/2017: Rencana Umum Energi Nasional. Right now, half of the energy used in our production is renewable, and we are taking bold steps to realize our vision to achieve Multi Bintang Indonesia's ambition for 100% renewable energy used in production by 2025. We plan on building another biomass facility in Tangerang Brewery as well as installing solar panels and agrophotovoltaics. We hope that one day in the near future we can produce beer that is "Brewed by the Sun" and continue innovating to ensure we are doing the best we can for the enjoyment of people and the love for this planet.

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Precision Irrigation for Circularity Realization in The Agricultural Sector

BACKGROUND

Dally C. Shaffar

Co-founder and Business Director at BIOPS Agrotekno

BIOPS Agrotekno Indonesia is a start-up company focusing on the development of agricultural tech-based solutions to help improving the Indonesian agricultural sector. Notwithstanding, we also focus on bringing environmental and social value through the implementation of our product. Our first solution ENCOMOTION is a machine-to-machine IoT-based product that enables our precious farmers to irrigate the farm automatically and precisely based on the real farm conditions. Our proprietary algorithm embedded to the system can calculate the crop water needs based on the current environmental condition.

WHAT IS THE PROBLEM

Indonesian Agricultural Sector

Agriculture is one of the key sectors in Indonesia's economy. It covers around 31% of the total land area and is the number two biggest contributor of the Indonesian GDP. However, the data also reveals that the agricultural sector utilizes enormous amount of scarce fresh water. The Indonesian Ministry of Agriculture reported that annually, around **80% of the utilizable water, nationwide, has been used for agricultural purposes**. It is a very astonishing number and makes this sector looks very unsustainable. On the other hand, Indonesian farmers still have to produce more and more foods for the increasing population and demand, so that reducing the number of farming land is not a choice. Therefore, sustainable changes in the food production process, including the way water is used, are key.



Water Management in Agriculture

As mentioned, the extensive amount of water has been reserved for the agriculture sector. Realizing this fact, we may assume that this sector should not have problems to fulfil its water needs. In some areas, this may be the case. However, sometimes, farmers are not aware they give too much water to their crops on the farm. The general thought of those farmers is: the more water the better. They do not realize this practice may lead to nutrition leaching which is another problem for the environment and makes the realization of circularity even more difficult. Climate change has also been causing various water related problems in other parts of rural Indonesia. One of the most common problems is the limited availability of water or drought. For example, every year, Nusa Tenggara region suffers a water deficit of up to 2.82 billion cubic meters due to low rainfall. For the sector that depends a lot on water availability, the Indonesian agriculture sector is threatened by this condition. Moreover, the fact that many agricultural areas in Indonesia are considered as rain-fed, meaning that it relies a lot on the rain as the water source, has caused it to be more susceptible. These two contrasting cases show how both availability and unavailability of water can cause problems to the realization of sustainable agriculture. Therefore, the adaptation of technology can enhance the water management to support the agriculture sector achieving sustainability and circularity.

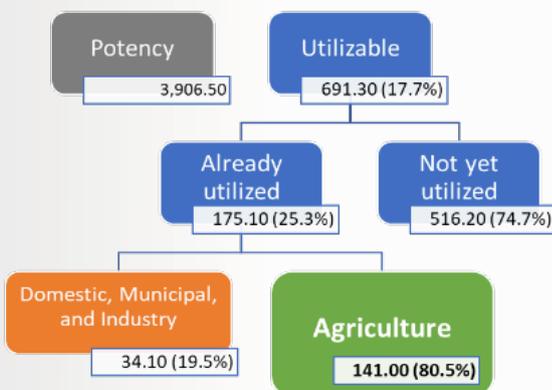


Figure 1. Fresh water availability in Indonesia in 10⁶ m³ per annum.
(Source: Indonesian Ministry of Agriculture)

The Adaptation of Recent Technology

Recent technologies including data-driven technology enable the fulfilment of the climate-smart agriculture concept. However, the adaptation of such technology is challenging. The knowledge gap between the current status of majority of the farmers and this kind of technology is very high. Take for instance the example of the implementation of a common weather station and other environmental sensors which are able to record various physical data that basically can be processed into valuable information for farm operations. The problem is, if it is only raw data, our farmers do not have the capacity to process the data by themselves. Therefore, it is crucial to really develop solutions that are adaptable to the current education level and knowledge of Indonesian farmers.

WHAT IS THE INNOVATION

Quoting from a publication by ING Bank, one of the corporate members of Ellen MacArthur Foundation, “Less is more: circular economy solutions to water shortages”, there are three circular strategies for addressing water shortages problem: 1) Reduce water demand, 2) Re-use of water, 3) Retention of water. From this concept we learn that looping the water use, by for example re-using wastewater, is crucial. However, we cannot neglect the importance of reducing the use of water itself. In the agricultural sector, it is not strict on only reducing, yet how can we manage the water input wisely and precisely. The report said, applying more efficient irrigation methods is one of the important elements on achieving circular water strategy in agriculture.

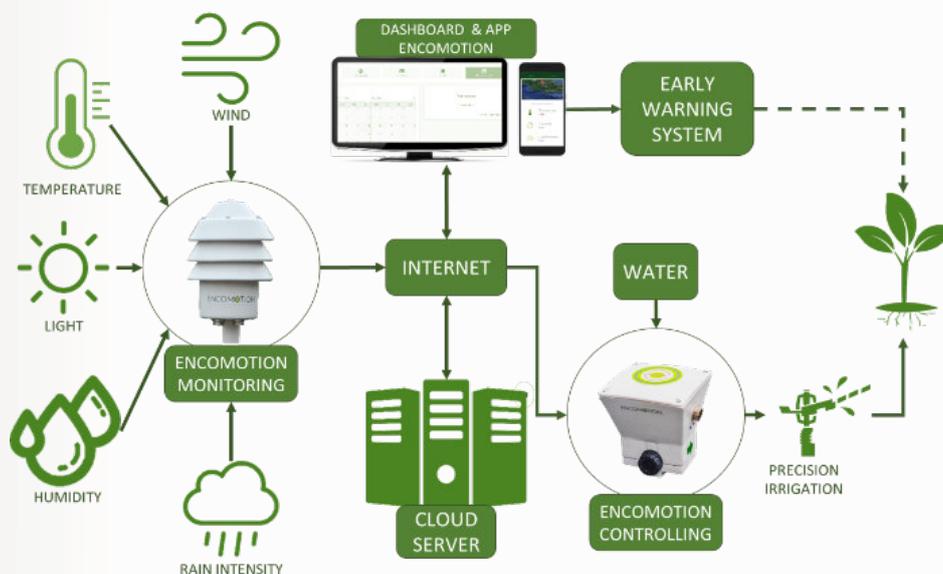


Figure 2. Encomotion monitoring and controlling system

Our proposed solution ENCOMOTION is a **machine to machine Internet of Things technology** that allows us to do automatic irrigation with the precise amount of water. The ENCOMOTION monitor is a ground sensor that acts similarly to a weather station and the data is sent to our cloud server. With the cloud computing concept, the data is processed with a unique algorithm to calculate the water needs by the crops. This data is sent to the ENCOMOTION controlling device to manage the irrigation automatically. The ENCOMOTION controlling device is attached to the irrigation infrastructure. In addition, the data can be accessed on a web-based dashboard and mobile app.

The utilization of the high technology may sound too complicated and sophisticated for the agricultural field. However, compared to the existing solutions (stand-alone monitoring system or app-based irrigation controller) where farmers still have to make the decision on the amount of water for the irrigation, ENCOMOTION can make that decision by itself to irrigate the exact right amount. ENCOMOTION with the embedded water-need calculation algorithm, connected to the automatic irrigation system helps tackling the water problems of farmers. Besides this technology, we also propose the use of drip irrigation system to further increase the precision aspect towards sustainable water management. With the implementation of ENCOMOTION we are targeting to bring the following impacts:

Reduced Water Use

From our previous user experience with one of the farmers in West Java, we have been able to reduce the use of irrigated water by 40% compared to the common practice without reducing the produce’s quality and quantity.

Increased Productivity

Irrigation is not the only factor affecting crop’s productivity. However, from previous experience, with only changing the irrigation system to ENCOMOTION, the **productivity increased by 40%**. Moreover, in the drier area where the water availability is limited, ENCOMOTION can reduce the harvesting failure rate by providing precise and efficient irrigation, thus also contributing to the reduction of food loss in the production chain. In the end, this increased productivity would bring benefits to our farmers income.

Reduced Human Dependency

The adoption of technology in Indonesian agriculture is relatively low. To put it in number, only less than 50% of Indonesian farmers has adopted mechanization and agricultural technology (BPS Inter-Censal Agricultural Survey, 2018). This is one of the main reasons why this sector is very labour intensive. Meanwhile, the data shows the regeneration rate of young farmers is very slow. It causes difficulties for farm owners to help them with the work. The use of ENCOMOTION as automatic irrigation system could bring benefit to farmers, as the dependency on human labour is decreased. Additionally, the farmers can reduce their operational costs for paying farm workers.



Figure 3: Encomotion in action

CHALLENGES

01 Market challenge

The biggest risk in the market aspect is the user readiness to adapt such technology for their operations. It includes the financial decision and knowledge capacity of the users. Mostly, the users can see the value of the product, yet they are too afraid to change the current system they have. Therefore, the market activation cost is high. Although we have put a lot of effort on the market activation, there is still high risk that this effort will fail. The main reason is because the wrong selection of early adaptors. Therefore, taking time to meet a lot of beneficiaries to find the **right early adopters** and gain some market knowledge is crucial.

02 Financial challenge

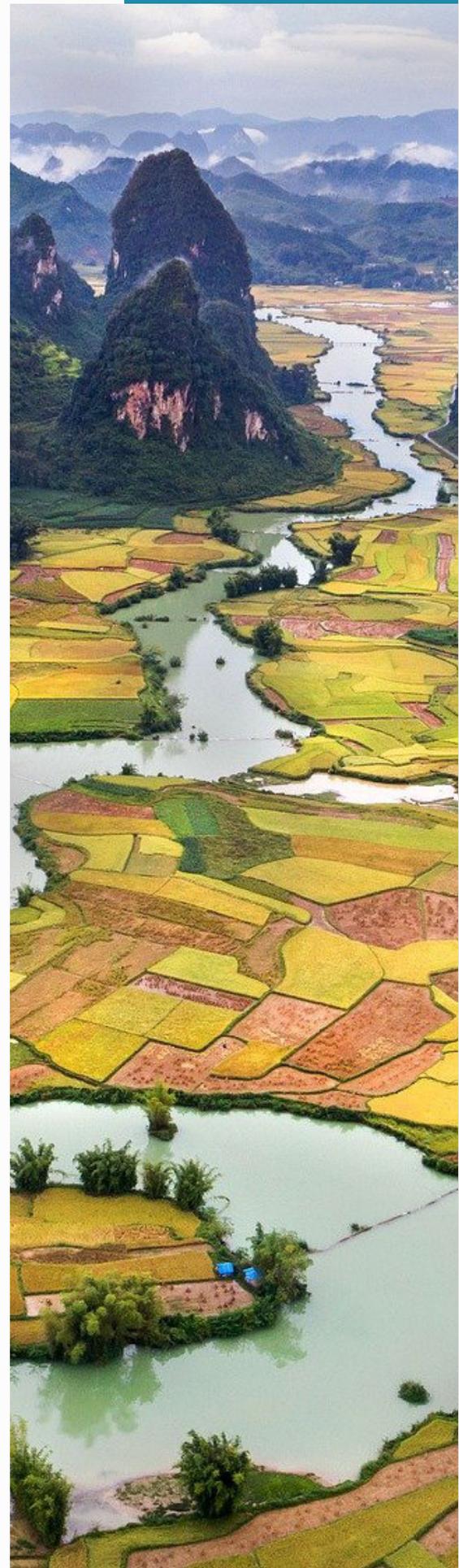
As a start-up company, we have very limited financial resources. We have been able to survive the early stage, such as the product development, yet scaling up and entering the next stage of commercialization is a different story. We need to grow the team, increase the marketing and customer acquisition costs, and build the proper production facility. Therefore, currently we take time and effort for fundraising and find the **right partner** to help us with the financial issue.

BUSINESS MODEL

We are aware that to make a great impact for the Indonesian agriculture sector, we have to target the smallholder farmers, which covers 90% of total farmers in Indonesia. Therefore, we have prepared various business models, including profit sharing which is desirable for them.

We offer three different ways to get our ENCOMOTION product. First, the user can buy the device, or as we call it the cash and carry business model. Secondly, the user can rent our device. Lastly, we offer a profit-sharing business model. The contract can differ from one case to another, depending on the agreement. The first two options are currently the most applied. We believe that the profit-sharing should be the best proposition for our beneficiaries.

Besides selling the device, we charge the use of our digital service as a subscription fee. Not only aiming long-term relationship with our customers, but this model also provides us the versatility for future product development. For example, currently we are developing a new solution utilizing the same data provided by our sensors: **Early Warning System for Pests and Diseases**. Having this subscription model, in the future the existing customers may upgrade the existing device with this new feature easily.



Zero Waste Management System of Dairy Communal Barn

BACKGROUND

Arif Wahyudin

Responsible for Agriculture-Sustainability Development Program at Danone Indonesia

Danone Indonesia is part of the global company based in France with a mission to bring health through food to as many people as possible. Danone's vision is One Planet One Health, where Danone believes that human health and planet health are interdependent. PT Sarihusada Generasi Mahardhika (Sarihusada) is a subsidiary of Danone in Indonesia.

At Danone Indonesia, this vision is translated through 4 pillars of the sustainability program: **Climate**, where Danone aims to participate in fighting climate change with the ambition to become a carbon neutral company in its entire production chain by 2050. **Water**, where Danone aims to conserve, optimize and provide water through water resource management, optimize every drop of water received from nature and increase access to clean water to the community. **Circular Packaging**, where Danone aims to recover more plastic than is produced by 2025, leads a national campaign on the topic of recycling and using 100% reusable, recyclable, or compostable by 2025. And lastly **Agriculture**, where Danone promotes regenerative agricultural practices that protect the land, improve animal welfare, and empower a new generation of farmers.

As an interpretation of the climate as well as the agriculture pillar at Danone Indonesia, through Specialized Nutrition business at Sarihusada, we carry out activities to improve the quality of fresh milk together with communities in Yogyakarta, Central Java. We do this through providing training, quality monitoring and mentoring for dairy farmers to fulfil agriculture practices that meet Good Farming Practices standards as well as paying attention to the effects of carbon emissions produced. One of the best practice we conduct is the development of integrated dairy communal barn with zero waste approach in 'Merapi Project'



WHAT IS THE PROBLEM

Fresh milk is one of the ingredients used by Danone as raw material for its production. As much as 52% of the carbon footprint of Danone's related GHG emissions is generated from raising dairy cows for milk production.

One of the emissions produced is methane gas that arises from the resulting cow dung. Although, in general, we do not produce milk directly, we can have an "indirect" influence on milk production (more than 100,000 dairy farmers in 30 countries). Danone's goal is to cut the company's emissions in intensity by 50% in 2030 and for the longer term, Danone is targeting to achieve zero net emissions in Danone's full scope of emissions.

In Indonesia, awareness on the management of dairy cow dung by farmers is still low due to a lack of technological and financial support. This condition has impact to environmental hygiene and finally can also have an impact on the quality of milk.

Another problem that dairy farmers face is the need for fertilizers to help them produce quality forage for their dairy cows. Quality forage is required to increase the total solid content in fresh milk, which can give a farmer a better price for his milk. However, on small plots of lands they often have to grow grass. Therefore, farmers are stuck with using chemical fertilizers which are easier to handle, but in the long run it has an enormous impact on the quality of the soil on the grasslands they manage.

WHAT IS THE INNOVATION

In collaboration with Danone Ecosystem Fund and Lembaga Pengembangan Teknologi Pedesaan (*Rural Technology Development Institute*) – LPTP as local partner, Danone Specialized Nutrition Indonesia has developed an innovative **large-scale bio-digester** for communal sheds in ‘Merapi Project’, located in Umbulharjo, Cangkringan, Sleman, Yogyakarta. LPTP is one of the experienced institutions on waste management in Indonesia. They have supported Danone from the design of integrated processes of dairy cow waste, manage construction, to establishing community empowerment.



Figure 1: Bio-digester construction process

The bio-digester is made **to capture methane gas** produced by dairy cow dung in an efficient way without the farmer having to bother transporting and stirring it into the bio-digester. The integration process is developed in such a way that the cow dung can directly enter the bio-digester together with wastewater derived from activities at the barn. To utilize the methane, the bio-digester is connected to a stove which is used for the internal needs of cooking within the communal barn. The methane is also flowed to the generator engine which is used for several lighting points near the barn. In addition, the methane is also distributed to the surrounding community via pipes of more than 200 meters supporting around 20 families.



Figure 2: Bio-digester after finishing the construction

As an output resulted from the bio-digester, the solid slurry produced by the bio-digester is managed through a process of **drying, milling and packaging** to facilitate the distribution process. Meanwhile, the liquid slurry is flowed to the reservoir for fermentation to increase the number of microorganism that can produce enzymes useful for plantation growth. After the reservoir, the slurry goes to the next stage where it will be packaged. All the solid and part of the liquid slurry are converted into organic fertilizer. The farmers will sell it to earn some additional income. Small amount of the organic fertilizer will also be used by the farmers themselves to be applied on their own grass land. Total solid fertilizer potential produced from this facility is around 3000 Kg per month. With this zero-waste approach, Danone expects 2 benefits: waste is re-used, and it will not enter the environment and all processed waste will bring additional benefit for farmers and the community.



Figure 3: Sludge Drying process

CHALLENGES

There were several challenges faced in the steps towards the bio-digester system to run. In maintaining the system, solid resources are required to manage it. It starts with community engagement. A challenge is the group dynamic and we had to make sure that everyone was on board with the vision and mission. Danone has provided assistance in the first and second year. In these years, we have reached that the community accepted the vision and mission. But we also conducted trainings in management, to strengthen the capability of the people involved. Our project had to be part of the community long-term goals.

In addition, the system needs to be supported by an ideal business model so that the system remains viable. Therefore, the business model needed to be developed as ideal as we can since the beginning, to avoid failure.

The last challenge is the high value investments. Since a communal barn bio-digester needs high investment, it is difficult replicate this model with other close-by communities. It is a challenge to convince other large-scale farmers to implement something similar. They need concrete evidence of the use of the existing technology and the perceived benefits so that they can be motivated to follow the technology and practices like this. Besides that, the access to the financial institutions are needed.

BUSINESS MODEL



As an innovation that requires a lot of investment and a need for the sustainability of dairy cow waste management to avoid environmental problems directly and indirectly, a profitable business model is essential. Financial sustainability is vital to cover the operational cost since the model we developed in this project is large scale. Danone covers all the investment and initial costs for several months, but the operational costs for the long term will be covered by the sales of the organic fertilizer.

In order to sustain, a type of fertilizer is developed that fits for every need, like bulk fertilizer that serves farmers to support them maintaining their soil quality for the cultivation of agriculture commodities. But in a smaller size, this type of fertilizer should also be serving people living in the city to help them maintaining their small garden. The liquid fertilizer can be packed with the easy-to-use spray so people can cultivate flowers in their small garden.

In addition, promotion is a key to help the sustainability of the business. It is hoped that with a robust marketing program, the products can be absorbed by the market as needed. In doing so, it will bring benefits to managers to cover operational costs and the costs for management services.



Organic fertilizer packing process



Bio-gas/methane usage for cooking



Bio-gas/methane usage for lighting



Organic fertilizer application for grass plantations



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