

## The World Deepest Protein Factory is Placed in Pyhäsalmi Mine

*Cricket farming is a fairly new phenomenon in Finland – the house cricket was approved as a food product as recently as in 2017. The demand of trendy cricket products peaked and this novel and interesting food article was at the top of its hype curve. As the market has become steady, the technology development behind the product has begun. In Callio Edible Insects From Mine project house crickets (*Acheta Domesticus*) are being reared in 1430 meter depth in Pyhäsalmi Mine in a Smart Farm.*

### Circular economy

Insect farms and greenhouses benefit from each other and it is possible to create closed-loop food production system. In Callio Edible Insects From Mine project circular economy principles in edible insect production is being tested: Utilising the insect frass and CO2 emissions produced by insects in plant growing.

House cricket frass is an excellent plant fertilizer, containing cricket manure, uneaten feed parts and cricket shells. Cricket shells consist of chitin which is transformed into chitosan in the fertilizer. Chitosan has been studied to increase the resistance of the plants and it makes them greener and more vital.

Carbon dioxide is commonly added to the green houses by gardeners to improve the growth of plants. In the project we test using the CO2 emissions of house cricket production for miniature green houses.

### Food to Mars

The conditions in Pyhäsalmi Mine cricket lab resemble the conditions in pressurized Mars Tunnels. House crickets thrive in warm and humid environment and the conditions in the mine are perfect for them. The natural rock heat keeps the temperature in 26-28 degrees Celsius and underground air humidity is about 60%. There are no living organisms in the environment due to the depth and distance from the natural ecosystems. Therefore, the external threats for the crickets are minimal.

### Virtual technology for research and experience

For safety reasons, visiting the farm is restricted to a number of visitor groups. Nevertheless, the visitors will be able to get a virtual tour around the cricket farm. The world deepest cricket farm is 3D scanned with laser scanning technology and a virtual 3D model is created. The project team located around Finland will benefit the virtual model in R&D purposes.

### Smart Farming is the future

Being in depth of 1430 meters, the cricket farm in Pyhäsalmi Mine is challenging to access. The remote monitoring of the farm is crucial for ensuring the animal welfare.

We are building a Proof of Concept system for Smart Farming of house crickets in Pyhäsalmi Mine and testing a modern easy-to-build and easy-to-use IoT (Internet of Things) system in the farm



having all the necessary sensors for sending the data to IoT Cloud. Collecting history data from the farm and analysing it will produce important knowledge for adjusting the environment and feed. *“In this kind of a special environment, we can solve many challenges that the extraordinary conditions bring with information technology. Having an extensive amount of data and data analysis enables optimal production.”* says project partner Janne Montonen, M-Solutions CEO.

We have ten automated cricket farming units in the mine. Each of them is 600 liters in size. Imagine scaling that up to hundreds or even thousands of units. It would be difficult to monitor and control the farm in plain paper in this kind of farm - Smart Farming is the future.

*“The first generation of cricket farms usually are small heated rooms equipped by number of small growing containers. Initial investment to start is low, however scaling the production for commercially relevant volumes would require lot of more hands to work with labor intensive methods. In Callio Edible Insects From Mine project we had a perfect opportunity to pilot our new 2<sup>nd</sup> generation cricket farming technology in very unique environment”* says Jaakko Korpela from project partner company EntoCube Ltd.

Insects have good nutrition values, the production is eco efficient, they breed well and produce a minimal amount of greenhouse gases. Insect rearing brings new opportunities to agricultural sector and food industry. Insects are a huge potential for global food production. Most importantly, professional chefs have tasted the Mine Crickets, and have found them very tasty!

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The project is being carried out between 1 December 2018 and 31 May 2021 in cooperation with the town of Pyhäjärvi, ALSO Finland, Entocube Oy, Pyhäsalmi Mine Oy, Probot Oy, M-Solutions Oy, Muon Solutions Oy and Callio Mine For Business. The project belongs to North Ostrobothnia rural development projects run by Centre for Economic Development, Transport and the Environment of Finland - European Union Agricultural Fund for Rural Development: Europe investing in rural areas.

