26 - The most extreme places to grow food

Matt Eastland [00:00:06] Hello and welcome back to a new series of The Food Fight podcast. I'm Matt Eastland....

Lukxmi Balathasan [00:00:11] And I'm Lukxmi Balathasan...

Matt Eastland [00:00:12] And we're from EIT Food, Europe's leading innovation community working hard to make the food system more healthy, sustainable and trusted.

Lukxmi Balathasan [00:00:24] So on today's episode, I have to say it's especially exciting one – we're talking about the most extreme places to grow food.

Matt Eastland [00:00:32] Yes. Have you ever thought of growing food in the subzero temperatures of the Arctic tundra or even in space? No. Well our guests today have? How and why would you bother? Well, that's what I'm so excited to find out about.

Lukxmi Balathasan [00:00:48] So joining us online is Benjamin Vidmar. He's the founder of Polar Permaculture Solutions and is also a chef growing food in Longyearbyen Norway, the northernmost town in the world.

Benjamin Vidmar [00:01:01] Thank you very much. Thanks for having me.

Matt Eastland [00:01:03] And speaking with us from the Netherlands (via a galaxy far, far away!) Is Angelo Vermeulen. Angelo is the co-founder of SEAD (Space Ecologies Art and Design) and is also a space systems researcher. He's a biologist and an artist with a huge range of appointments in projects alongside the likes of the European Space Agency and NASA.

Lukxmi Balathasan [00:01:25] It's really great to have you guys here today. It's going to be a really great episode. So thanks so much for joining us. Hi, Angelo.

Angelo Vermeulen [00:01:30] Hi. Thanks for having me as well.

Matt Eastland [00:01:32] OK. So to kick it off, guys... And before we go into the specifics of what you're both doing... In your own words, why is there a need to grow food in these extreme places? Angelo, maybe I can start with you.

Angelo Vermeulen [00:01:47] I'm focussing on growing food and space, in deep space. And the thing is, if we develop long term space missions and long, deep, deep space missions... If we want to develop space colonisation (space settlement is actually a better word for it) we can't just rely on bringing supplies from Earth all the time. So we'll need to start growing food locally on the moon or on Mars, or on board of a space ship. And so that's the main reason this has been a research topic for quite some time, actually.

Matt Eastland [00:02:16] Fantastic. Thank you. Benjamin, what about you?

Benjamin Vidmar [00:02:18] Well, I would say that we don't need to grow food in the Arctic. But the problem is there's a lot of people here. So then it makes more sense to have local food, like Angelo said, instead of importing everything. And of course, some things we can't grow here – it will have to be imported – but I think we should try to grow what we can locally and then at least cut back on some of the imports. Because at the

present here in Longyearbyen, we import 100 percent of our food from the mainland and from all over the world. And, you know, it doesn't compare in quality to what we can produce here, for example, with our leafy greens, with our herbs, with our micro greens – to fly all of that from [The] Netherlands where it normally comes, compared to what I can produce here, it's not the same quality at all. So that's why it's important, I think, to have some local food here.

Matt Eastland [00:03:03] Okay. And for both of you, is there like a climate change impact aspect to what you do? Or is it simply what you guys were saying? Is it about quality on the one side in the Arctic? Is it about just making sure the astronauts have the right food in space?

Angelo Vermeulen [00:03:18] The thing is, if you're able to grow fresh food in space, you will be able to grow food anywhere on Earth, even within a condition of climate change. This is not to err... how to put it... make the problem of climate change smaller than it is. It is definitely something we need to avoid at all costs. But space is such a hostile environment and a difficult environment, [that] if we can overcome those challenges we've learnt so much [about], we can provide a much higher food security on Earth.

Matt Eastland [00:03:47] Great. Love it. And what about you, Benjamin?

Benjamin Vidmar [00:03:49] I think it's a combination of all of those things. I mean, we have to look at the big picture. And I think a lot of times we just focus on one or two parts of it. But the climate is changing. It's much warmer in the Arctic. They say, Longyearbyen, is one of the fastest warming places in the whole world. Like, I'm not an expert on it, but is definitely warming up and, you know, things are changing. And, you know, fossil fuel is not as cheap as it used to be. So all of the costs are going up and that means the food is much more expensive. So I think it's a combination of factors, not just one factor.

Lukxmi Balathasan [00:04:23] So, Benjamin. You know, we were just chatting before we started recording. You've worked all over the world and now you're based in Longyearbyen. It's a place that spends nine to 10 months of the year below freezing point and, you know, huge variations in sunlight hours between seasons. So first for all you know, tell us about your relationship with the area and how you came to set up Polar Permaculture Solutions.

Benjamin Vidmar [00:04:43] Basically, I grew up in Ohio in the U.S. and I was always very passionate about food. And my mother and my grandmother were, you know, my first foodie heroes. They would always go to the market, buy fresh food... they would go shop every day. So for me, food was very, very important. And then when I started to work on the ships, because I took a job as a head chef on an expedition cruise ship, and it was going to Antarctica from Ushuaia... when I started working on the ship, that's when I started to use frozen fish, and that's when I started to use, like, you know, things that have to last longer. So it was a bit strange for me. And when they sent me to Longyearbyen, when I came here, I worked on the ship and then I started to. Work at the hotels here. Just living here, it's very challenging for food. It's very expensive to send it here. I like salads and herbs and things like this – you can't put it on a ship has to come by plane, and anything you put on a plane is very, very expensive. And, you know, it's just so challenging. And I just don't understand. Like, I was reading around, like how many people in the Arctic were starting to grow their own food. And I just don't understand why anyone here didn't consider it. We have a university. We have the Norwegian Polar Institute. We have so much infrastructure. But it's like they only care about what's here now. You know,

when they don't want to change things. But the problem is everything is changing. For me, it was very easy... It came down to either I was going to grow my own food or I was going to leave. That was the point I was at. I was thinking, I can't be here. I'll just go back and just, you know, do this back in the States. But then I was thinking, yeah, but why not here? Like, why not this place?

Lukxmi Balathasan [00:06:18] Tell us a little bit about know Polar Permaculture Solutions. What is it, and what is it that you do.

Benjamin Vidmar [00:06:23] Yeah. So the Polar Permaculture Solutions, the company that I've started to basically have as much local food as possible here and Longyearbyen, Svalbard. For me, you know, it's very important to consider the permaculture ethics of Earth care, people care and fair share of, you know, better share of the resources. So, I mean, of course, here it's very challenging to do growing and permaculture like you do in other parts of the world. But there's still ways to do things here. So we use a lot of indoor growing. We have an outside greenhouse that we use in the summer because we have a lot of light. It's been a lot of trial and error and a lot of experimentation to try to grow as much food as possible. We've been getting a lot of support from the government and from different organisations. We were able to work on a feasibility study with the German company EDF, and they've helped us to complete a feasibility study. So now that we show it's possible to grow and it's like feasible to grow food here. So now we have support from many different people who want to have more local food. And it's not just to grow food. Of course, it's very easy just to set up a bunch of hydroponic systems and grow food. But then we also try to take into consideration like what's coming out of that? Where does the waste go? Ok, you have to import fertilisers and then you dump it into the water that goes into the sea. And then we ship up a lot of resources and then we have to ship back a lot of garbage. So we're trying to look at it on the bigger picture. Whereas where does our waste go? Can we not have waste? Can we try to find other ways we compost and things like that? So it's not just to grow food, it's trying to make the longer being more sustainable and more like zero waste and more circular.

Matt Eastland [00:08:04] I love that. Yeah. Thanks, Benjamin. I'm wondering if there's some parallels here with Angelo. I mean, Angelo, I know you obviously you don't live in space, but you're here because your mission is to connect space, technology and horticulture, to foster innovation in global food production. So, you know, how on earth did you get into this? And where did your interest in this kind of space food start?

Angelo Vermeulen [00:08:26] I've always had this interest in both biology and space exploration, but it took me a while to really connect both. And it actually happened because I got an invitation from the MELLiSA Research Programme at the European Space Agency. They saw my work in which I combine technology, biology, art, engineering into kind of futuristic setups. They saw the work and they invited me basically to think along with them to see if I could kind of come up with ideas to keep on developing their system. And the MELLiSA system is actually a circular artificial ecosystem that is used to basically recycle all the waste that comes out of a human body, gradually transform it into nutrients for plants and other plants, to provide oxygen and food for the astronauts again. And it's doing that using a series of bioreactors with different microorganisms. So to the molecules that come out of the human body, which include toilet waste and CO2, everything is basically broken down gradually through the different processes within these microorganisms. This is a beautiful vision of the future of course, it's like a circle or a fully circular system, a closed-loop system. And so what happened when they invited me to start working with them, I was immediately hooked. And this basically started my career in

space exploration because this was not planned. I actually am a biologist, I'm an ecologist and developmental biologists. I'm also a visual artist and I've started combining both. And I was at this stage for us combining arts and biology. One of us...when I made this connection for the European Space Agency and then basically the world of space exploration opened up for me and I started venturing deeper and deeper into it. And logically, my focus was really on connecting biology and space exploration in different kinds of ways.

Matt Eastland [00:10:12] That is incredible. And I mean, talking about, it's fantastic to know kind of where you've come from but space food itself, I mean, isn't at all like a little bit...theoretical and futuristic? And, you know, why are you looking at this now? What's the drawn? You say you've been doing it for such a long time. What, why does it keep you going?

Angelo Vermeulen [00:10:33] There is, on one hand, today the topic of space food in general, which is not necessarily related to agriculture. I mean, there's a whole history of space food. And I think the archetypes that it brings up and people when you talk about it, are mostly tubes with paste and pills when everybody...many people still believe that's what astronauts eat. Another is the whole issue... There's the whole topic of actually growing food in space. At this point, of course, food has been grown in space. Plants have been grown in space. The first plant that was ever grown in space was back in nineteen eighty-two by the Russians. So there's a whole history there. But the food that has been growing in space so far on the board of the International Space Station, for example, was mostly for research purposes and only as a little snack, as a little extra to the diet of the astronauts. We're not talking about growing calories in space and this is what really interests me. How can we grow significant amounts of calories and vitamins in space to sustain long term space exploration? That's a whole different stage where we're we're not there yet. But research is being done just like in the MELLiSA programme, for example.

Lukxmi Balathasan [00:11:41] So you both touched a little bit about on the challenges. So we really get to dig a bit deeper to pin a picture for our listeners. What would you describe as the main challenges of going in your location? So, Benjamin, can we start with you in terms of growing in the Arctic?

Benjamin Vidmar [00:11:57] Yeah, I think the biggest challenges have been like political. Just getting people to like there's really no laws for growing here on Svalbard. There was agriculture up until like the nineties, because you have to understand, Svalbard is kind of the international place. So there was the main ones active now are the Russians and the Norwegians, and there's a small polar station. So it's kind of like a space station on earth. Everybody has a little areas and then they kind of you know, everyone has to answer to Norway in the end because they have this sovereignty. There's no rules here. There were no rules for agriculture. So they stopped in the nineties. The Russians were producing a lot of their own food during the Soviet Union times. And then after that collapse, then they stopped sending a lot of resources here. And there was like everything, everyone just imported it. And then when I started to I mean, there have been people who have been trying to bring growing things here, but it was always like on the private level and no one was really trying to do it on a commercial level. And like also, our laws have been very weird because this was set up as a company town. So it was kind of like the company made all of the rules and they didn't want people coming here who are supposed to be working and becoming like businesspeople. So, for example, our fish, for a long time, our fish was only for private use. So that meant our fish had to be caught, sent somewhere, processed, and then we had to buy our fresh fish back frozen. We weren't allowed to sell

the frozen fish. And we have some reindeer's here, but it's not much. So pretty much everything that you eat here is from somewhere else. So this is like one of the most challenging places to be because it's so much pressure to have everything imported, like there's nothing basically from here. So it's been really challenging to get the, you know, permissions for things like, I wanted worms, composting worms so that I can compost. It took one and a half years just to get permission to have worms so that I could compost.

Lukxmi Balathasan [00:13:54] I hadn't appreciated sort of the economic challenges from being in...being so far away in a smaller town. What about in terms of the climate? So, you know, the lack of sunshine and the temperature. What are the challenges there that you've had to overcome?

Benjamin Vidmar [00:14:08] Well, to grow indoors, it's not so bad because most of that we have we produce energy from coal at this point. So we have hot water and they'd used this district heating to warm the houses. So the houses are very warm, it's just to set up some lights. But to grow outside has been quite a challenge. So we can only do that in the summer because I once used as much natural light as possible. I mean, it's very easy just to set up and just run lights, you know, eighteen hours a day for the whole year. But I really want to try to use as much sun as possible and try to work with the nature here as much as possible. So that's been quite challenging. I mean, the easiest way would have been just to set up a grow room, just produce as many salads as possible, take the money and just, you know, take it to the bank. But I don't think that would really help the town in the end. So we would still be shipping everything out and all of the organic waste and the sewage here we'd dump into the sea. So it's like a lot of nutrients are just wasted. They go into the sea and then you don't get them really back. So we've been trying to think of a smarter way where we can kind of close this nutrient cycle where we know, of course, we have to import things. But, you know, we tried to do as much as we can here. And that's just pretty much how we've been trying to operate.

Matt Eastland [00:15:18] And what about you, Angelo? I mean, you obviously don't even have that aspect of nature, really, if you're designing food for astronauts. Tell me what makes it particularly difficult for astronauts in terms of the food that they...

Angelo Vermeulen [00:15:33] Yeah well, there are essentially two components to this answer. First of all, the actual plants and the properties of the crops. And then secondly, the specifics of the space environment. If you want to develop a space crop that is really ideal to grow in space, it needs to have a multitude of properties. And it's first of all, it needs to have a high nutritious value of course, you need to be able to cultivate it in a very compact way. Low resource needs low maintenance. It needs to grow as fast as possible and it needs a high harvest index, that's like the ideal crop of course. It's like basically the ideal crop on Earth, but on steroids. You know, it's like really just trying to maximise every single thing in that plant and that is still under full development. So you have to know like and you have to realise, like in the International Space Station, every single square centimetre is expensive. So you really want high yields and a very small volume, so that's one challenge. On the other hand, barring space in the International Space Station, there's microgravity, hardly any gravity. And even on Mars, on the moon, there is reduced gravity. So developing agriculture in those micro or low gravity environments is also still a bit of a challenge. There's, of course, also the element of radiation in space, but that's something that can actually be solved architecturally. You can actually build a grow room, for example, underground on Mars or on the moon and cover it with regulate to protect it from radiation. So that's actually the least of the problems. It's mostly about finding those crops

that are ideal for space. And then secondly, dealing with those specific conditions of micro and low gravity.

Matt Eastland [00:17:10] Okay. So natural follow up question then. So what are those ideal crops and what is it that, the food, that astronauts are actually are eating now or going to be eating?

Angelo Vermeulen [00:17:20] Research right now is mostly focussed on traditional crops. We're talking about wheat, potatoes, soybeans, spinach, even algae. So at this point, we're still at a stage where a lot of fundamental research is being done. We're not yet at the stage where we can like I said, we can produce large quantities of food that astronauts could rely on because we're still trying to understand this whole challenge and the solutions for space farming. And right now, what we have on board of the International Space Station are actually really well-developed meals that are basically ready meals, you add hot water and a meal is ready, and what astronauts prefer to eat is actually comfort food. One of the favourite food items in the International Space Station, for example, are tortilla breads because it's quick, it doesn't crumble, so bread is really a problem in a space station but a tortilla bread is it's really handy. And the neat thing is, and this is really key, is you can customise it if you have a ready mean in a bag and a vacuum bag and you add some water, all the ingredients are there and you can't really customise it. But with tortilla bread, you can actually add a few things, you can rewrite a few different things and you can customise it. And this is really key because there is a problem if you have to eat ready meals every single day, you do get sick and tired of those meals after some time.

Matt Eastland [00:18:46] I can imagine.

Angelo Vermeulen [00:18:46] Menu fatigue and this could tackle this by allowing astronauts to control meals.

Lukxmi Balathasan [00:18:53] And I guess the same question to you Ben, I know you touched a little bit on the difficulties of growing in the Arctic. But in terms of your setup, what makes it difficult to grow with the set up that you have right now in the Arctic?

Benjamin Vidmar [00:19:03] I think pretty much you can grow just about anything if you have the right conditions but for us, we found that as from the feasibility study that is most profitable for us to focus on leafy greens, herbs and microgreens. And we calculated the market and then we would eventually like to expand into potatoes, tomatoes, cucumbers, mushrooms would be nice to do, but you just can't do everything at one time. So for now, we focus on the things that we can sell for the highest value.

Matt Eastland [00:19:34] I'm really interested in hearing a bit more about, you know, the technology that you're using, well both of you using in fact. You know, so what are some of the best innovations helping to grow the food in the extremes that you're both working in right now? So, you know, Benjamin, you've got some sort of vertical farming. What are the technologies that and for our listeners, what does that actually look like? So if you go to your town and you go to your set up, what does it look like to people?

Benjamin Vidmar [00:20:03] So we're just in the process of changing our setup. So the previous setup was that we had one place that's maybe around ten to fifteen square metres, we call it the lab, and that's because we've done a lot of our experimenting there and it's everything started there. And inside of there, we had shelves and we had like LCD lights going across the shelves and we were growing different types of microgreens and

salads and different things like that. We would have some fans to make the circulation and we didn't have any, like automated watering, we were doing it, we did it by hand. And then we had another location, which was like a small shipping container. We call it the Baric and inside of there it's full of Basil. So we use shelves and we used LCD lights, we used fans. And then now what we did is we got a new location, which is like it is a three-bedroom house, actually, and the house the problem is here now because there was an avalanche zone, so a lot of houses are being torn down and there's like two or three houses that the government-owned that they're not going to tear down now because it's on the other side of the house. So they're letting us use this three-bedroom house, so we're going to combine the two locations into one and then we want to have one room that we use, like it's a bigger room, maybe about twenty square metres and we want to focus more on hydroponics and we want to grow. We were working with two companies, so we want to have those two companies to provide systems that we will use to see which one we like and then our next step is that we're going to get a three hundred square metre setup sometime next year. And we want to have all of this experience to carry to the new location and then we would just focus on whichever machine worked the best now, if that makes sense.

Matt Eastland [00:21:51] Amazing. That is truly growing food in the extremes.

Benjamin Vidmar [00:21:55] Yeah. So it's all indoors and then we have an outside dome greenhouse, which is like a hundred square metres. And we use that normally from May until September. So everything starts indoors and then we move it outside around May and then we have twenty four hours of sun here basically until end of September. So the plants just grow from the sun light, we don't use any energy there.

Matt Eastland [00:22:19] Oh okay.

Benjamin Vidmar [00:22:19] So, it's just the passive solar setup outside there. Now everything is moving to, we want to scale up and become more of a larger setup.

Lukxmi Balathasan [00:22:26] And what type of technology are you looking to sort of expand into? Hydroponics or?

Benjamin Vidmar [00:22:31] Yeah, we really like the hydroponics, but we also grow in soil. We like the soil as well. We just probably will have both because then the outside greenhouse, we don't want to put hydroponics because then you have to have electricity. You have to have pumps. You have to use a lot of different things. So I think we will use both soil and hydroponics.

Matt Eastland [00:22:47] Okay. Wonderful. And Angelo, is that similar to what you're doing for space? Is that what they're using now? Is it like hydroponics? Those sorts of things? Or is there additional space tech which you're using to grow food?

Angelo Vermeulen [00:23:00] So that the MELiSSA system right now there is actually a pilot plant, which is a combination of the five compartments of the MELiSSA system. One of the compartments of the MELiSSA system is actually the humans, they're considered one compartment. Right now they're being simulated by a bunch of rats, lab rats, sixty lab rats represent one human. That's kind of how they're using them now.

Matt Eastland [00:23:22] Oh right.

Angelo Vermeulen [00:23:22] And so all the output of those humans is going to three different types of bioreactors and a bioreactor is basically a sort of glass vessel with a liquid that is with a lot of microorganisms. And it's bubbling and it's processing and then particular chemicals come out of that and go to the next bioreactor. So it looks very much like a laboratory. It doesn't really look like an ecosystem as we envision it. It's not like you have all kinds of beautiful trees and flowers. It's really a lab setting and at the end, all the CO2 and all the nitrates that have been produced through these processes are being fed to a growth chamber. And that's basically the kind of technology that Benjamin was talking about. It's a closed growth chamber with hydroponics, with LCD lighting, a series of traditional crops that is being grown there. But interestingly in the MELiSSA system, we are also growing algae, single-celled algae, spirulina. And the idea is that algae are actually, they contain a lot of proteins, I think that's well known. But the advantage of algae is that they're really nutrient-rich state and I mean, the advantage is that you can grow them in a very compacted space. If you compare it to, for example, a potato plant with all the leaves coming out, well that needs a lot of space. But algae are really very complex and they provide a good source of nutrients, the thing is, you can't feed astronauts just on algae. I mean, that is something pretty horrible.

Matt Eastland [00:24:51] Hahaha yeah, I think they'd get pretty upset.

Angelo Vermeulen [00:24:52] Horrible diet. As you can imagine, it has a kind of long vertical towers full of green bubbling liquid surrounded by LED delights, illuminating the algae, and that produces part of the food. So that's how the system really looks like.

Matt Eastland [00:25:06] Wow, amazing. I'd love to see that someday. That sounds incredible.

Lukxmi Balathasan [00:25:09] Picturing a lava lamp right now ahah.

Matt Eastland [00:25:13] Ahaha an algae lava lamp.

Lukxmi Balathasan [00:25:17] One other thing I was thinking of while you were speaking is, I feel like a lot of the lessons learned from growing food in extreme locations. It might sound quite niche and specialised, but to me it sounds like a lot of this could really apply to the real world. So, you know, from you, what do you think are some learnings that, you know, current agricultural farmers can learn and use in their everyday farming practises?

Angelo Vermeulen [00:25:41] Yeah, it's it's a bit like what I said before, right? Embracing that circular thinking and looking at those technologies that have been developed for space about closing the loop, sensor technology, climate control technology, automation, robotics, all those things are are really well advanced in the field of space exploration and could be useful, I think, for farmers on Earth. Especially in terms of big data and A.I., maybe that's a topic that's going to come up later during the conversation.

Matt Eastland [00:26:12] Yeah, we were going to ask about that. I mean, obviously big data, an A.I. is, you know, it seems to be one of these things that is on everybody's lips, particularly when it comes to farming. But I mean, we work with a number of partners who are looking into this, but it's certainly something which hasn't taken off in any big way. So I'm just wondering, do you both think that that's something which is going to really start happening very soon? And is there something that you've both been learning about that which can be applied to like more modern farming techniques?

Angelo Vermeulen [00:26:41] There is a lot going on for sure. I think there are a few things in which big data and A.I. and robotics are all converging and are having, and will be having, and already having, a huge impact on the future of agriculture. One of the really hot topics right now in the agricultural industry is plant modelling. Basically, the idea is that we are really, really, at a stage, technological stage, in which we can start to figure out plant growth recipes. There's something called life recipes for plants, which means that by applying specific types of LED lights with specific properties and frequencies and colours and intensities, you can actually modulate the growth of the plants. And you can actually shape the morphology of the plant, but also how much fruit or vegetable or how much produce it actually generates. So these are light recipes, but you can actually extend it to more general recipes like what's kind, what is the influence of all these environmental factors on the productivity and the growth of a plant of temperature, ventilation, substrate, nutrients, microbiology? You can investigate each single one of them but of course, it's also interesting to investigate all possible combinations of these for all kinds of crop varieties. You can already sense this, right? This becomes hugely complex. It's not like having a plant and then just following up the growth in a few temperature ranges. This is a really complex issue. And for that, we need a lot of processing power. We need A.I. we need a lot of data and then put them together in plant models so we can actually understand the growth of a plant and more importantly, we can predict the growth of a plant. So we can predict we can precisely predict the productivity of a plant and we can intervene when it's needed. So plant modelling is really big on the research agenda of a lot of companies right now. And that's where big data comes in because we need to get as much information as possible. Another one that is really interesting as we're starting to understand, because we're only at the beginning of this, to understand the relation between the composition of DNA and actual specific plant characteristics. It's not like scientists they know, they can just read a chunk of DNA of a plant and they can just immediately pinpoint like, oh, that's how sweet the plants will be and that's how long it will be. That doesn't exist. But of course, there is a relationship between those two. And for that, once again, you need a lot of data, you need a lot of computing power and possibly A.I. to figure out the relationship between DNA and plant characteristics. Then when we move into the more, into the hardware, I'm talking about sensors and robotics, there's a few interesting things that are actually happening at my university, Delft University of Technology. One of the projects at my university, is coordinating, it's called Plantenna and it's actually to create a cyber plant. The goal of the project is really to build a sensor inside the plant and so the plant can continuously send data about its own state and also about the environments around itself. So suddenly you really have an understanding of the plant itself and you can modify the conditions of the plants to make sure it grows optimally. This is actually a quite interesting project, which is done by the four technical universities of the Netherlands, all working together on this. The last quite, one of my favourite examples, once again of my university is in the field of robotics. It's called DelFly and this is a really small robot. It's a lightweight robot that is built as if based on insect movement, It has two wings. It only weighs twenty-nine grams. It's like a really very lightweight robot and it beats its wings like seventeen times per second or something.

Matt Eastland [00:30:38] Right.

Angelo Vermeulen [00:30:38] You could really imagine a swarm of these robots investigating crops within greenhouses to cheque for pests and other things you want to know about the plants. And once again, there is a lot of technology and computing technology, of course, involved in coordinating all this.

Matt Eastland [00:30:54] Wow. Ok Angelo, you've just blown my mind.

[00:30:57] I know, It's really really impressive and it's really great to hear about all this technology. And for me, the question is like, how does this become reality? Like, you know, do you do you think that the use of this technology is going to make extreme or unusual locations capable of becoming farmland so that weekend sustainably feed more people? And for this to happen, what needs to be in place? Because I'm also thinking it sounds a bit sci-fi to me right now, like how do we make this reality and how do you make it affordable so it can be widely adopted? Like for you, Benjamin, for example, bringing in the technology of hydroponics and aeroponics, that comes at a cost. How have you been able to make that a reality where you are?

Benjamin Vidmar [00:31:36] For us, we've been able to make good connections with people and we've had a lot of support. So for us, it's been very important to reach out and connect and to work with different people. So that's how we've been able to get to where we needed to be.

Lukxmi Balathasan [00:31:50] And what about you, Angelo, of the technology that you've spoke about, like what needs to be in place to make that a reality?

Angelo Vermeulen [00:31:55] It's a gradual process, right. For example, over the past decade, a lot of advancement has been made in hydroponics. Hydroponics is actually a really old technology. It dates from like, you know. Examples are like six hundred B.C., the hanging gardens of Babylon were hydroponics so it's nothing new, but it's like the last two decades actually a lot of insight has been gained in how to modulate the growth environments within a greenhouse of the hydroponics environment, to grow to specific plants that you want with a specific productivity that you want. There is already a lot of knowledge there, but we're usually talking about one single crop and one specific greenhouse. And the knowledge doesn't extend much further, but the knowledge is there and that knowledge, which is pretty sophisticated, is actually ready to be exported. It's not like, you know, it's the only thing is it's costing.

Lukxmi Balathasan [00:32:47] Yeah.

Angelo Vermeulen [00:32:48] These greenhouses, especially for the global south, some of these technologies, even though they're relatively simple, you know, hydroponics is not all super high tech. You can have a basic hydroponic system that works well without, you know, this... It's still relatively costly in comparison to traditional farming. So the costs still need to go down. Whilst we're talking about these more science fiction like solutions that I was talking about, like Plantenna and under the small swarm robots. Well, that's in early stage and gradually over time, this will become a new normal. We're not there yet. So depending on which aspect of contemporary agriculture you are looking at, it's ready to be exported or you know, or it's still in a development stage. Now I want to stress and it is something that I definitely want to stress within this conversation, is we also need to go back to local and traditional knowledge. Not everything can be solved using just focussing on technology. It would be a mistake to do that. And it's not just traditional to put it regular agricultural knowledge, there might also be local knowledge that is very specifically geared towards sustainability because generations of people that have lived there before have to deal with a lack of resources without all the technology. So before we kind of jump into this technology, positive future, everything is solved by technology. Let's not forget the past and let's make an interesting balance between the two.

Matt Eastland [00:34:18] Totally agree and I think I see Benjamin nodding his head away while you're talking the Angelo. And I mean, do you look to look to local knowledge in terms of what you're doing, Benjamin? Is this something that you're relying on?

Benjamin Vidmar [00:34:29] Yeah, definitely, because we're not the only ones growing here. I mean, everyone here is growing usually and their houses or just for fun, but we're the ones trying to do it more on a commercial level. So I don't claim to be the first or the one or the only, but we all just kind of work together and share knowledge and it's very important. I mean, this is the only way you can, you know, get through it is by sharing and learning from each other.

Lukxmi Balathasan [00:34:52] You know, we are in a situation now due to technology and productivity, we've had a result in over farming and overuse of our land. So to both of you, so how do we make sure that the techniques and technology that you're both using to grow food in the Arctic and grow food in space, that it doesn't eventually end up doing any harm to the areas that you're growing food locally? So, Benjamin, what were considerations you take into account?

Benjamin Vidmar [00:35:16] Well, for us, it's really tough to..we don't grow in the ground, everything is kind of in a controlled environment and we don't grow in the permafrost here. I know in Alaska and some other places, they actually grow and the permafrost, but we don't do it here. And that's kind of how we, it's all in a controlled environment.

Lukxmi Balathasan [00:35:34] And I guess what you've sort of mentioned about, you make sure it's a circular system. So whatever waste and stuff you're producing, it's almost built back into your food production.

Benjamin Vidmar [00:35:44] As much as possible. I mean we don't, we're not one hundred percent efficient with it, but we work as much as possible to make it a circular as possible. So that's what we've been trying to do.

Lukxmi Balathasan [00:35:54] What about you, Angelo? What are some things that you need to consider when you're thinking about growing food in space?

Angelo Vermeulen [00:36:00] In terms of sustainability, well that's basically exactly the same thing as what Benjamin just said, this quest to make things fully circular. Like I said, it's it's been a part of the MELiSSA programme since it started thirty years ago. It's nothing new and of course, one of the advantages of growing plants inside grow chambers is that the chances for pests is much lower than if you if growing outside. And so it is, it avoids the use of pesticides which of course, in space, you wouldn't want to dump toxic pesticides outside of your space station of course.

Lukxmi Balathasan [00:36:34] Absolutely not.

Matt Eastland [00:36:35] Yeah. So guys, I mean, we're very nearly out of time actually. But I mean, Angelo, I was wondering, do you think we'll ever get to a place where we could farm at like a commercial level in space? You know, you sort of touched on the ability to scale these things up and that's been proven to be possible. So do you think that will happen? And what do you think will be needed to make that happen?

Angelo Vermeulen [00:36:57] This is a deep question. This is really a question about the future of humankind in space. And yes in the long term, there will be extensive farming in

space and there will be an economy around farming space, just like it is here on Earth. I'm sure about this. But is this going to happen any time soon? No. So we're still far away from an actual full-blown economy in space where farming is one of the elements. But it's inevitable it's going to happen, but it might take another two, three hundred years before we get there.

Matt Eastland [00:37:28] Ok. So from space back down to Earth. Benjamin, what would you need where you're based to kind of scale up what you're doing to get to a level where I think you're trying to make, you're trying to make your town completely self-sufficient. So what is it that you need to make that happen?

Benjamin Vidmar [00:37:43] Yeah, I don't think I can make the town completely self-sufficient.

Matt Eastland [00:37:46] No, okay.

Benjamin Vidmar [00:37:46] That's very difficult. Maybe I mentioned it before, but after we've done the feasibility study, like there's a lot of things that we just can't do. So we calculated the market and we figured that we want to, we have goals that we want to reach each year. So for example, twenty twenty one we want to be at, I think it was sixteen percent of the market production of vegetables. I mean, we just we have to run it like a business. We have to run it like a business but we also want to be conscious and we want to be, you know, as sustainable and as smart as possible with how we do it. The biggest challenge has been working with all the different parties that politicians, the businesses here, the people, it's just been trying to put all of that together and it's umm. I didn't expect that. I didn't expect I was signing up for that. So the the growing part is the easiest part. But that's not the main part. The main part is dealing with people and, you know, getting people to agree and to do things. So, yeah, it's been it's been a big challenge, but now everybody wants it. You know, before I have to say that, Longyearbyen was one of the places that had the highest CO2 footprint per capital in the world because we import everything. Not only do we import everything, but we ship all of the waste back to Norway and it's processed there. We dump the organic waste and sewage into the sea, which they say is not so bad because we have good circulation. We also burn coal and we import diesel because we can't produce enough energy from coal. So our footprint is very, very high. And no one really cared for a long time because this was a coal town and it was the core business. But now things have changed. And because we have been pushing and doing what we've been doing, the whole town has decided that they now want to become a circular city and they want to focus on the three areas of energy production, food production and waste management. And this is because of what we have been pushing for all of these years. Now, the whole city, the government, everybody is on board with it. So I have to say that's a huge accomplishment. And from there, we just have to see where it goes.

Matt Eastland [00:40:01] Huge congratulations. That's amazing.

Lukxmi Balathasan [00:40:03] Wow well done.

Matt Eastland [00:40:04] And would you say that's the thing that you'll now most excited about? You know, it's given you the most sort of energy to keep going?

Benjamin Vidmar [00:40:10] Yes, I would say so, because before I was like I was saying all of these things and it was like I was speaking another language and people just didn't

understand. And now it's kind of like finally to be understood, like people understand what I've been saying all this time. And now they all want it. So it's took, like taken a huge burden off of me.

Lukxmi Balathasan [00:40:28] Well done.

Matt Eastland [00:40:28] Big congrats. Big Congrats. And Angelo, what about you? What are you most excited about going forward?

Angelo Vermeulen [00:40:34] So for me, it's it's really most interesting to bridge both worlds also to bring them together. And then secondly, it's just this whole sort of, this whole idea of closing the loop and creating a so-called greenhouse, which is high on the agenda now in countries like in the Netherlands. This is a very interesting prospect. And there's all kinds of ways and there's not going to be one single solution to do this. There's all kinds of ways to accomplish this, I'm very much looking forward to the future of such concepts as circular greenhouse.

Matt Eastland [00:41:02] Fantastic.

Lukxmi Balathasan [00:41:02] Brilliant. And I guess it feels like you're both very hopeful for the future. If you can both send a message to the food industry, so what would you really urge them to adopt based on your experiences?

Benjamin Vidmar [00:41:15] You know, I think it's kind of hard to say because I think it's it's not just the food industry. It's the consumers, it's the one who are paying. So it's like was it the chicken or the egg that came first? We have to kind of like, agree that, I mean, it's like more difficult now to, and more expensive to buy organic produce than it is to buy conventional produce. When you're organic, you have to pay for certification. So like we need to find a way that makes sense where, you know, where people want to buy it and people want to produce it. And we just need to work together. We need to figure out some way to do this where we don't deplete all of the resources and we don't, you know, use up so many of the things that we have now. And it can be done much smarter. And I think we need to really move away from this, you know, linear economy and think we need to figure out a way to repair and to reuse things and not just by throw and buy.

Lukxmi Balathasan [00:42:14] I seem to be getting the loud message now from both of you that you're very big into the circular economy.

Angelo Vermeulen [00:42:20] Yes, absolutely. Yes, of course.

Lukxmi Balathasan [00:42:22] Brilliant.

Angelo Vermeulen [00:42:22] Absolutely.

Matt Eastland [00:42:23] And I was just gooing to ask, as I've been meaning to ask this, as we've gone through the whole recording. Given what you now know about each other and what you do, which is the most difficult place to grow food, is it space? Is it the Arctic? Is it the oceans? Is it desert? You know what if there was like a fight between most difficult place to grow, what's the hardest?

Angelo Vermeulen [00:42:46] Space. I'm afraid space is.

Lukxmi Balathasan [00:42:51] Ahahaha.

Matt Eastland [00:42:51] Ahahaha space wins.

Angelo Vermeulen [00:42:51] Yeah, I think it's pretty obvious. I mean, you're operating in vacuum or near vacuum, the temperature ranges are insane. You have radiation, microgravity. I mean, this. Yeah, this is a whole different thing than anywhere on Earth. But I also want to ask for the question about what I would say to this food industry, because I haven't been I haven't answered that. I must say, I've seen a lot of really positive developments in the food industry recently, especially the embrace of circular economy. It is being embraced more and more by food industry and also something like the protein transition, which I think is a really good thing. That's where transitioning proteins away from animal sources to all kinds of other sources, like bacterial or vegetable sources of course. But one of the things that I think we still need to to work hard on is the whole issue of pesticides. I think that's just still a big issue. Some of the schemes that are being developed using genetic modification in order to create plants that you can even, you can you can apply even more pesticides, I mean these kind of schemes are not really the future, I think. So I think our whole idea on how to deal with pests needs to be tackled much more from a biological perspective, using biological control and less from a strictly chemical perspective. I think that that would definitely be something that I would advise the industry to have a deeper look at.

Lukxmi Balathasan [00:44:14] On that note yeah, thanks very much. That's a really inspiring way to sort of end the podcast today. So it's been so great talking to you both. But before we close, it would be good for our listeners to find out a bit about where they can find out more about your work. So, Benjamin?

Benjamin Vidmar [00:44:29] Yeah, you can just Google Polar Permaculture or you can visit us at our website, polarpermaculture.com. Or you can just Google Benjamin Vidmar, it all comes up and everything is there. There's a lot of documentaries, there's a lot of articles and many people have reported on what we're doing. So we look forward to meeting all of you soon. Thank you.

Lukxmi Balathasan [00:44:47] Brilliant, what about you Angelo, where can people find out more about your work?

Angelo Vermeulen [00:44:50] Simply go to our website, which is seads.network. It's S-E-A-D-S.network and there you find basically our portfolio of different kinds of projects and also my personal profile.

Lukxmi Balathasan [00:45:02] Great thank you both.

Matt Eastland [00:45:02] Amazing. Guys thank you so very much for being on the show. I'm really looking forward to seeing what you get up to in the future. This has been The Food Fight Podcast. As ever, if you'd like to find out more, head over to the EIT Food Web site at www.eitfood.eu or hit us up on Twitter @EITFood. But that's it for now. We'll see you in a week's time. Thanks for listening.

Lukxmi Balathasan [00:45:29] Thanks very much.