The current global policy situation regarding GM insects for disease control
John Marshall
House of Lords, London, UK, 10th February 2015

Current global policy reflects a world in the early stages of technology adoption regarding transgenic insects with applications to health and agriculture. The UK is more a developer than an end user of this technology, and relevant policies therefore focus on ensuring the technology's safety and efficacy prior to export with the intention of release, although there are potential agricultural applications of GM insects in the UK that could be warranted in the future[1].

There are two broad categories of GM insects with very different regulatory requirements – self-limiting strategies, for which transgenes only persist in the environment for a few generations, and self-propagating strategies, for which transgenes are designed to spread into a population and potentially across national borders[2]. The benefits and risks of the latter strategy are clearly of a greater magnitude; however, many of the same issues regarding trust exist for both. Genuine engagement with community members and other stakeholders and gaining support from regulators will be essential in enabling the benefits of these technologies to be realized.

The US has been an early adopter of GM insect technology. Releases of GM pink bollworms, an agricultural pest, were approved by the US Department of Agriculture and have been carried out since 2006[3]. The US Food and Drug Administration is now considering whether to approve the release of sterile GM *Aedes aegypti* mosquitoes to control the spread of dengue fever in Key West, Florida. Due to the sterility of these mosquitoes and their lack of human toxicity, the risks are very low; however certain vocal groups are opposed and care should be taken ensure open communication and to address their concerns in a comprehensive scientific risk assessment[4].

It is important to acknowledge the interaction between public attitudes and government policy, and hence the importance of regular dialogue. An Indian sterile insect program in the 1970's was derailed by conspiracy theories before it began[5]; however, comprehensive community engagement has led to widespread support for recent dengue control projects involving *Wolbachia*-infected mosquitoes in Australia, Vietnam and beyond. Dengue control projects involving releases of sterile GM *Aedes aegypti* mosquitoes in Brazil have also enjoyed widespread support, with approval for commercial release granted by the Brazil National Biosafety Technical Commission pending final support from the Ministry of Health[6].

Applications of self-propagating GM insects are further from implementation; but successful demonstrations of self-limiting GM insects will likely boost trust in these strategies. The most widely-discussed application of self-propagating GM insects is the control of malaria in sub-Saharan Africa. Computer simulations I have been involved with at Imperial College London highlight the strengths of GM mosquitoes for malaria control stemming from their ability to spread beyond their release site and to be unimpeded by the compliance issues inherent in other interventions.

While one may expect community and regulatory consent to be difficult to achieve in Africa, my experience with conducting public attitude surveys in Africa on GM mosquitoes is that the majority of respondents would support a technology shown to be capable of reducing malaria prevalence without significant side-effects[7].

According to the Cartagena Protocol, a GM mosquito capable of spreading across national borders may require a regional agreement prior to its initial release[8]. Zambia, who rejected US GM food aid in 2002, could be seen as a potential obstacle to this; however, their rejection in 2002 was based on a lack of pre-existing biosafety laws and the idea that these were being effectively imposed on them by the US[9]. Zambia now has its own national biosafety laws, along with 18 other African nations.

Public and regulatory support will be hard-earned and should be viewed as delicate; but my contention is that it is achievable and that, given the tremendous social and economic burden that vector-borne diseases pose on our planet, it is our obligation to enable this technology to be realized.

References:

1. Webb, D., 2010 The economic and social impact of the Institute for Animal Health's work on Bluetongue disease (BTV-8). Institute for Animal Health, Edinburgh, UK.
2. Marshall, J. M., and C. E. Taylor, 2009 Malaria control with transgenic mosquitoes. PLoS Medicine **6**: e1000020.
3. Simmons, G. S., A. R. McKemey, N. I. Morrison, S. O'Connell *et al.*, 2011 Field performance of a genetically engineered strain of pink bollworm. PLoS ONE **6**: e24110.
4. Ernst, K. C., S. Haenchen, K. Dickinson, M. S. Doyle *et al.*, 2015 Awareness and support of release of genetically modified "sterile" mosquitoes, Key West, Florida, USA. Emerg. Inf. Dis. **doi**: 10.3201/eid2102.141035.
5. Davidson, G., C. F. Curtis, G. B. White, and P. Rawlings. Mosquito war games. Nature **296**: 700.
6. Thompson, T., 2014 Press Release: Oxitec's solution for controlling the dengue mosquito is approved by CTNBio. Oxitec Ltd., Abingdon, UK.
7. Marshall, J. M., M. B. Touré, M. M. Traore, S. Famenini *et al.*, 2010 Perspectives of people in Mali toward genetically modified mosquitoes for malaria control . Malaria J. **9**: 128.
8. Marshall, J. M., 2010 The Cartagena Protocol and genetically modified mosquitoes. Nat. Biotech. **28**: 896-897.
9. Marshall, J. M., 2011 The Cartagena Protocol in the context of recent releases of transgenic and *Wolbachia*-infected mosquitoes. AsPac. J. Mol. Biol. Biotechnol. **19**: 93-100.