Transcript of ‘Antimicrobial Resistance’

Season 2, Episode 37, Transforming Tomorrow

[Theme music]

Paul: Hello and welcome to Transforming Tomorrow, the podcast from the Penland Centre for Sustainability in Business. I'm Paul Turner

Jan: And I'm Professor Jan Bebbington.

In this episode, we are chatting about antibiotics, but not in the way that you might be familiar with, because today we're covering shrimp farming, antimicrobial resistance, and the impact of this on food security.

[Theme music]

Paul: Now Jan, I don't know if you know this about me, but my body does not necessarily like antibiotics as much as I'd like my body to like antibiotics.

Jan: Oh, that's interesting. So is that um, like an allergy?

Paul: I have an allergy towards penicillin. So whenever I get anything that is antibiotic-like I have to make sure I get one that does not include anything that's penicillin.

Jan: Well, you are already probably ahead of quite a few of our listeners, and certainly the general public, of realising that there's different antibiotics for different purposes and actually which ones you use, in your case for human health, really matters.

Paul: Yes, it really does matter. I mean, no one's ever told me what will happen if I was to start taking antibiotics that contain penicillin, but I've just been told very definitely you have an allergy to it.

I don't want to experiment to find out if we're being honest. It doesn't sound like the kind of thing I want to experiment with. Ah, you know, I'll just die. It'll be fine.

Jan: Yeah. But antibiotics are really important for, for human health, so it's important you get the right ones for the right thing.

Paul: Yes. And they've become increasingly important over the last hundred years, but it hasn't all necessarily been positive around how antibiotics have evolved and their, their effects.

Jan: Absolutely. So, how are we gonna find out about that topic?

Paul: Well, and I think we should invite two people onto the shore to see if they can tell us a lot more about antibiotics, a lot more about how antibiotics relate to human health, how it relates to sustainability. And particularly, how it relates to shrimp, because I know that's the part that you've been looking forward to most.

Jan: [laughs] Yes. Well, these are, these are buddies of mine from the, the Seafood Business for Ocean Stewardship. So in that respect, it's uh, it's folk I know well and whose work I really admire. So I think our listeners are in for a real treat.

Paul: Yes, because we're being joined by Dr Oskar Nyberg from the Royal Swedish Academy of Sciences and Dr Patrik Henriksson, from Leiden University and the Stockholm Resilience Centre. Welcome both of you.

Oskar: Thank you.

Paul: One thing we're gonna have to stress from the very start is that one of our guests is joining us from a beer garden in Germany. And so if you hear lots of wonderful birdsong in the background, possibly an oompah band, possibly who knows what going on.

'Cause he's in Dortmund, which is a big football town. And it might be, you know, I don't know if Borussia Dortmund are playing a game tonight and the fans are just gonna congregate in this particular beer garden, but anything could happen.

Jan: Well, we'll be ready for anything.

Paul: It's an element of jeopardy to this episode that I have not anticipated, even greater than whether you were to inject me with antibiotics now and discovering whether they contained penicillin.

Can we start off then Oskar and Patrik, both of you, just briefly introduce yourself, tell us a little bit about your backgrounds and what it is you work on together.

We'll start with you first, Oskar.

Oskar: So, um, I'm a former chef having worked around the world in several places, in Germany as well, where, so I, I recognise the background sounds that Patrik is listening to.

Currently I'm a, I'm a marine biologist with a PhD in ecotoxicology. And I've been researching antimicrobial resistance from an aquatic food and environment perspective for about seven years now.

Paul: And then Patrik, can you tell us a little bit about yourself?

Patrik: Yeah. My name is Patrik Henriksson. I am Swedish. I, uh, I did my PhD in Leiden University in Netherlands, but the last nine years I worked for Stockholm Resilience Centre, and then I moved back to Leiden University just last year, uh, to begin as an Assistant Professor.

And my background is also marine biology, and the reason I started to work with antibiotics was because me and, and my colleague, Max Troell, we got very annoyed at an article that proclaimed that, that there was a lot of antibiotic use, uh, used in aquaculture because we work mainly in, in aquaculture domain and with sustainability.

So we wrote a rebuttal to that article, and ever since then I've kind of been associated with a field of aquaculture and antibiotics.

Jan: And of those descriptions, I mean, ecotoxicology sounds like a really horrible field 'cause it's [laughs] it's toxic.

So what's, what do people do in Ecotoxicology?

Oskar: It's, it's a still a pretty broad subject, but when looking at, uh, how chemicals disperse into the environment, how it affects animals and organisms in the environment, and how it can reflect back to us, uh, human health as well. Yeah, I it's very diverse.

Jan: Yeah. But no, that makes good sense. So, and I think our listeners will appreciate realising it's what happens in the marine environment.

And then of course, because we, we eat creatures from the marine environment, of course it will happen to us in, in due course, um, if, if things aren't well managed.

Paul: Which is where we come to aquaculture, which is something we've discussed before.

You'll remember the episode on salmon…?

Jan: …yes, indeed…

Paul: …where we just spent a whole episode talking about salmon farming. And I know we're gonna talk about shrimp later, so I'm only imagining that over the course of the next few years, you've got a whole list of every single item of seafood and you want an episode on each of them.

Jan: That wouldn't be a bad thing.

Paul: I dunno how you're gonna fit it in, but if you, you can do it Jan, you do it.

Jan: [laughs] Okay. Well let's start with at the very beginning.

So can you explain, uh, for our listeners what are antibiotics and how, how they work?

Oskar: It's basically chemicals that are only harmful to bacteria. Uh, there's another term called antimicrobials, which is, uh, an a, a broader term, which envelops, uh, antiviral medicine, anti-helminthics against worms and other microorganisms, uh, antibiotics or chemicals that target bacteria.

They affect specific physiological processes that are unique to bacteria. So we can, we can take them without killing ourselves in the process. Or at least, minimising the, the harm to our bodies.

Jan: So what would, would the world look like, um, in human health terms if we didn't have these kind of chemicals available to us?

Oskar: It would be highly unpredictable, I would say. It was highly unpredictable, and it will be. Right now we can, we can take a cure for an infection, or we can cure our animals, uh, and, and treat them if they get infected by, um, some, some bacteria.

Uh, a, a world without antibiotics would imply that surgery would come at a huge risk of infections, which would be untreatable. So anything involving infections, uh, would rely more on your personal fitness level rather than the possibility of getting a cure.

So I would say it's, it would be highly unpredictable.

Paul: Patrik, is this what the world was like then before antibiotics came about?

Patrik: Yeah, so antibiotics have been around for a very, very long time. So there are studies that have found, uh, antibiotics in, in permafrost that were hundreds of thousands of years old, so there's nothing that we as humans have invented.

Uh, they've been used to fight bacteria by different organisms in different ways. I think we all know with Ian Fleming how, uh, penicillin was found, uh, by accident, uh, on a petri dish.

Uh, but, uh, the problem is that the more you use it, the more resistant genes are evolving in bacteria. In any bacteria, and also those that are pathogenic bacteria, and that's where we have the big problem today, is that we've been overusing it for too long, which is resulting in more resistant genes, which means that this miraculous mere medicine that has saved so many lives. It's losing in its, uh, efficacy.

Paul: Yes, you mentioned resistance there. So can you tell us then, what antimicrobial resistance is and how it's come about?

Patrik: Yes. So resistant genes, um, with the, in bacteria. They are a response, an evolutionary response to antibiotic agents.

So it comes at a metabolic cost for the bacteria 'cause it has to produce these genes, but they're, you know, every, every kind of antibiotic have a functions in different ways.

So different responses and resistance has evolved for different types of antibiotics. Uh, it could leave, be anything from having a thicker, uh, cell membrane to having other mechanisms in, in the bacteria that actually helps them survive antibiotic, antibiotics.

And this means that if you're treating someone that has resistant genes, the antibiotics are not gonna kill the bacteria and they're gonna come back. And that's the big problem.

Paul: So would this be, you talk about the fact that antibiotics were there in permafrost hundreds, thousands of years ago. Is antimicrobial resistance a natural thing as well?

Uh, is it just the case that it's maybe being accelerated by humans working so much to develop new antibiotics?

Patrik: Yes, exactly. Yes. So the frequency of antibiotics is of course, driving the natural selection for these resistant genes. So suddenly those bacteria that are investing in the mechanisms to deal with antibiotics in their environments.

Uh, they have a evolutionary advantage by having the resistant genes. So even if it costs them metabolically, they will still survive in greater numbers and therefore they will multiply.

Jan: So this kind of sounds like an arms race, doesn't it, Oskar?

Oskar: It is. Absolutely. It was, I was about to say, it's, it's, uh, it, uh, textbook survival of the fitness paradigm. Uh, plus very much in the case of bacteria in that are present in a hostile environment. And it's been a natural phenomenon as an arms race between antibiotic producers and antibiotic resistance mechanisms, uh, for millions of years in the natural environment.

And it's only recently, until we started mass producing these antibiotics and emitting them into the environment that it's, yeah, we opened up for huge areas, uh, in the environment for bacteria to get exposed to these antibiotics, and subsequently needing to evolve a response to it by either perishing or acquiring resistance.

Jan: And quite often you read in some of these big risk reports that, you know, there's climate change, there's, you know, pandemics, there's all sorts of these things that we kind of make some sense of. But, antimicrobial resistance to antibiotics is often highlighted as well.

So, if that were to become a widespread phenomena, are we back in the past where, you know, a, a cut and an infection could, you know, literally kill you?

Or, what kind of world are we in if we get in trouble with these medicines?

Patrik: That's unfortunately the way that some, uh, researchers are predicting we're heading, and this is often what we refer to as super bugs. So, uh, there's been quite a few outbreaks, different types of bacteria and none of the antibiotics we know of.

So we often start with the milder ones. Things like penicillin. If they don't bite, you try something else. Uh, in modern medicine we often test, which antibiotics that the bacteria are resistant against before we, uh, medicate people.

But if your bacteria is resistant to the whole arsenal, then we are in a very bad spot and we're back to medieval times, in terms of medical treatments.

Paul: Are there particular groups in society who are gonna be worse affected by this, maybe those who are immunocompromised, those who maybe have be other existing ailments, et cetera? Who are the people who are gonna be worse hit by these changing developments in antimicrobial resistance?

Oskar: So it, it's a quite complex, uh, picture there. On one hand, anyone who's prone to get an infection will be a target for antimicrobial resistant bacteria. But then you can, you can look at, at a large scale, low, uh, low- and middle-income countries. The healthcare system isn't as advanced like as in our western society, come, it comes at a, a large risk for these populations, uh, specifically.

You have, uh, climate change affecting the disease patterns on a global scale as well. It's hard to predict, but, uh, tropical areas where, uh, you have higher rates of, uh, infections in general.

Patrik: Sorry, just to add to this, I, I would like to also refer back to Oskar mentioned earlier is that, this is only, not only if you get a disease, it is also used, uh, pre-emptively to treat, for example, infections, uh, following surgery.

So it's not just disease outbreaks, but it's also a lot of modern, modern, uh, medical treatments that are where we use antibiotics to sterilise and, and prevent infections that also would not be effective.

Jan: So I'd like to pivot our conversation a wee bit now because, and this has really sort of had a human health focus to today, which is appropriate, but, but you guys aren't human health researchers.

Primarily you're looking at, at, uh, the marine environment and looking at, at seafood. So antibiotics are also used in food production systems, not solely in, in seafood, but in other production systems as well. Why would farmers be using antibiotics?

Oskar: Main for the same reason that you would like to use antibiotics. You don't want your animals to die from an infection or, or, um, experience morbidity from an infection, as simple as that.

You, you can, uh, prevent crops or your, uh, um, yeah, in, in this case, uh, that we are working in, you know, a, a whole shrimp pond worth hundreds of

thousands of dollars, you can prevent mortalities in this pond and produce food and earn money.

Jan: And is there some link here between, uh, the intensification of, of some forms of farming and antibiotic use in terms of, if you put lots of critters close together, you'll have a more of a need for, for antibiotics?

So is there a sort of like some, you know, farm management or, you know, animal management processes that might also help with this process?

Oskar: Absolutely, uh, farm management and, and animal densities play a huge role in, in why you would need antibiotics. Uh, low densities of animals in pastures, uh, means that they're less stressed and, uh, then they aren't as prone to, to get an infection.

But animals at high, high densities, uh, generally experience, uh, increased stress and increased stress is just bad for the, uh, the body's immune defence system.

Which, uh, and then also the, the densities just imply a shorter vector of disease transmission between animals, which would then lead to a, a higher spread of infection within a population.

Paul: So I'd like to assume that farmers can't just go out there, or anyone involved in any kind of food rearing, and use whichever antibiotics they want whenever they want, wherever they want. So what rules are there that are in place when it comes to using antibiotics in food production systems?

Patrik: Historically, we, when we started using antibiotics in food production systems there, it was also a realisation that by using them prophylactically, which means that without even having a disease, a lot of animals would grow faster. So some farmers in the past were actually using antibiotics as, as sort of a growth hormone.

This is today, uh, not legal in most parts of the world, but we know it exists in other parts. And building on that, the use has kind of been regulated differently in different parts of the world, and most countries have different strategies for this. Some are more elaborate than others. Many have a list of antibiotics that are allowed, and many only allow antibiotics used, uh, after being prescribed by veterinarians.

Unfortunately, there's many parts of the world that also don't regulate their antibiotics so, so well. So you can sell, uh, over-the-counter antibiotics, which

means that farmers themselves might go and buy those antibiotics and treat their animals themselves. And because we know it's a broad-spectrum medical agent, it's often preferred if you can't diagnose this disease. It's the first go-to medicine for a lot of animals.

And when farmers get stressed, 'cause their animals are sick they often just use antibiotics because it's the easiest way to go about. We know also in recent years there's been a lot of development of vaccines, which have reduced use and, and some vaccines are very efficient at reducing use.

And for example, with Norwegian salmon, antibiotic use is almost eliminated, uh, thanks to vaccines. Unfortunately, it doesn't work for all animals. So invertebrates has a different immune response system than vertebrates, which means that we can't develop vaccines for invertebrates like we have done for vertebrates.

And that's where animals like shrimp are more challenging than, than fish.

Jan: So when a farmer is facing an outbreak, um, are there, and you say a vet will prescribe, um, antibiotics, are they different antibiotics and my doctor would prescribe me? So are there sort of like categories of antibiotics that are cat separate for different populations of animals versus humans, but also between different types of animals as well?

Oskar: There are definitely several different categories of antibiotics. Uh, you got, uh, the World Health Organisation that produced a list of, of different categories that are prioritised according to human health.

Some of, uh, the antibiotics that are used are, are free to use for veterinary purposes that aren't really necessary in human health because they don't target any disease that are affecting us humans, but rather animal disease.

Jan: I imagine, but, but you are the, you are the experts that the worst possible thing you could do is to use antibiotics that are really critical to human health on food populations, animals, and that were in the food system.

So would there be some antibiotics that like a vet couldn't prescribe, that only a doctor would have access to, and do those separations break down where there's poor regulation of antibiotic use in general?

Oskar: Short answer, it's complicated. But yeah. When, uh, veterinarians prescribe antibiotics for animals here in Sweden, for instance, there's a highly

regulated area, uh, comparing to, uh, Southeast Asia, it's much less regulated on what is, what will be prescribed to animals versus humans.

Paul: Are there potential health implications for humans if they're consuming lots of food that's been treated by antibiotics, animal antibiotics?

Oskar: Short backstory - that the, the only way that, for instance, we in EU can regulate that we're not importing, uh, animal products that comes from antibiotic use is to screen these products for antimicrobial residues.

Eating animal meats or, uh, food products that contain an, uh, antibiotic residues, I wouldn't say is of a, of a huge importance to our health or even, uh, would impact antimicrobial resistance development in us severely at all.

The thing is that if you can prove that antimicrobial, antimicrobials have been used in the production of these animal food products, chicken or, or fish or, or beef or whatever. Then you will know that antibiotics have been used and we don't want to use too much antibiotics in our animal production, simply.

So that's how, how these regulations come in. But, but consuming products that contain residues of antibiotics, it's, it's a dose exposure issue of course, but generally, uh, antibiotics don't accumulate in muscle tissues, which is the things that we eat.

Uh, so I wouldn't be too worried about consuming antimicrobial residues via our food, but rather the effects in the direct environment where these animals have been raised.

Jan: That's really helpful and our listeners will thank you for that, 'Cause I could just see all sorts of food disappearing off people's diets the longer you spoke because [laughs] we're like, I'm not gonna eat that stuff, not gonna eat this, which is, is pretty tough.

So, so, that was really sort of a bit of a long introduction to get to the absolute core of this podcast…

Paul: …shrimp. Is it time to talk shrimp Jan…?

Jan: …it is time to talk shrimp…

Paul: …let's get the shrimp…

Jan: …so, can you tell us about the work that you're doing, um, under the auspices of, uh, the Seafood Business for Ocean Stewardship, looking at the challenges of antibiotic use in the Thai shrimp production system?

Maybe our listeners probably don't know what Thai shrimp production systems look like. So if we maybe start there, and then you can describe your work and, and what you're trying to understand and what the implications of the outcome of your work will be.

Patrik: Yeah. I can tell a little bit about, uh, how we ended up working with the Thai shrimp farmers. And, uh, that all started, uh, many years ago within the SeaBOS network where we had, uh, discussions about antibiotic use. And for certain production systems, for example, the salmon farmers, they keep pretty good track of their antibiotic use. And many of them even, uh, make that data public so we can keep track on how much they use.

But in shrimp farming in Thailand, and the most part of Asia, is a very different landscape, where these producers rely much more on contract farmers. Which means that they don't really have the same control over how much antibiotics these farmers use.

Secondly, there's um, not so good diagnostic systems in Southeast Asia, which means that, uh, many farmers, like I mentioned earlier, they use antibiotic as a kind of a first, uh, line of defence if their animals get sick.

Thirdly, shrimp don't have the same immune response, so you can't use vaccines. And also, uh, lastly, a lot of these farmers don't always know exactly how much antibiotics they're using because you can buy, um, you know, shrimp growth formulas that are not explicitly antibiotics, but do contain antibiotics. So we've seen this, uh, in several places throughout Southeast Asia.

So all these factors combined, uh, led us to focus on, uh, shrimp farming in Thailand as a, uh, focal point. This goes hand-in-hand whether the government there, uh, bans the use of antibiotics in shrimp farming. But we know that of course if farmers get, uh, you know, shrimp that are critically ill, they, uh, will sometimes resolve to using antibiotics still.

But we don't know exactly which doses, we don't know which types of antibiotics. And we don't really know how much that influences the resistance development in those farming systems.

So that's how we landed, uh, working in Thailand with shrimp.

Jan: And before we go on, 'cause I, I'd like to bring Oskar in as well about, you know, the, the, the testing for, for, for genes, which becomes very technical, but you know, absolutely fascinating. What does shrimp production look like?

I know they're not roaming green fields like they are in the Cumbrian, you know, sort of highlands, but how long does it take to grow a shrimp?

And you talked about shrimp ponds. So are there lots of them in the same place or are they spread out? What kind of water do they use? What kind of food do they use?

So just a wee pen picture of what that looks like would be really great.

Oskar: So shrimp in the tropics are generally raised in, in dug, uh, ponds in the, uh, in the coastal region.

Uh, so shrimp, naturally spawn and, and live in, in the mangrove, uh, forest areas where, where you have, um, brackish water. So it's, it's a mix of, of fresh water and, and saline marine water. And they thrive in these environments. So it, usually, um, ponds are, are situated in these, uh, estuaries and, and, uh, coastal zones.

I would say it's pretty boring to look at. It's a square hole dug and you got water filled and it's not much going on. Sometimes you have paddle wheels paddling around the water for circulation.

But down there, under the water, there's thousands and thousands of shrimp that are, are being fed these, um, tiny pellets of, uh, of food containing a wide variety of, of stuff. A mix of proteins and, and grains and, uh, fish meal and, and, and such.

I'm, I'm actually not sure exactly the details of what shrimp love to eat, but um, I'm sure it's not sausages, at least.

[suppressed general laughter]

Oskar: Um, yeah, it takes about, uh, around 90 to a hundred days to grow shrimp, to market size, so you can have about two or three production cycles per year if, if the weather is allowing.

Jan: And can you, um, harvest your shrimp and then put shrimp back into the same ponds, or do they need resting periods in between growing different crops?

I suppose at that stage you can call a shrimp harvest a crop, 'cause it's sort of a crop-like nature, isn't it?

Oskar: Different farmers do it differently. There's uh, of course many different ways to, to grow, uh, to cultivate cattle as well, but, but, uh, generally I would say that you need to, you need to drain the pond. You need to empty the pond, dry it out to prevent disease.

For instance, some areas have you, you can line your ponds with like plastic liners and just rinse it off and disinfect it, until you get a new batch of disease because the tiny juvenile shrimp are generally much more prone to this disease than, uh, than adult ones.

Um, it's very high-risk life stage when, when you're young. As are we. [Jan laughs] So nothing unique to us or shrimp.

But then you generally flush the ponds and then, uh, new water as clean as possible. And then, um, some can form a disinfecting, disinfectant stage of the ponds.

Paul: I'm taken back to our discussion on salmon for obvious reasons, and then the difference between farmed salmon and wild salmon.

And I get to thinking about not Thai shrimp, but Morecambe Bay shrimp, which come from rather than, you know, 8,000 miles away, eight miles away in, uh, the middle of Morecambe Bay.

As far as I'm aware, they're not farmed. I think they're just wild. So it's an entirely different process again. And it shows, like you say, it's obviously an entirely different way of breeding shrimp than from breeding cattle.

And there's gonna be different ways of breeding one type of shrimp from breeding another type of shrimp.

Jan: And they, they are, they must be, having seen both lots, they will also be quite different species.

You know, a shrimp, Morecambe Bay shrimp are sort of probably as big as your little fingernail. Um, so they're quite, they're quite tiny and…

Paul: …I'd have said a tiny bit bigger than that, but not much…

Jan: …yeah...

Paul: …yeah.

Jan: Whereas you can think about those, you know, those big prawns that you get…

Paul: Yes. Yeah, yeah, yeah…

Jan: …yeah. So quite, quite sort of different in scale and nature. Yeah. So, no, and I'd imagine there'll be everything in between.

Paul: Yes. And the ones there that, obviously these are the ones that are at risk when it comes to, um, antibiotics.

The ones that are in Morecambe Bay, what are they being exposed to? They're not necessarily being exposed to antibiotics, but they might be exposed to different things. Gosh, it's a very complicated area.

Jan: It is. But also the Morecambe Bay ones, I know from time to time they close the fishery…

Paul: …yes…

Jan: …so they may be, uh, at risk from over-exploitation.

Paul: Yeah. And very much, you know, I don't know if it's treated as in all shellfish. You know, it's like if the month's not got an R in it, you don't harvest them. You know, that's it. I imagine it's probably the same with the shrimp. You certainly, it's seasonal. You're not getting them all year round. But if you've got a farm where you can replenish the pond or change it to a different pond, and do it all year round.

Jan: So. I know there's more of a story. [laughter]

So, you'll be working at the moment looking at whether or not you can trace anti resistant genes within the landscape in which the, the fish are being raised.

So you can tell us about that part of the project because it's, it's, at one hand you know deeply technical and scientific, but it's absolutely essential work for us to be able to understand, you know, what's happening in that food production system and, uh, what's happening for the farmers, et cetera.

Oskar: So, it kind of stems from, from what, uh, Patrik mentioned, uh, that the government in, in Thailand, they banned the, uh, the use of antibiotics, uh, or addition of antibiotics in animal feeds.

So, communicating and talking to, to shrimp farmers in Thailand, you, you can't really ask the question are you're using antibiotics, because if they would admit to it, they would be breaking the law.

Uh, and obviously they've tied a whole bunch of money up in these ponds with the animals, so they might be using antibiotics to have a better sleep at night. If, if infection comes to the pond, then you, you'd lose basically everything. There's, there's lots of economics involved in this, and there's incredibly much money tied up into these animals that live in your backyard, in, in your pond.

So we still need to, to find ways of how it works. How, how is the landscape looking with antimicrobial resistance in this area. Are bacteria coming in from the outside environment or, are antimicrobials being used? And are these potentially used antimicrobials promoting resistance in the bacteria population within the ponds in the farm system, and what is being flushed out back into the environment from these ponds? So that's what we're studying.

And we are looking at genes, because genes are the fundamental core of antimicrobial resistance in bacteria. What's good is that you can measure the abundance of genes in a, in an environmental sample or in a shrimp sample.

So what we are doing is we are measuring how many antimicrobial genes we can find in different samples. Uh, shrimp, aquaculture, landscape. We are looking at the external environment, we're looking at, so the water that comes into these ponds, we're looking at the feed that is being fed. We are looking at the shrimps themselves, and also in the, in the water that is emitted back to, back into the environment.

So we can kind of trace and, and make pretty interesting pictures of how the landscape looks, and compare it to other environments as well.

Paul: What's been the most interesting element for you, Patrik?

Patrik: For me, I think, uh, working with industry and understanding that they don't necessarily know exactly how much antibiotics they're using themselves.

Uh, it's quite, alarming, but also interesting. And I think we've been helping them to really understand that this is an important topic.

We have helped them understand that there is actually large differences between different types of antibiotics. Those that are more commonly used for animal farming, and those that are set aside to be exclusively used for human medicine.

And, and I think that that work has actually yielded results, which has been very, very rewarding for us. And we hope to continue working with the companies and, and expand this and come up with good interventions.

'Cause of course, if you want to reduce antibiotic use, you have to change your practices. And sometimes it's easier than you ,one might think, um, 'cause there's always a vector. And a vector is a animal or inlet water or something that contaminates your pond. And if you can start eliminating those vectors of antimicrobial resistant genes, the less likely you are to have issues with, uh, resistant genes.

But the same with, with disease outbreaks. If you have a good biosecurity on your farm, you're less likely to get disease and therefore you're not gonna use antibiotics.

Jan: What I really like the way you described that, Patrik, because in some ways you can almost see it as being, you know, a police force, like, stop doing this, don't do that, bad people, bad this.

But I like the way you frame it, that it's actually about farmer livelihoods, and how they can understand the environment within which they're operating, and how your data and expertise and the, and the, you know, the, the highly technical information you can generate from, from sampling what's happening in the landscape can help a farmer actually produce good food, live well, et cetera.

So, I mean, that's the essence of sustainable development as we might be trying to achieve it.

Patrik: Yeah. And some of these early lessons that, uh, aquaculture farmers learned, that they were sharing equipment and then they were moving equipment from farm to farm. And of course that was a great way to spread disease.

So if you have better practices and simply sterilise your equipment and you, you know how these simple tools can really, really reduce the need of antibiotic use.

Oskar: And I would, uh, it's, it's a really interesting landscape. So in, in Thailand there's so many different ways to deal with biosecurity and increase biosecurity. Everything from raising the absolute bar just a little bit up can have a massive improvement.

And you can see everything from cultivating shrimp in any adjacent waterway that you have no control over, straight into a pond, grow shrimp and water straight out to having, uh, chemical treatment of water in a separate pond on your farm, up to high, highly technological, uh, water treatment plants with, with ultra, ultra-filtered water and UV sterilisation and, and recirculating water, which are super-duper high tech operations.

So there's a whole range of how different farmers deal with, with biosecurity and, and preventing disease from breaking out.

Paul: As a consumer, then, what sort of safety guarantees are there in place when it comes to the food you are buying and the level of antibiotics that may have been used in its farming?

Patrik: Yeah, so when we were kind of looking at our, um, rebuttal to, towards this article that was proclaiming that aquaculture was a hotspot for antibiotic use, we went and we looked at, uh, import records in the European Union, the US and Japan, because there, there are screenings for antibiotic residues.

So residues are, uh, the active ingredients or the metabolites from the use of antibiotics in the farm. The thing with those traces is that they, of course, disappear over time. So if you used antibiotics early on in your farming cycle, there's not gonna be any traces of, uh, residues.

Secondly, uh, you, you can only do so many tests. So we know there's limitations. There's massive amounts of animal products being imported to Europe and America and Japan. So this is just a random, you know, random straw from the whole hay bale.

But, uh, the issue with antimicrobial resistance still persists. So even if you used it early on in the farming systems, there might still be a lot of resistant genes in those animal products.

And of course, that contamination can also happen at the processing plant. It can happen when they're reprocessed. So, the contamination of resistant genes can happen all throughout the supply chain. And that's why we're trying to really understand, from the farm to the consumer, where resistant genes, uh, might occur.

And I know that the European Union now has a programme to start screening for antimicrobial resistant genes rather than just reduce use.

Jan: Quite amazing that food, I mean, I know it's only a percentage, but actually those kind of technical tests, uh, are clearly at a price point where you can actually be checking a lot more of, of material coming into the market that you then buy as a consumer.

Paul: That's all been really brilliant. I want to wrap up with the usual question where we're looking for where people are finding inspiration.

So, start with you first, Oskar. So, where are you finding inspiration from this work, and around sustainability generally and, and yourself and you know, all the, regarding all these areas?

Jan: What Paul wants to know is, why are you so happy? [everyone laughs]

Oskar: Can start with, I, I find inspiration for this work through actually my, my father who, who is a veterinarian, or was, he's retired. And I've been raised with him talking about Swedish animal agriculture and, and topics thereof. I'm, I'm really, I'm brought up in a system that has been actively doing everything they can to thwart, uh, the development of antimicrobial resistance.

So I see that lots of work does pay off, and that's kind of what keeps me going because it's, it's a pretty grim situation we are facing on the topic of antimicrobial resistance. It's not fun all the time to read about the numbers and the projections, but I, I see that we can do a difference.

It requires massive amount of works from all areas. And it really is a, is a field where people need to work interdisciplinary across all kinds of disciplines. Um, and it's, but it's fascinating to see that you can make a difference here.

Paul: And how about you, Patrik? Where's your inspiration coming from around these areas?

Patrik: Yeah, so my, uh, I mentioned before, my background is in marine, marine biology and, and I started my career working much more with fish physiology. You know, doing experiments, but it was more the research for, for the curiosity driven research.

And I ventured into aquaculture because I, I felt it was more applied and I wanted to make a change. And I find aquaculture sector is a very, very interesting food production sector. 'Cause it's evolving very rapidly, it's very diverse.

So there's just still a lot of things we can change quite, um, progressively and very quickly in this sector, and once I got introduced to the topic of antibiotic use in aquaculture, I also realised that there was huge gains to be made here.

And by working with these companies, I think we also have realised that they can make these changes quite rapidly, because it's crazy for us that we're using these very, very valuable medical treatment systems to produce animals.

And therefore I think that we should be very, very restrictive in the use in animal farming to make sure that we still have efficacy in human medicine for future generations.

And because we have made with great gains in the last few years working with these companies, I think everyone is on a winning side. Everyone has the interest to reduce antimicrobial systems. 'Cause we know that super bugs are not gonna be selective, they're gonna affect us all.

Paul: Well, that's been a really fascinating talk, Patrik and Oskar.

I can safely, I say that much as when we had the salmon discussion, I now know far more about shrimp than I did before we started. Particularly Thai shrimp, an area I had zero knowledge of before we started.

Uh, it's been a really good discussion. Thank you very much for joining us.

Oskar: Thank you. It's been a pleasure.

[Theme music]

Paul: Well, Jan, I think I've got more things to worry about when it comes to antibiotics than I did beforehand, when I was simply worried about my allergies towards penicillin.

Jan: I suppose, um, one of the reasons I was really keen for, um, yourself and for our listeners to, to hear from these guys is that there's a whole complex system behind food production about, you know, how, how things be grown in particular places and how they're processed, how they're moved around the world, when do they come into consumer markets, et cetera.

And because we eat globally then exactly these kind of issues, you know, come to the fore. And so I think it's a really good case study that highlights the complexity of our modern lives, but also then the complexity of, of trying to be, uh, less unsustainable in that context.

Paul: Less unsustainable. That's a…

Jan: …yeeeeah…

Paul: …great word. I would've said 'more sustainable', but you go for 'less unsustainable', that's fine. [Jan laughs]

Um. Interesting to see, I know Oskar was keen to say that the health risks to humans aren't necessarily great from ingesting food that maybe has a lot of stuff inside it when it comes to antibiotics, but then also, and this is the word they used, alarming, that the farmers who were farming these shrimp in Thailand particularly don't necessarily know how much antibiotics is going into them.

Jan: Yeah.

Paul: It's a really, there's, there's some things that are that are certainly reassuring towards you at the regulations that are in place, the safety guarantees, and some things that are really worrying.

Jan: It's also a really good example of something called the 'one health' agenda, which is you can't separate off animal health, human health, and environmental health.

All three of these things have to work together and all, and one underpins each other, and so this is like the perfect topic to see that unity of, of concern.

Paul: And seeing, in the more broad scope, how antibiotics have evolved over the last hundred years when humans have got involved with them, how the fact they've existed for hundreds of thousands of years, which wasn't something I was aware of…

Jan: … I wasn't aware of that either. That was an, that was a insight that I hadn't gripped.

Paul: Yeah, I, I hadn't realised that this is an, humans have adapting antibiotics essentially, rather than creating them from nothing. They're adapting them to be a treatment, whereas what, permafrost a hundred thousand years ago, a form of antimicrobial that, that's amazing that these things exist.

Jan: It is, it is, and that's one of the reasons I love science and the kind of, uh, you know, scientific insights that, uh, that the likes of Patrik and, and Oskar can bring to us is just realising, you know, how, how the world has always exist.

Some things have always existed in the world and they have changed their function over time.

There was another thing that I think really came out to me, which, which really links to a lot of the work that we've talked about in Transforming Tomorrow, uh, before, and that is this complex supply systems and, and how if you are, so if you have a contract farmer, you might have a relatively poor farmer that has two ponds, for example.

And, but that all then feeds into a global supply chain. So it's, it's another complex supply chain problem. But then also right at the heart of it is, you know, farmer livelihoods. So how can people, you know, live well and have money to be able to do the things that they want and need to do for their families is also at the heart of this as well.

Paul: And you heard the examples there of saying that if you get asked what antibiotics you've been using, you don't necessarily want to tell the truth because it might be that that causes problems for you and your income.

But if you didn't use the antibiotics in the first place, you wouldn't have an income because they'd be disease maybe spreading in amongst your stock of shrimp.

It's, yeah, it's a very complicated procedure. Like you say, there's lots of things to consider. Not quite as complicated though, as the life journey that Oskar's gone through, which I was quite impressed on. [Jan laughs]

The son of a vet who used to be a chef and then became a marine biologist and is now working on antimicrobial resistance.

Jan: He is a, he is a fantastic, uh, example of it. You don't have to stay where you started. And, uh, it's always nice, uh, going out to, to eat with Oskar, 'cause [laughing] he really understands what you're eating, from more perspectives than you probably wished he had.

Paul: Yes. I dare say that it's nice going out with him, but when he says no, I wouldn't have that if I were you, [Jan laughs] you suddenly wonder what you were letting your body in for if you had ordered what your initial instinct was to order.

Jan: But also sticking with that consumer perspective. So, if we paid more for food, then stocking densities could be less.

So in some ways, this comes back to the kind of issues that we were talking about when we had our mini-series on the Lake District Farmers. That actually food production systems can be intensive, not so intensive, and that there are different farm livelihoods, you know, food outcomes, animal outcomes that arise from it.

So really in the microcosm of a, of a Thai shrimp, you can open up all of those, those conversations,

Paul: And I remember from those discussions we had with the Lake District farmers, the fact that you don't necessarily have to eat as much in quantity if what you've got is packed better with the elements, the vitamins, et cetera, the various ingredients that your body needs.

And I daresay, the same is true for shrimp as well. So it's not as if we need to have shrimp farms here, there and everywhere, producing millions more shrimp every year, if we can make sure that the nutrients that the shrimp that are being produced have within them, are there.

Jan: Yeah, absolutely. Uh, there we are in a, I was gonna say in a nutshell, but it's not a nutshell, it's a…

Paul: …in a shrimp shell.

Jan: In a shrimp shell. In a shrimp shell, I can't even say that.

Paul: She sells shrimp shells. No, hang on. [Jan laughs] That's not quite right.

Jan: No, that's something different, indeed.

Paul: Yes. Let's not get our tongues twisted. Let's instead look ahead to next week, because next week, and we're coming towards the end of the series, but not quite there yet, but we're very nearly there.

We're gonna be talking about education, university transformation, and how all of this relates to sustainability.

Jan: Yeah, it's a, it's a topic we've touched on before, but one for which there's many reasons to come back to.

Paul: Yes, we've spoken about it with people from within this University. We're gonna be speaking with someone from outside the University next week.

Dr Alex Ryan is gonna be joining us and that's gonna be a really interesting conversation.

Until then, thank you very much for listening. I'm Paul Turner.

Jan: And I'm Professor Jan Bebbington.

[Theme music]