



Insect Hour

Deepa Senapathi: Land Management for Beneficial Insects & Smallholder Livelihoods

Transcript

Hello everyone, a very warm welcome to this month's Insect Hour. Thank you so much for joining us today. Just two quick things before we get started. We are recording this session and the recording will be available after the event. Um if you have any questions during the talk, please pop them into the chat box. We'll come back to them at the end of the session.

First of all, we'd like to share a few updates from the Royal Entomological Society.

A reminder, Insect Hour takes place the second Wednesday of the month from 1 to 2:00 p.m. However, we do take a little break in August, September, and December. Our next talk will be on the 14th of October. We will be welcoming Professor Andrew from UCL. If you'd like to hear about future talks and register for upcoming sessions, please do scan the QR code on the screen.

Membership is open to anyone who loves insects. To all of our current members, thank you for your continued support.

And if you are not yet a member, membership starts from just £17 per year. And if you are a student, your very first year is completely free.

Plus, if you join us um this July, you can get a 20% discount by using the code shown on the screen. As a member, you'll get access to our entomological library and all of our scientific journals. You'll also receive discounts on events and publications.

You can apply for awards and research grants and receive updates through antenna magazine and our newsletters.

Next up, a massive flagship annual conference Ento26 which will take place from the 8th to the 10th of September at Cardiff University. There will be keynote speakers, member symposia, workshops and plenty of opportunities to network. You will also have the chance to showcase your research through talks and posters. The abstract deadline has officially passed now, but you can still purchase your tickets to attend. We have extended our early bird registration deadline until the 10th of July. So make sure to grab your tickets soon.

We also have some wonderful in-person events coming up. These include meetings and events organized by our Special Interest Groups and opportunities to hear about current research and developments in the field. Coming up is our sustainable farming event on the 14th of July. So please do scan the QR code and have a look.

Finally, if you're thinking about publishing your research, our journals are of high quality peer reviews and fast turnaround times, massive global audience, you can share your entomological research with us and support the wider entomological community.

And now it's my absolute honour and pleasure to introduce our speaker today, Professor Deepa Senapathi from the University of Reading. Senpathi is a professor of light ecology



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and the head of department of sustainable land management. Her incredible research looks at how massive environmental changes like climate change and land use affect our biodiversity and ecosystem services. She has done amazing work in both tropical and temperate climates taking tracking everything from endangered bird populations to our local insect pollinators. She's also worked directly with policy makers at DERA to turn science into real world action.

Today she's going to share some fascinating insights from two major projects in South India looking at how we can work directly with small holder farmers to protect local biodiversity while completely safeguarding their livelihoods. So Professor Deepa we are really happy to have you with us today. I will now hand over to you.

Thank you very much, it's a real pleasure to be here and thank you to everybody who's logged in online.

So good afternoon everyone and thank you for taking time out of your busy schedules to come and hang out with me for the next hour, and this talk is a little bit about the journey I've been through over the last sort of seven years or so working with small holder farmers in India but trying to sort of actually transfer or exchange knowledge of things that have worked well in UK and in the global north and how that might work in an overseas development context. So I guess for any of us who work in biodiversity conservation, these sort of headlines are not new.

We are living in the age of the Anthropocene, we know that over 1 million species are currently threatened with extinction, and according to the Living Planet report from 2024, at least 73% of declines have been seen in wildlife populations in just the last 50 years. And insects are no different. So again we are used to seeing sort of popular science articles and headlines such as insect Armageddon or "Insectageddon" and so the vanink paper from 2020 particularly showed how terrestrial insects whether you're talking about their abundance in biomass or whether you're looking at them across geographical regions or biomes overall terrestrial insects are doing far worse than perhaps freshwater insects.

There's also been these alarming sort of statistics that we're losing about 9% of insects per decade, and in this sort of catastrophic world where we are losing biodiversity at an alarming rate, most of us are trying to do our bit in trying to understand the drivers of decline but also then try and find sort of adaptation and mitigation solutions. So again I think we're all very familiar with um the big five drivers of biodiversity decline.

So you can't talk about biodiversity decline without bringing climate change into the conversation. We talk about habitat loss, overexploitation, whether that's you know overexploitation over land or over water pollution, air, water, soil pollution and invasive species.



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And while these are sort of understood to be the broad drivers of biodiversity decline, there have also been insect specific studies that talk about pretty much the same drivers of decline but perhaps in a slightly more in-depth context.

However, what regardless of what the major driver of decline is, none of these drivers work in isolation. They're all interacting with each other quite often, exacerbating the effects of each other. But ultimately it all comes down to the fact that we as humans and how we've utilized our land is the biggest driver of biodiversity loss including the insect declines. So these are some of the more recent papers from 2021/2020 that talk about how much we as humans have altered the earth's land surface.

So about 3/4 of Earth's land surface has been altered within the last millennium. And particularly you know when you're talking about conservation or protected areas whether that be national parks or natural 2000 sites or you know any sort of area that has protected status only 10% of the global terrestrial protected area network is structurally still connected by intact land.

So if the way we use our land and the way we manage our land and the way we change our land use is leading to these biodiversity declines and causing huge amounts of problems.

Surely the way we use and manage our land can be the solution to our problems as well. So most of you if you're working in a sort of UK, European, North American context will be familiar with agri-environmental schemes and quite often agri-environmental schemes over the last sort of decade or more have been focused on increasing floral resources in farmland and arable landscapes in particular to boost pollinator communities and beneficial insects, and quite often this has been achieved by improving semi-natural habitat around arable sites or actually taking a bit of land out of production and putting in wildflower strips.

Now, wildflower strips obviously are improving the floral resources and there's been a wealth of evidence across Europe and North America about the efficacy of these floral interventions as part of agri-environmental schemes. So, not only do these floral interventions boost the abundance and diversity of the floral resources, they then boost the abundance and diversity of beneficial insects. but are then quite beneficial to wider biodiversity for example farmland birds which both gregarious and insectivorous birds.

So these sort of agri-environmental schemes that are aimed at boosting biodiversity without sort of impacting production in a in a sense or providing incentives to farmers to take a bit of land out of production and compensate them for any loss in yield have been popular for many many years.

However, creating wildlife friendly habitat does come with a cost. Now, this is a study by Blau and Isox across the pond in Michigan State University, and this is from just over well, this



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is about 12 years old this study. However, the central premise of this study still holds and that is to say regardless of whether there are financial incentives in place or subsidies in place whenever there is a shift in management from a sort of high intensity production focused management to a more sort of environmentally wildlife friendly focused management. the farmer or the land manager or the land owner is going to experience a dip in their profits.

Now the duration of this loss in profits varies and subsidies and incentive financial incentives help weather that gap. But you can see from this graph that it takes anything between 3 to 5 years for farmers to start breaking even before they start seeing a return on their profits or their return on their investment.

Now this if this is the situation in the global north where agri-environmental schemes and financial incentives exist that this poses a huge challenge in small holder farming systems where these incentives do not exist where farmers are usually their livelihoods depend on that season's harvest and they do not have the financial buffer of 3 to 5 years to be able to weather that.

So this this really becomes a question of whether farmers can find other ways of boosting biodiversity on that land but without those sort of without taking a financial hit as it were. So it was under these circumstances that project tropical was born.

So this project, I mean, it was a nice little acronym that we managed to come up with, but it basically it does what it says on the tin. It was about translating research opportunities to enhance pollination benefits to economically important crops, but the key thing was to also improve livelihoods. Now we had a project in the UK which was looking at sustainable management of orchards apple orchards in Kent. And what we found was having these wildflower strips in amongst the orchard tree lines boosted the abundance and diversity of pollinators and it improved pollination and it also improved the yield and quality of the produce.

But translating this into an overseas development context, particularly talking to farmers and asking them whether they would be inclined to put wildflower strips was an absolute no-go. So this project was actually done in my home state in India called Tamil Nadu and the farmers were quite amused that this girl from Tamil Nadu who'd gone over to England was coming over and asking if they could put wildflower strips and she and they were like surely you're slightly insane if you're talking to us about putting wild flowers in a drought prone water stressed area with labor shortages! So we said no this is just an idea - The basic premise of that is to boost floral resources.

They were aware of pollinators and pollination but they hadn't quite made the link between boosting floral resources for pollinators which would then translate into yield benefits. So we initially had many discussions with them before we even put a project proposal together. But

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our aim was to combine this sort of existing evidence that we had from our projects in the UK and combine it with local expert knowledge to determine what would be good floral enhancements.

And so it was the farmers themselves who came up with a long list of co-flowering crops rather than wildflowers. They said why don't we plant co-flowering crops in um around the field edges or interspersed between our trees and you know that that would provide the floral resources for the pollinators if what you say is true. So that is what we did, and we did this in mango and in moringa but in the interest of time I'm just going to chat about the moringa work. So what you see in this picture is a moringa orchard.

The bushy trees there are moringa and moringa is very much part of the staple diet in in South India and Southeast Asia and some African countries as well. So it's an iron rich vegetable food but currently it's an emerging superfood. The moringa leaves and stems are being powdered and exported all over the world because it's iron rich and it's high in nutrients. So these moringa orchards we had orchards some orchards as control without any floral interventions. But the orchard that you see in this picture, what you see as the yellow flowers are marold. So marold was planted in between the trees. And then on the edges, we planted red lentils. So that is also it's a fabi. It's also a flowering plant that's quite attractive to pollinating insects.

And what we found was that diversity-wise, we had the same insect pollinators in both the control orchards and in in the orchards with these floral interventions, but the abundance was significantly higher in the orchards with these floral interventions.

So for those of you who are interested in what species we actually saw, I mean carpenter bees are known to pollinate moringa very efficiently. But other than the carpenter bees, we had you can see quite a few honeybees here, but these are all wild honey bees. So these were not managed honey bees. There were no hives in in the area. So these are all the bees that you see here are wild pollinators. And we had quite a lot of different types of bees, hoverflies, butterflies, which are not the most efficient pollinators, but they were seen in large numbers and also quite a lot of wasps, so what did that actually translate to?

So having a higher abundance of pollinators meant there were lower pollination deficits. So if anyone's unfamiliar with the term pollination deficit, it means the actual pollination realized the gap between the actual pollination realized and the maximum potential pollination that could be realized. So the gap was reduced. We did see an increase in yield in those orchards with the floral interventions. The quality of produce was better. So, so the weight of the vegetables, the weight of the maringa pods, the girth of the maringa pods so the quality metrics of the that vegetable were significantly enhanced in the fields with the floral interventions.



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But more important than that from the farmer's perspective was the secondary benefits that they got from these co-flowering crops. So for example, marold is used in a lot of sort of um religious rituals and people do wear it in their hair quite a lot. So marold could fetch a high market value for them where they could harvest the flower flowers and sell them in the market. And then with the red lentils, even if they couldn't harvest enough to sell, they could use it for their own household nutritional needs because it is a high source of protein.

So most farmers realized either an economic benefit, a nutritional benefit or both in terms of having these co-flowering crops. So in this case, we actually found a win-win for the biodiversity and the farmer. However, I would just throw in a note of caution here and say that any ecological interventions that we choose need to be context specific.

So for example, the marold worked really well in in the sort of monsoon post monsoon season where there was ample water. Now maringa is a drought resistant crop. Marold isn't. So in the height of summer, marold would not survive without the farmer having to put in additional resources to get irrigation to the field. So so these sort of contextspecific nuances always need to be considered.

So this was sort of looking at beneficial insects boosting beneficial insects from a pollination perspective. But most farmers you talk to are worried about pest control. And so when we're talking about land management for controlling of pests and things and management that would help kind of help biodiversity, we cannot shy away from the fact that we need to reduce our agrochemical input. However, the UN Food and Agricultural Organization estimates that up to 40% of global crop yields are reduced each year due to the damage caused by pests.

Now, if that is the case, again, thinking of it from a small holder perspective, you cannot afford to lose 40% of your crop yields or your family is going to go hungry for that season. So to to sort of ask them not to use agrochemical inputs unless you can give them a viable alternative is just it's a non-starter as far as conversations go. However, we all know as entomologists that natural enemies of crop pests can be a good alternative to insects. But it is kind of showing to the farmers that this can work that that there can be land management that can boost beneficial biodiversity that in turn can control the pests on their farms. So this was the second project that we were involved in um sorry before I jump into the India project. So this again we were trying to sort of use evidence that we had from research in the UK to show how this could be translated into an overseas development context.

And here again there were wildflowers that were used in apple orchards that that actually boosted natural enemy populations and reduced crop damage by pests. but also a more economically focused study showed that even a 10% reduction in natural enemy density from what is normally a full community reduces yields in economically important crops in the UK. So you can see that between barley and oil seed rape and wheat the percentage

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reduction in yield if there is a drop of 10% in natural enemy composition. So we know that you can manage land. So you can put in floral resources that will attract natural enemies and lack of natural enemies actually has a detrimental impact on yield. So armed with this evidence we had more conversations with farmers. This time farmers growing rice which is, you know, a staple food and grown across the country. And we had two sets of sites. One in North India in Uttarakhand and the other one in the south in Puducherry.

And here again we had fields with and without floral interventions. But we also had fields with high agrochemical input and low agrochemical input. So the number of times they sprayed and the intensity in which they sprayed. So that that was the difference. So the floral interventions were planted in the rice buns, and the interventions we planted here were black gram cow pee and agati which is kind of part of the spinach family. It's the greens. And while natural enemy pest interactions are harder to quantify than say pollinators we focused on a single pest in this study. So we focused on the yellow stem borer which is the biggest problem that the farmers have and then looked at um the natural enemy communities in these fields.

So again I'm talking about the results from Pondicherry in the interest of time, so what we found was in low input fields where fields were not spread um excessively or intensively with chemicals there was an increased natural enemy um numbers and diversity.

So this was not a real surprise, but what was further surprising is the results of the pest abundance. So just to talk you through the graph, the purple ones, the purple lines indicate the high input fields.

The green lines indicate the low input, low agrochemical input fields. And where you see the flowers shown are the fields with the interventions. So very low input fields with no floral interventions had high pest abundance. there's nothing to control the pest species there. But where they had floral interventions, it was comparable to the high input fields without floral intervention. So having floral interventions actually meant that farmers could you know um that that was a good alternative to bring in natural enemies to control their pests and therefore not have to spray as much. And this then had showed up in the yield results as well.

So we were always expecting the high input fields to have the higher rice yield. It's and that that is the reason people use high agrochemical input. But it was it was heartening to see that even in fields with low agrochemical input where there were floral interventions the yield wasn't reduced and it was comparable to the high input fields with the floral interventions.

And we've had farmers with um talk to us about this and basically a farmer said once he put in the floral interventions normally if he sprayed you know four to five times a year a season this time he sprayed once or twice and that saved him a lot of money.



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It saved him about 2,000 rupees. So, in addition to the scientific evidence, we also have anecdotal data that is helping the farmers with their livelihoods and their yield. And in a similar um story to the maringa that I told you, the black gram and the cow pee, they harvested and they sold at the market for an additional source of income.

Now, both of these examples talk about beneficial biodiversity, beneficial insects. And so we're looking at it from a sort of ecosystem service perspective and you know boosting insect populations that are useful to us as humans that provide a service. So if we are using that ecosystem service argument does biodiversity really matter? Is it not just about the numbers of insects?

So this study which some of you may be familiar with from 2015 looked at crop pollination in across global crop data sets and the end result showed that 80% of crop pollination needs are fulfilled by just 2% of bee species. So if we use the ecosystem services argument only then it kind of limits us because we can focus all our conservation efforts on the 2% of insects that deliver the ecosystem services we need. However diversity has a huge implications. For example, we showed with again this this study that we did were was using 42 crop data sets from across the world. And what we found was those systems that had a bigger diversity of pollinators was more stable from one year to the next.

So if there was a stable pollinator community, a diverse and stable pollinator community, that meant that there was less fluctuations in yield and the farmers depending on these pollinator dependent pollinators and pollinator dependent crops would not have to worry about a boom bust fluctuation in their yield.

But also it's again going beyond what we need in in terms of ecosystem services. There is also ecosystem function and resilience and diversity can confer resilience. So this sort of seems like a good time considering there's a World Cup footy on at the moment to use a football analogy, but it works for any team sport if you're not interested in football. So if you're playing competitive sport, the manager or the team coach or whoever's in charge puts their best playing 11 on the field, and while that is the best strategy, you can't put all your efforts into the playing 11.

Your bench strength counts. So for whatever reason, if your star striker or your best defender gets injured, somebody needs to come off the bench and fulfil that role. And diversity works in the same way. it. We cannot say with with the changing environment, with our changing climate, we cannot be certain that those species that we have that are keeping our ecosystems resilient and functioning will be the same species in 10, 25, 50 years time.

And if we invest in diversity, even if we lose a few species, whether they move away or whether that that habitat becomes non-conducive for them, then there are other species waiting in the wings, so to speak, to take over that role and ensure that our ecosystems continue to function and are resilient for the future.



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So on that note, what have I learned from these two projects and the various sort of years of working with insects? I have found that to protect biodiversity without ignoring the livelihoods of the people involved, co-design is crucial.

You need to talk to people beyond academia, beyond the science to actual people on the ground who are doing the land management and come up with solutions that work for them and but do it in a scientifically robust manner so you could provide the evidence co- benefits must be considered. I think the argument I am a conservation biologist and I believe that biodiversity has intrinsic value but if you are not in that sphere then you have to consider what benefits co- benefits might be achieved whilst saving whilst focusing on conservation efforts but also ensuring that the farmers are benefited in some way.

Knowledge sharing ensures success. So this was one of the best projects I've been involved in just because we kind of planted the seed and it's taken on a life of its own. So those farmers who initially were really sceptical and said we'll we control farmers and not we don't want to put in these interventions because I do we don't think they'll work they've sort of started putting in interventions of their own volition. The projects have long ended but these farmers are putting in these interventions on a regular basis.

They've also gone and told their friends and family and kind of spread the word through village knowledge centres. And now we have about 50 farmers in the surrounding areas all um uh doing well they're testing out different floral interventions um kind of you know so it's that sort of peer-to-peer knowledge sharing and knowledge exchange that's working.

And finally, I would say that these sort of participatory approaches are required to identify context specific solutions because clearly what works in the UK is not going to work in India and what works in one season in India is probably not going to work in another season and what works for one crop is not going to work for another crop. So, if we do need to have those conversations to sort of encourage those participatory approaches and empower those people who are custodians of the land to help um conserve our insect populations whilst reaping the benefits that they sow as well. So I'll leave it there and just say thank you to a whole host of people who've been involved in these projects, the funders of course and my collaborators across the world. Thank you.