

SEI Asia Podcast Series: Environment and Policy in Asia

Episode 12: Monitoring air quality is crucial in the fight against pollution

By Charmaine Caparas, Achim Haug and Anika Krause

00:00 – 00:24

Welcome to SEI Asia's podcast on environment and policy in Asia. In this podcast series, we invite experts to discuss the many critical and complex environmental challenges in Asia, and how to find solutions through policy and partnerships.

00:35 – 00:53

Charmaine: Hello everyone! Welcome to environment and policy in Asia. I'm Charmaine from the Stockholm Environment Institute, Asia Centre. In this first episode of our two-part series on air quality, we are joined by Achim Haug and Anika Krause from AirGradient, a leader in air quality monitoring technology.

00:54 – 01:11

Charmaine: We will discuss the importance of air quality monitoring, highlighting the critical role of indoor air quality and explore air gradients, innovative work in schools through the SAMHE initiative that ensures safer air for children. Achim and Anika, welcome to our podcast.

01:12 – 01:13

Achim and Anika: Yeah, thank you Charmaine.

01:13 – 01:35

Charmaine: SEI and AirGradient have worked together in the past on some of our research on air quality, not just here in Asia, but in some other centres as well so we are quite familiar with each other's work, but maybe some of our listeners are not very familiar. So can I please ask both of you to tell us a little bit about yourself and your role in AirGradient?

01:36 – 02:31

Achim: Thank you, Charmaine. At AirGradient, I have the role of CEO and I take care primarily on developing partnerships like SEI for example, doing business development and looking at these strategic orientation of the company. My co-founder, Nick, is taking care of R&D, our data platform, the coding work and also the manufacturing. What I'm particularly interested in is to really build a business that's not purely focused on making as much money as possible but also taking into account our social responsibilities and being environmentally friendly. So what we do is we try to keep our monitors as affordable as possible so that they can be a good choice for countries in the Global South and we donate 1% of our revenues to NGOs that care about the planet.

02:32 – 03:12

Anika: So my name is Anika. I did a PhD at the Center for Atmospheric Sciences at the University of Cambridge. And there, I worked with air quality monitors so I tested them and I developed them further to improve their performance and I also applied them in research projects for example in China, Kenya or the UK and after my PhD, I stayed in contact with my colleagues, which are actually now my dear friends. And they told me that they have been starting working with AirGradient and I got quite curious about the approach which was quite different from other manufacturers from AirGradient. So the focus on sustainability and environmental impact open data, so I got in contact with Achim.

03:13 – 03:34

Anika: I coordinate a large global project to test and improve our monitors. I make sure that all of our research results and data. Are shared openly and I also create educational materials to make our research results, but also air quality science in general more accessible to everyone.

03:35 – 03:53

Charmaine: Thank you. What inspired the creation of AirGradient? And you mentioned Anika that this is quite a unique set up and it got you interested. So the question is for the both of you, what inspired the creation of AirGradient? And what about it drives your work?

03:54 – 04:23

Achim: Yes. So five years ago I was on a sabbatical in northern Thailand because my last job was based in in Thailand and when the so-called “burning season” or fifth season that the local people here know very well hit and I experienced really first hand how this affected the schools that my children attended. So we began as a volunteer project actually helping our schools monitor air quality more effectively.

04:24 – 04:52

Achim: So you know that the students and the teachers just kind of could protect themselves better and knew what's going on with the air quality and this really shapes us till today. So from the start we put a strong focus on open designs, robust and long-lasting hardware and a desire to support people from all around the world with, you know, affordable and effective air quality solutions.

04:53 – 05:14

Achim: AirGradient is currently the only global air quality monitoring company that actually makes all its hardware designs available for free under Creative Commons license. This means actually you can go to our website and you find all the electronic schematics, the firmware, CAD files for the enclosures, for example openly available.

05:15 – 05:53

Achim: We also publish all our research and algorithms so that others can really benefit from that extensive research that Annika, for example, is doing. By making our hardware open source, we also empower users, for example, to easily repair the monitors or upgrade them or basically tune them to their needs, and this extends the lifespan of the monitors and avoids things like they're not logged into subscriptions or things like that. So far, we have provided thousands of monitors into more than 70 countries.

05:54 – 06:36

Anika: it aligns with my values, so I'm quite environmentally aware and I like that they're impact driven and they work towards a greener future and the other fact is, before I started working with AirGradient, I worked a lot with chemical industries and they are very secretive in a way, so you cannot even take a group picture in front of the company because they're afraid that some secrets are being stolen so that was really annoying for me because it just slowed research down so much and I'm really enjoying now working for AirGradient because I don't need to worry about anything like I can just publish everything and I won't get into trouble with it. So these two factors, actually I really like.

06:45 – 07:08

Charmaine: Air quality is a hot topic these days. Whenever we look out the window in the morning, it's looking a bit gray, at least here in Bangkok, we say oh PM 2.5 is high today. Is that the same thing as saying air pollution is bad? Is PM 2.5 the new buzzword that people are using? how do we define air pollution?

07:09 – 07:43

Anika: In general, air pollution can be all kinds of substances that are harmful to the human body or also to the environment. But as you say, it's not only PM 2.5, there are actually a lot of types of air pollution, so the World Health Organization (WHO) has identified 5 big air pollution or pollutants that are harmful to human health. So the big 5 are particulate matter but also ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.

07:44 – 08:22

Anika: But it is true that particulate matter is of these five, probably the most monitored and studied pollutant. So if you read health studies or newspapers which mention the term air pollution, then very often they refer actually to particulate matter and particulate matter are very small solid particles that fly through the air basically so they're so small that they are invisible to the human eye. And they're so light that they don't settle down so that means they stay in the air for really long times, and we continuously keep breathing them.

08:23 – 08:49

Charmaine: In your opinion, why is air quality monitoring so crucial these days? And I don't know, just to put it into context, how much air pollution exposure would make it dangerous? Cause we always say now that you know the deaths that are linked to air pollution are even higher than other medical conditions combined so can you elaborate more on that?

08:50 – 09:09

Anika: So first of all, we need to realize that air pollution is a very severe issue that affects the entire global population. So outdoor air pollution alone causes 4.2 million premature deaths annually, according to the World Health Organization (WHO).

09:10 – 09:54

Anika: This roughly matches the deaths from traffic accidents, dementia and Alzheimer, malaria and suicides combined. On top of that, there is another 2.5 million deaths associated with household air pollution so indoor and not outdoor and therefore it is very essential to monitor air quality, because this helps us to better understand where air pollution actually comes from. So the sources how it spreads over different environments and how it affects our health in the end and if we know these information in more detail, we can also design more efficient strategies to protect the population from the health risks posed by air pollution.

09:55 – 10:55

Anika: Air quality monitoring is very useful to raise awareness in the population and that again can drive political changes or also behavioral changes of individual people to protect themselves from air pollution. It is also important to realize here that air quality is the whole time, so there are several factors that can affect it, for example, the time of the day, the wind direction, the traffic volume, rain and other emission sources in the near in the environment. So it is important to continuously monitor the air pollution in one place to capture these changes and air pollution can also change a lot across very small distances. So ideally to fully understand the air pollution in the region, you would also need a dense network of monitors to capture these differences in different places.

10:56 – 11:28

Charmaine: There is a recent article on The Guardian last week calling for a global fund to tackle air pollution. I thought it was interesting because when it comes to air pollution, those in more developing countries tend to fare much worse than those in richer or more developed countries. And for me, this shows that there is an unequal exposure to air pollution, and some might even call it environmental injustice. So for you as a researcher, what are your thoughts on this?

11:29 – 12:14

Anika: Well, first of all, I think this environmental injustice has many causes, and there are also political and economic factors that play into it, which I am not an expert on. From a scientific point of view, we can say that in these affected countries, there is only little or no air quality data at all available while in the economically strong countries, for example in Europe or North America, the air quality is already very closely monitored and research has found that the simple act of recording air quality data and then making it available to the public will eventually lead to an improvement of the air quality.

12:15 – 13:06

Anika: Just to give you an example, the United States has started to place air quality monitors in their embassies, especially in regions where there no or little air quality data available. And after some time, the PM concentration substantially reduced in these places where the monitors were installed and this is probably due to the attention and the awareness that these monitors and the publication of the data has created, and this eventually lowered the health risk for millions of people, and I think also in the Guardian, it was mentioned that the health costs you save by starting such a monitoring program are actually much higher than the costs for the monitoring program itself.

13:07 – 13:25

Charmaine: I know that both of you have worked really long time on this area, so maybe from the time that you have started to now I'm just curious how have air quality trends changed in the past decade? Is it becoming worse or is there some silver lining?

13:26 – 14:00

Anika: I have to answer this question looking at different regions in the world. So for example there are countries which already have established environmental regulations such as North America, Europe, Japan and China. There, the overall air quality has actually improved. So this is encouraging news. That means the environmental regulations actually do have a positive effect. But then there are also regions that have experienced strong increases of air pollution, and that's probably due to the population growth and industrialization.

14:01 – 14:34

Anika: And these regions include the Middle East, sub-Saharan Africa and Southeast Asia. If you want to know about it more in detail, the University of Chicago has made a fantastic visualization for that. So if you google Air Quality Life Index (AQLI), you can find a map where you can see how the air quality concentrations have changed over the past 20 years, I believe. And you can also see how this affects the life expectancies of people living in that region.

14:43 – 15:05

Charmaine: When people hear the words air pollution, they immediately think of smog, fumes from cars and burning smoke from agriculture, but no one immediately thinks about air pollution at home, like no one thinks about indoor air pollution, and research has shown that we should also be concerned with indoor air pollution. Can you expound more on that?

15:06 – 15:38

Anika: Sure. Well, first, we need to realize that people spend about 90% of their time indoors, for example, at home or in their work environment. So we breathe in far more indoor air than outdoor air. The indoor air can be just as much polluted as the outdoor air, of course, outdoor air pollutants can penetrate inside a building, and sometimes they can even accumulate there. But there are also additional indoor emission sources of air pollution and another factor is that indoor air quality is harder to regulate for governments, for example. So in some ways it makes it more dangerous.

15:39 – 15:45

Charmaine: Yeah, you mentioned additional sources of air pollution inside buildings. Can you give some examples?

15:46 – 16:40

Anika: A large contributor to household air pollution is definitely cooking or heating indoors with polluting fuels, for example, burning coal, wood, kerosene or or just waste, but also gas stoves, candles or incense burning can create harmful air pollutants that can get trapped indoors for a long time when you don't properly ventilate. Beside the five big pollutants which are interesting, maybe outdoors, there are additional indoor pollutants that deserve our attention. For once, there is CO₂, which we breathe out, so the concentrations can rise really quickly indoors if we don't properly ventilate. There are also indoor halogens that might be generated from mold or from mites. And then you might have already heard of volatile organic compounds or VOCs.

16:41 – 17:09

Anika: These are thousands of substances that can be much, much higher, concentrated inside a building than outdoors. Some of them can be really harmful, for example, because they cause cancer but some are also pretty harmless, for example, ethanol vapor or eucalyptus smell are VOCs, so that can make it a little tricky to gauge the health risks of just looking at the VOCs concentration inside a building.

17:10 – 17:38

Anika: What we know, however, is that especially when you're renovating so new building materials like your floor paint on your furniture, they can emit VOCs that are pretty harmful to us, and they can actually continue to emit them over several years. So especially when you have just a newly built house or freshly renovated or bought new furniture, you should keep VOCs in mind and adapt your ventilation habits to that.

17:39 – 17:48

Charmaine: You mentioned adapting habits. What are some things that we can do at home to protect ourselves from indoor air pollution?

17:49 – 18:35

Anika: So there's actually quite a few things you can do to keep the air quality in your house clean. One thing is you can use clean energy sources, so if you have the choice, use an electric stove not a gas stove and then avoid burning basically anything in your house, for example, candles, cigarettes or incense. If you have to do it, then just ventilate at the same time and that is really a keyword ventilating also when you're cooking or after cooking or when you have new furniture, for example ventilating, so just opening a window can help a lot and if you monitor your air quality indoors then you get a better feeling for when you need to ventilate or open the window.

18:36 – 19:26

Anika: However, some regions sometimes opening the window doesn't help because the outdoor air is worse than indoor air, so ideally if you combine an indoor monitor with an outdoor monitor, you would know the best times of the day where ventilation gives you the best outcome for your indoor air quality and then sometimes air purifiers can also be a good helping thing to improve your indoor air quality. Another fun fact is that particulate matter accumulates in carpets and it can be resuspended continuously so it increases your PM concentrations indoors. If you think about renovating your house and you are worried about air pollution, you should perhaps consider a different floor coating than carpets.

19:27 – 19:54

Charmaine: That's a really good fun fact. I do not have carpets at my home, I maybe have one in the future. Thank you, Anika. The next question now is for Achim. I've mentioned earlier that AirGradient has worked with SEI quite a few times so how does AirGradient technology help organizations like us or even the private sector or at the household level? How does it help in monitoring and improving indoor air quality?

19:55 – 20:51

Achim: Yeah Charmaine, I think that's a really good question. Being able to read the real time air pollution concentration at home at any time can have a really large impact on people's awareness of indoor air pollution. This already will most likely lead to behavioral changes. So the continuous monitoring allows you to firstly really understand the air inside your home, what makes it worse, and what makes it better so it shows the different pollutants in different rooms as well. With that understanding, you have the base for targeted improvements that become then much easier because once you start trying to improve, you have the old data and you compare and see ok does this thing that I'm actually doing really have an effect on the air quality? And then there are things that can be really fixed fast.

20:52 – 21:20

Achim: You can go to a supermarket and buy an air purifier with the EPA filter and switch it on and you will immediately see an improvement in PM 2.5 levels, for example. This is something you can do within hours, but then on the other hand there are other things that might be more complicated. So if you think about gassing of VOC is from building materials, for example. That could actually lead to being or needing to do renovations for retrofits.

21:21 – 21:53

Achim: So this just with the monitoring you will get a really good understanding on the healthy air and with the awareness on the indoor air in your home. You can actually bring that knowledge, for example to your workspace, to your office and talk with your coworkers and discuss with them how can we actually improve the air quality in the office as well. All in all, this really just the monitoring technology can really help individuals and also organizations to monitor and improve the air quality.

21:54 – 22:22

Charmaine: You also mentioned a while ago that the beginnings of AirGradient actually came from you and your children being exposed to air pollution in northern Thailand. Did this pave the way for your work in partnering up with schools to monitor their air quality? And can you tell us more about the SAMHE initiative?

22:23 – 23:14

Achim: Yeah, sure. I always say having started as a school project is still in our DNA even it's now like five years ago and really this mission to educate the next generation is really close to our heart. So I think the key thing is if you talk about schools or education and equality, there are so many opportunities in that fields and a lot of different perspectives you can look on this from an educational point of view, but also from air quality monitoring. So I want to mention a few things. So one thing that's really important is really understanding air quality inside this course that we work with understanding what's the air quality in classrooms and other spaces like common areas or sports facilities or maker spaces.

23:15 – 23:34

Another really important aspect is improving the awareness inside the community. I think this school is a great example of a very holistic community where actually not only the children, but also like parents often spend quite an amount of time and going to events and so on.

23:35 – 24:20

Achim: So we have organized in schools, for example, workshops around air quality or roundtable with parents. We discussed how should the air quality policy be in your school? Like at what level, for example, do you want to stop sports activities? Because maybe the PM 2.5 goes beyond a certain level and what's really important is to have these open discussions with the whole community. It's not only the parents and the teachers, but also including students actually and come to a common agreement on

ok what should the community do and create a common understanding and the awareness of the air pollution and the policies.

24:21 – 25:17

Achim: Another aspect with this course is that we actually really passionate about is the signs and coding aspect of air quality monitor, so we have a very popular air quality monitoring kit actually so it's not a ready-made air quality monitor but it's a kit that's very easy to assemble and it's very popular among students actually because it can be very well integrated into, you know, educational settings so the students can, for example, learn about how different types of sensors work, but it can also embed it in some kind of like electronics class and tell them, that's our basic electronics work or even like doing easy coding exercise and say hey, how can I actually write 5 lines of code and get data from the CO2 sensor. This gives a lot of ownership to the students as well to really feel ok, they can actually do something and have an impact.

25:18 – 25:39

Achim: For the ones who are not familiar with the word SAMHE means Schools Air quality Monitoring for Health and Education. It's a very big project in the UK where we deliver more than 2000 AirGradient indoor air quality monitors and this makes it actually the largest study of classroom air quality anywhere in the world.

25:40 – 26:15

Achim: So our work with schools and the SAMHE project as well goes really beyond just providing hardware so we believe in creating a comprehensive ecosystem of awareness and education, and ultimately action is really essential so we want to empower schools with the knowledge that that we have and the tools that we developed to improve our quality then contribute to a healthier learning environment and raise awareness of this bigger importance of air quality for public health and well-being.

26:16 – 26:27

Charmaine: Achim, I'm curious this sounds like a really amazing project that you initiated. During the implementation period, did you face any challenges with this?

26:28 – 26:53

Achim: I can think about two key challenges in in general and one is specifically in the global South, it's budget constraints I think is really a key issue that's still kind of struggling to overcome and another thing that's often not visible from the start or and more unknown issue but that can have a huge impact as the stakeholder engagement.

26:54 – 27:32

Achim: There's often just no money for buying any expensive air quality monitors, it's just not there. But we try as much as we can as the companies provide our monitor designs and the software like available or make it available for free so that actually schools can take these pieces from our website and build their own monitor and then save a lot of money. It is to make it cost effective, but also gives them a trusted solution because we tested this monitor about what Anika mentioned like in with a lot of universities and in so many different fields.

27:33 – 28:28

Achim: We also collaborate with partners and initiators to help funding these installations in the schools. For example, in the last 12 months together with other donors, we funded hundreds of monitors actually for schools and that makes an impact to help them. Regarding stakeholder engagement, I think this is really a key to success. So we often see the schools that maybe one person in the school wants to improve the air quality but doesn't really have the support from the whole community and this is often very challenging to do. The best successes we see is really the whole community is engaged in the implementation of the air quality improvements in the school and like having a very effective communication with all stakeholders is really key.

28:29 – 28:59

Charmaine: In Thailand, you know where air pollution is considered seasonal, there is a burning season and all of the other months it seems that we're fine. What would be a good approach or for policy makers or what are some of the key things that they should keep in mind if they really want to address this air pollution crisis really effectively?

29:00 – 29:44

Achim: Charmaine, I think that's probably the most difficult questions because we have since decades and so far it hasn't been fixed, but let me give my two cents on on this. I think it's really a multi-layered issue so you need you need a balanced approach that also includes regional collaboration because often the smoke goes beyond borders and it needs long-term planning. It needs obviously money, economic consideration and awareness. So let me dive in on a few things. So a lot of the pollution is caused by, you know, burning crop residuals and this means that there needs to be economic support for farmers, they need to get better access to technologies and methods for like sustainable farming.

29:45 – 30:26

Achim: So this has some basically financial incentives that are required and also obviously educational aspects that need to be considered here and so this shift away from this traditional burning method, I think is hugely important. What's interesting and I mentioned before, just and public awareness and what was really interesting to see I was in Thailand during the COVID lockdown and suddenly everybody was wearing masks but not because of the air pollution, because there was also in March and April when the lockdown was not because of air pollution, but because of COVID. So it's interesting to see how the COVID campaign to wear mask was actually much more successful than the air pollution.

30:27 – 31:01

Achim: You also need to convince people at certain levels to wear masks. I think it shows that actually there can be an improvement in public awareness to protect themselves so I think this is something that can be focused on just for your personal protection. But I think also super important is regional collaboration. When you look at NASA, they have this map about the wildfires, and if you zoom into Southeast Asia, you see basically it's burning everywhere, and the smoke obviously doesn't hurt if there's a border; it just blows right across the border.

31:02 – 31:34

Achim: Obviously, a lot is also made inside Thailand, a lot coming from outside, so everybody has a share, but it also means that to really combat this, you need to cooperate across borders and work with neighbouring countries and see if they can align policies with the other countries to tackle air pollution. Another thing that makes it really challenging is that we talked at the beginning and we called it the fifth season, so it also implies that actually, especially for northern Thailand, the other four seasons the air quality is actually pretty good.

31:35 – 32:19

Achim: So, but what it causes is that once you get into that period, March and April where the air quality is getting bad, everybody is starting to being very concerned and trying to do something and then in May and June when the rain starts and everything drops down to green. It is actually really difficult to achieve meaningful change because you just don't have this constant pressure on doing something. Nevertheless, if you put these things that are mentioned together into a comprehensive strategy, it's something that's ongoing and not dependent on who's in power or what's the season and things like this and hopefully like step by step we can come to healthier air quality.

32:20 – 32:45

Charmaine: You mentioned public awareness and how that's really important. If we want to tackle this issue really head on, I'm very curious sometimes it seems that you know all of the decision making is not within the ordinary person's power. What are some of the steps or some of the more simple things that we can do to just give us that agency that, "You know what I can breathe cleaner air."

32:46 – 33:23

Achim: One thing Anika mentioned at the beginning is like we have a lot of areas in the world particularly in the Global South there where there's not much monitoring data, so just by getting an air quality monitor, deploying it and contributing the data to organizations like Open AQ that collects it and then makes it available for research that ultimately also drives policy changes I think is a very good action and but we saw with the US embassies just putting one monitor on the roof and the impact they have, like you can really replicate this as a single person.

33:24 – 33:42

Achim: Another thing I think what's often undervalued and where everybody can play a role because it doesn't cost any money, is really raising awareness so talk to your family, talk to your friends, talk to your neighbors and make them aware hey, there are really significant health risks associated with air pollution.

33:43 – 34:30

Achim: Like often people know roughly PM 2.5 is not good, but really talking about them in a little bit more detail on like how bad these health impacts are. That can really motivate them to do something. You can use social media, you can go to meetings, you can just spread your knowledge and share your personal stories on air quality and how you personally affected or how you personally reduced your exposure. So reducing personal emissions, I think is another really undervalued things so you know, are you taking the car or the bike? Are you taking the bus or driving again? So like, just choosing your transportation method in in Bangkok, you know you can use the Skytrain, which uses a lot of emissions or you're sitting in an idling car in the traffic jam.

34:31 – 34:49

Charmaine: Thank you so much Achim and Anika. We have definitely covered a lot of important things on air quality monitoring and practical things that we can do to make a difference. Thank you so much.

34:58 – 35:16

Charmaine: I have mentioned that this is part one of a two-part series. So on our next episode we will talk about Thailand's draft Clean Air Act, which aims to regulate activities that cause air pollution including agriculture, transport and businesses. Thank you for listening and tune in again next time.

35:17 – 35:18

Achim: Thank you for having us, Charmaine.

35:27 – 35:39

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