



Full Circle Biotechnology, the Bangkok startup revolutionising the future of sustainable protein feed through a unique use of insect larvae and microbes

Providing the world's farmers with an affordable alternative to soy and fishmeal production for animal feed, up to 650x less carbon emitted in the process

Full Circle Biotechnology (www.fullcirclebio.tech) is a Bangkok-based deeptech animal feed production startup, founded by Briton, Felix Collins (and with backing from Norwegian investment company, Katapult VC), with a mission to create a global and inexhaustible supply of sustainable food. Full Circle's breakthrough technology allows agricultural waste to be upcycled by microbes and insect larvae, creating an animal feed ingredient which is rich in protein and low in carbon emissions. In 2023, Full Circle Biotechnology will be opening its second operational facility and announcing multiple new partnerships within the agribusiness space.



Much agricultural waste is difficult to reintroduce into the food system due to safety, quality and digestibility issues. Full Circle has developed a waste-to-protein production system that offers animal producers the chance to cut both emissions and costs through its unique protein ingredient. Full Circle's animal feed yield is ten times more efficient than typical black soldier fly ingredient production and emits up to six hundred and fifty times less carbon than fishmeal. As a result, the company is uniquely positioned towards accelerating the food industry transition towards circularity and sustainability.

Soy production, the most used feed protein, has severe environmental consequences; it is an intensively-grown crop with high energy and water demands. The Cerrado ecoregion in South America is a striking example: it covers nearly a quarter of Brazil's land area (the size of England, Germany, Spain, France and Italy combined), of which [over half of the 100 million hectares](#) of land has been lost, largely driven by soybean farming. Over [80% of the soybean production](#) is fed to farmed animals, with only 6% being converted into products for human consumption.

Fishmeal is considered a gold-standard protein source due to the quality of its amino acids, but is possibly the most destructive protein in the world. The ocean is a major carbon sink, but fishmeal harvesting methods often disrupt the ocean floor, causing major carbon releases. Both fishmeal and rainforest-farmed soymeal pose significant threats to biodiversity, an often ignored threat to all life on earth.

Farmers have little authority over what goes into their feed and are forced to sacrifice control of their carbon footprints to feed providers. Markets are so volatile that feed prices often have to be negotiated every few months. The sustainable protein that Full Circle has invented is so affordable that it can actually save farmers money while reducing their carbon emissions overnight. This breakthrough can give farmers real ownership over their animal feed, as Full Circle allows any farmer to order their own sustainable protein mini-factory, deployed and operated by Full Circle themselves.

With the global population forecast to reach 10 billion by 2050, there is increasing pressure on food production to meet the growing demand. The food industry is evidently not prepared for the effects of climate change that impacted the food supply chain last year. Floods, drought and war are causing starvation thousands of miles away and the food industry appears unable to innovate. Aquaculture alone is the fastest growing food production sector globally, but wild fish stocks used to feed farmed fish are dwindling. Both fishmeal and soymeal are carbon intensive; producing one kilo of fishmeal equates to a 250km flight. Protein emissions are a large contributor to the 1/8th of global greenhouse gases attributed to animal feed. High fishmeal prices and poor soy amino acid quality create an opportunity for Full Circle to

fill the gap with a low-cost, high quality sustainable protein. Both Katapult VC and Asia Sustainability Angels (run by the Chief Investment Officer for the IFC and a venture partner at Antler) are among the syndicate that have backed Full Circle in its goal to achieve this.

Full Circle's Unique Process

Full Circle combines biology with engineering to maximise the efficiency of black soldier flies and microbes. Its technology tackles unsolved issues around agricultural waste and food security. Much agricultural waste cannot be fed to animals for multiple reasons, including the fact that it is often composed of big proteins and long carbohydrate chains that are hard to digest as well as potential toxins and pathogens. Through a proprietary, patent-pending process, Full Circle solves these problems, transforming waste into a high-quality, low carbon feed ingredient.

The process uses an ecosystem of over 10 different species. Together, they transform the low quality nutrients in waste products, rebuilding them into proteins that are most suitable for animal feed. The agricultural waste is combined with the black soldier fly treatment and put through a precision fermentation procedure. After the bioprocessing, the raw material is dried, processed and packaged. There is no costly or energy-intensive protein-extraction and yield rates are unprecedented at 22-26%. This biomass generation, using both insects and microbes, creates a yield ten times more effective than traditional black soldier fly farms, which have a yield of about 2.5%.

Its 1,500 square metre IoT-enabled automated facility allows Full Circle to monitor and constantly measure the process. Fully understanding and measuring the processes and pathways that contribute to the product allows for constant enhancement.

Felix Collins, Managing director and founder of Full Circle Biotechnology comments:

"With over 9% of the world being food insecure and as this global population continues to rise, it is critical to provide an inexhaustible supply of sustainable food and Full Circle is leading the charge. Traditional protein feed is responsible for global deforestation and greenhouse gas emissions. A new alternative that is both low cost, localised and sustainable is pivotal if there is any hope in reducing emissions and making sustainable farming possible."

FULL CIRCLE FOUNDING TEAM

Felix Collins, Managing Director and Founder



A serial entrepreneur, Felix has been working with black soldier flies since 2017. He was among the first to commercially farm black soldier flies in Thailand. He has worked with NGOs (i.e. executive committee of the Asian Food and Feed Insect Association) and is considered an expert in the field by organisations such as WtERT (Waste to Energy Research Technology) gmbh. Industry magazine Intrafish has called him a visionary who is reshaping global aquaculture.

Dr Shivan Chetty, Chief Scientific Officer and Co-founder



Dr Shivan Chetty is CSO and co-founder of Full circle Biotechnology. He has a biological product development and systems design background. Dr Chetty is currently the Director of the Biomedical Industrialisation and Globalisation division at the University of Witwatersrand in South Africa. As an applied scientist he previously worked on HIV/TB diagnostics and vaccines before focusing on non-communicable diseases by assisting in the establishment of Africa's first immuno-oncology diagnostic and therapeutic R&D infrastructure. Dr. Chetty

expanded his focus towards nutrition, which has a significant impact on health and interplay with disease. He has over 15 years of experience in biotech R&D and is advisor to the South African National Advisory Committee on Innovation.

Nuttanon Boonra, Operations Lead and Co-founder



Nuttanon received an MSci in Sustainable Engineering from Strathclyde before returning to his home country of Thailand to work on bio-engineering projects. Specialising in waste-management, Nuttanon has set up five industrial facilities since 2017 in areas such as biogas production, wastewater treatment and agricultural waste reduction (e.g. palm, cassava and slaughter processing). He joined Full Circle as an operations lead and co-founder in 2021.

About Full Circle Biotechnology

Full Circle Biotechnology is a Bangkok-based (and Singapore-registered) manufacturer of high-quality, low cost, sustainable protein feed, created to enhance the animal-protein supply chain. Modern food production comes with severe costs: fishmeal and soymeal have fed animals that in turn have fed billions of people, but they can be extremely damaging to the environment. Full Circle provides a much-needed alternative protein, with low cost and high-quality, that makes carbon neutral farming possible. Through its proprietary technology and use of upcycled waste, Full Circle offers a source of protein that is closer to the price of soymeal than fishmeal due to its substantial yield increases. Its unique feed has a carbon footprint that is almost 100 times lower than soymeal and almost 700 times lower than fishmeal. Its patent-pending process is the stepping stone to creating sustainable feed and increasing food security globally.

Full Circle's team has advised the FAO and specific governments and is in partnership with various universities. Full Circle is working alongside the University of Witwatersrand (South Africa) and Mahidol University (Thailand) to increase research opportunities within the space. Full Circle has received investment from Katapult and Asia Sustainability Angels among others.

www.fullcirclebio.tech/

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