The prevalence of neglected tropical diseases has in many parts of the world decreased significantly – while there has been significant focus on collaboration and access in terms of clinical strategies, attention to integrated vector control has in places been lacking. What has been the experience for Ghana in terms of integrating vector control in disease control strategies?

The NTDs that are amenable to preventive chemotherapy which could also benefit from vector studies or vector control activities are onchocerciasis and lymphatic filariasis. These are the two main diseases of the PC-NTDs (the NTDs which can be controlled with Preventive Chemotherapy) which could benefit significantly from vector related activities. Unfortunately, there is less integration of vector control in disease control strategies in Ghana.

Looking at lymphatic filariasis as an example, what type of vector control interventions would you consider appropriate for Ghana, its setting and its elimination and eradication goals?

Currently, the use of bed nets impacts on vectors of lymphatic filariasis, because they happen to be the same vectors as those of malaria. The only difference is that in a few small places, you seem to have other vectors that are not the same vectors as those that transmit the malaria parasite. It will be useful in those specific areas to try to understand a bit more as to what are the vectors, their behaviour and how they can be controlled. The reason being because those vectors could be more important in areas with low level infection in the human populations, for example the lymphatic filariasis programme in Ghana has worked so well and the infection levels are much lower in the human population but in some areas there is still ongoing transmission and this could be due to the vectors in those areas.

From a tool perspective, is this the type of work that you are carrying out at the Noguchi Memorial Institute for Medical Research to improve the understanding of the vectors and their ecology?

The studies that are currently being undertaken are looking at areas where mass drug administration has gone on for quite some time, and yet, the disease in terms of transmission appears to be ongoing. In those areas we are trying to understand a bit more about what could be the driving factors; for example, is it due to coverage issues, to some cultural issues, different vector species? We are undertaking some research on mosquitoes that could serve as vectors, their behaviour and ecology among others in those areas.

The distribution of vectors is constantly changing due to external factor such as commerce, human migration or global warming. Also, many countries including Ghana have had MDA programmes in
place for some time - would there be an effect on the disease reservoir? Is it worth investigating that and then looking at the interaction with the vector and disease distribution?

I don’t think that the MDA on its own will impact much on the mosquito vectors in terms of lymphatic filariasis or on black flies for onchocerciasis. However, they will impact on the reservoir of parasites that vectors can pick up. In onchocerciasis for example, the WHO guidelines indicate that vector evaluations are critical in stopping MDA decisions because at lower parasite intensity when parasitological assays may not be sensitive enough to assess whether there is ongoing transmission, blackflies can still pick up parasites during blood feeding. Even though the drug will not impact in terms of the vector numbers and so on, it impacts on how many parasites the fly can pick up.

In lymphatic filariasis, there are two scenarios; firstly when the intensity of infection is high and secondly the infection intensity in humans is very low, Different vector species perform differently in these situations. Anopheles mosquitoes are not good enough to pick up parasites and transmit when the intensity is low. This is the basis for the strategy that when MDA drives infection to a low level, one can stop treatment and the transmission will die out. However, there are other vectors that could be able to pick up low levels of infection and transmission could continue. This is the case in places such as French Polynesia, where vectors, such as Aedes polynesiensis are involved in transmission, so there is an interplay of vectors and parasites in the outcome when MDA is being administered.

As someone who is conducting studies, and very much aware of the overall perspective in terms of vectors, what type of partnerships on a data level would assist in better understanding the vector distribution changes?

I think that given the current recognition of the importance of vectors which is building up after the recent zika outbreak, there is a need to understand more about vector biology, ecology and vector control strategies. Furthermore, in many meetings it would be important to have the vector component and related data discussed, but if you don’t get that, it falls off the radar for most of the NTD communities (Donor Partners, NGDOs, countries) and hence not considered important enough for investment.

Perhaps as a response to a global lack of attention to vector control in disease control discussion, we often hear (for example at our own annual vector control conference ISNTD Bites) about the lack of of the entomologists and in fact also the anthropologists. Is this the case?

You often hear about the importance of vector control (which is only one aspect of entomological activities) including in the WHO perspectives. There is even going to be a possible World Health Assembly resolution on vector control. So yes, it is an exciting time for vector-related activities but I still feel that even though it is upcoming, it will be better to have more entomologists trained and also participating at international meetings on disease control and also have a forum to discuss some of the challenges in vector control at such meetings.

Vector control shouldn’t be seen only as a stand-alone strategy, but as a valuable tool and an integral part in the context of vector born disease control and MDA, in monitoring and evaluation, and so on. Thus, if there are challenges in vector control and any other entomological aspects, these can be brought up and discussed as the whole NTD community moves forward on the agenda. Otherwise entomology will lag and by the time we feel that it has to be part of the mainstream there won’t be enough entomologists.

Sustainability through knowledge transfer is key. As a professor and from this applied entomology perspective, is there room to develop entomology courses and embed them into WASH, or perhaps even drug discovery or disease control?
surveillance, and have a component onto courses? Would you advocate for that?

Certainly, having a component of entomology is important. If you ask medical officers or trainees in Ghana, they know which mosquitoes are the ones that transmit malaria and are aware of using bed nets for example. There is a component of their education that taught them about disease transmission, but it did not translate to be well versed in entomology.

The other way is also as important: to be able to have entomologists process disease control issues, there should be a public health component in the entomology curriculum so that you can train entomologists to have public health knowledge.

This means that conversations and discussions can go across both ways. The language in entomology is different from the language in public health, and educating people in both helps.

Building on the *lingua-franca* concept, is there scope in the Ghanaian system for courses to be rolled out or produced with a curriculum modulated to reflect what you just said?

There are courses at the university level, for example there is the African Postgraduate Programme in Insect Science. This deals with both agricultural entomology and medical entomology. And so, in the past there were discussions to link this course with the School of Public Health. However, modifying curricula is not an easy thing. Nevertheless, I think it is possible and I do know that the WHO was supporting a programme in Sudan some years back where the idea was to have an entomology curriculum that actually included a lot of public health concepts.

**Do you think the next generation of entomologists will be African?**

I don’t think it will only be African, because we have started seeing vector-borne diseases cropping up more and more in Europe, US and in other places, maybe because of global warming and other causes such as trade and shipment of goods. As that happens, the schools of tropical medicine that are in almost all European countries will start to see entomologists from all over Europe including the UK getting involved in field entomology. I feel that it’s good that we all meet up and collaborate from the North as well as the South.

This applied concept in terms of teaching entomology, not from a pure perspective, but from an applied perspective and a two-way relationship. Has there been any traction in the WASH community from this?

I don’t think there has been that much of this conversation in the WASH community because if you view the general NTD community, the WASH community interaction is just building momentum. I think this will come up, because I remember when I was a child there were sanitation officers who would come to your house, and use a dipper into your water containment vessel to try and find out whether they could find mosquito larvae in there. And so, once the WASH community gets more integrated with the NTD community, this will come up and which will lead to interactions.

One other thing I want to mention: vector control is mentioned a lot but I think it should be more on all vector related activities, because vector control has its components that deal mostly with the control the vectors. However, other vector related activities are also needed to monitor for example the impact of programmes such as MDA on communities. These are the things which need to be captured more in the conversation, and not just the purely vector control aspect. This will then bring to the fore the need for entomology and entomologists in all aspects of disease control.