

Yaw Afrane
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Department of Medical Microbiology
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EDUCATION

- B. Sc 2000 Biological Sciences
Kwame Nkrumah University of Science and
Technology, Kumasi, Ghana
- M. Sc 2003 Medical Entomology
Kwame Nkrumah University of Science and
Technology, Kumasi, Ghana
- Ph. D. 2006 Medical Entomology and Parasitology
Kwame Nkrumah University of Science and
Technology, Kumasi, Ghana

ACADEMIC POSITIONS

- 2001-2003 Research Assistant, Kumasi, Centre for Collaborative Research in Tropical
medicine, Kumasi, Ghana
- 2003-2006 Research Officer, Kenya Medical Research Institute, Kisumu, Kenya
- 2006-2009 Postdoctoral Research Associate, University of California, Irvine based in
Kenya
- 2009 – 2014 Senior Research Associate, Kenya Medical Research Institute, Kisumu,
Kenya
- 2014 – present: Visiting Scientist, Kenya Medical Research Institute, Kisumu, Kenya
- 2014 – present: Associate Professor, University of Ghana, Accra, Ghana

OTHER EXPERIENCES AND PROFESSIONAL SERVICES

2013 - Member, Pan-African Malaria Control Association.

2014 - Member, Roll Back Malaria Vector Control Working Group.

2009 – present ad hoc reviewer for PLOS One, Acta Tropical, Malaria Journal, Parasite and
Vectors.

PERSONAL STATEMENT

I am trained in vector and parasite biology and molecular biology. The focus of my research is on the ecology of malaria vectors particularly on factors that regulate the ecology of malaria vectors and their malaria transmission potential. The sustainability of current malaria vector control strategies which depends on the use of insecticides is threatened by the widespread resistance to insecticides in vectors. Insecticide resistance is a major problem in malaria control in Africa and has significantly hindered the malaria control efforts in Africa. I recognize the threat posed by insecticide resistance on the sustainability of vector control strategies based on insecticides and I contribute with my expertise in malaria ecology and epidemiology in the current application. The current application is timely and innovative in addressing a very important aspect of insecticide resistance that is to with developing resistance surveillance markers based on metabolic detoxification. The application encompasses a comprehensive work in molecular biology to achieve the aims. My previous research has laid the groundwork for the proposed research and have established strong ties with the investigators and vector control personnel in Ghana to undertake the proposed project.

CONTRIBUTION TO SCIENCE

My overall research interest is in malaria epidemiology and vector ecology. Within this general interest, specific topics of my work are:

1: Insecticide Resistance in Malaria Vectors. Insecticide resistance is the biggest problem affecting the control and elimination of malaria. Currently there is intensive malaria vector control activities

that is taking place in Africa to eliminate the disease. Vector control through the use of LLINs and IRS are the main tools for malaria control. However, the effectiveness of these tools are hampered by increasing insecticide resistance.

My research focus is to understand the effect of insecticide resistance on the fitness and behavior of malaria mosquitoes and their overall effect on malaria transmission. With a team of researchers, we are looking at the mechanisms involved in the mediation of resistance and how to diagnose resistance in the field.

Key citations:

I. Bonizzoni M, Afrane Y, Dunn WA, Atieli FK, Zhou G, Zhong D, Li J, Githeko A, Yan G. Comparative transcriptome analyses of deltamethrin-resistant and -susceptible *Anopheles gambiae* mosquitoes from Kenya by RNA-Seq. PLoS One. 2012;7(9):e4460.

II. Bonizzoni M, Ochomo E, Dunn WA, Britton M, Afrane Y, Zhou G, Hartsel J, Lee MC, Xu J, Githeko A, Fass J, Yan G. RNA-seq analyses of changes in the *Anopheles gambiae* transcriptome associated with resistance to pyrethroids in Kenya: identification of candidate-resistance genes and candidate resistance SNPs. Parasit Vectors. 2015 Sep 17;8(1):474.

III. Wanjala CL, Zhou G, Mbugi J, Simbauni J, Afrane YA, Ototo E, Gesuge M, Atieli H, Githeko AK, Yan G. Insecticidal decay effects of long-lasting insecticide nets and indoor residual spraying on *Anopheles gambiae* and *Anopheles arabiensis* in Western Kenya. Parasit Vectors. 2015 Nov 14;8(1):588. PMID:26567915

IV. Wanjala CL, Mbugi JP, Ototo E, Gesuge M, Afrane YA, Atieli HE, Zhou G, Githeko AK, Yan G. Pyrethroid and DDT Resistance and Organophosphate Susceptibility among *Anopheles* spp. Mosquitoes, Western Kenya. Emerg Infect Dis. 2015 Dec;21(12):2178-2181. doi: 10.3201/eid2112.150814. PMID:26583525

2. Environmental changes and malaria transmission. The highlands of East Africa have relatively low temperatures due to their altitude. These are also heavily forested areas. The forest serves as a buffer for lower temperatures. However, when the forest is cut, it opens up the land and microclimatic changes such as increases in indoor and ambient temperatures occur. Swamp cultivation also leads to the creation of breeding sites for malaria mosquitoes. I worked with other investigators to look at the role of these environmental changes in the East African highlands on malaria transmission. These environmental changes could explain what could happen under climate change situations.

Key citations:

I. Afrane YA, Lawson BW, Githeko AK, Yan G. Effects of microclimatic changes caused by land use and land cover on duration of gonotrophic cycles of *Anopheles gambiae* (Diptera: Culicidae) in western Kenya highlands. J Med Entomol. 2005 Nov;42(6):974-80;

II. Afrane YA, Zhou G, Lawson BW, Githeko AK, Yan G. Effects of microclimatic changes caused by deforestation on the survivorship and reproductive fitness of *Anopheles gambiae* in western Kenya highlands. Am J Trop Med Hyg. 2006 May;74(5):772-8;

III. Afrane YA, Zhou G, Lawson BW, Githeko AK, Yan G. Life-table analysis of *Anopheles arabiensis* in western Kenya highlands: effects of land covers on larval and adult survivorship. Am J Trop Med Hyg. 2007 Oct;77(4):660-6;

IV. Afrane YA, Little TJ, Lawson BW, Githeko AK, Yan G. Deforestation and vectorial capacity of *Anopheles gambiae* Giles mosquitoes in malaria transmission, Kenya. Emerg Infect Dis. 2008 Oct;14(10):1533-8;

V. Afrane YA, Githeko AK and Yan G. Malaria Transmission in the African Highlands in a Changing Climate Situation: Perspective from Kenyan Highlands. In Global Warming Impacts - Case Studies on the Economy, Human Health, and on Urban and Natural Environments, 2011. ISBN 978-953-307-785-7;

VI. Afrane YA, Zhou G, Githeko AK, Yan G. The ecology of *Anopheles* mosquitoes under climate change:

case studies from the effects of deforestation in East African highland. Ann N Y Acad Sci. 2012 Feb 9.

doi: 10.1111/j.1749-6632.2011.06432.x

3: Malaria Vector Ecology and Human Activities. Many farmers use low-lying riverine areas within major cities in West Africa to engage in irrigated vegetable farming. This creates opportunities for

malaria vectors to breed and transmit disease in these major cities which should otherwise be malaria free. Malaria vectors prefer to breed in clean open sunlit waters which are found in rural areas, not in polluted waters of the cities. This makes malaria a rural disease. However, the irrigated vegetable farms use water that seeps from the ground that are relatively clean for breeding of malaria vectors that transmit urban malaria. My colleagues and I investigated the role of irrigated vegetable farming on urban malaria transmission in Ghana.

Key citations:

- I. Afrane YA, Klinkenberg E, Drechsel P, Owusu-Daaku K, Garms R, Kruppa T. Does irrigated urban agriculture influence the transmission of malaria in the city of Kumasi, Ghana? *Acta Trop.* 2004 Jan;89(2):125-34. PubMed PMID: 14732235;
- II. Afrane YA, Lawson BW, Brenya R, Kruppa T, Yan G. The ecology of mosquitoes in an irrigated vegetable farm in Kumasi, Ghana: abundance, productivity and survivorship. *Parasit Vectors.* 2012 Oct 15;5:233. doi: 10.1186/1756-3305-5-233.

RESEARCH SUPPORT

Ongoing Research Support:

1. National Institute of Health (NIH) R01 AI123074 19/02/2016 - 18/02/2021 NIH/NIAID
"Impact of insecticide resistance on the behavior and fitness of malaria vectors" The goal of this project is to determine the effect of insecticide resistance on the behavior and fitness of the main malaria vectors of Sub-Saharan Africa, *Anopheles gambiae*, *An. arabiensis* and *An. funestus*, and their impact on malaria transmission in Ghana
Role: Principal Investigator

Completed Research Support

1. R01 AI094580 Afrane (PI) 02/01/11-01/31/16 NIH/NIAID
"Epidemiology of Clinical Malaria in the western Kenya Highlands"
The goal of this project was to determine the risk factors causing malaria reemergence in high-altitude areas in Kenya, and to develop models for forecasting malaria outbreaks.
Role: PI

PUBLICATIONS

1. Afrane YA, Zhou G, Githeko AK, Yan G. Utility of health facility-based malaria data for malaria surveillance. *PloS one.* 2013; 8(2):e54305.
2. Lo E, Zhou G, Oo W, Afrane Y, Githeko A, Yan G. Low parasitemia in submicroscopic infections significantly impacts malaria diagnostic sensitivity in the highlands of Western Kenya. *PloS one.* 2015; 10(3):e0121763.
3. Zhou G, Afrane YA, Malla S, Githeko AK, Yan G. Active case surveillance, passive case surveillance and asymptomatic malaria parasite screening illustrate different age distribution, spatial clustering and seasonality in western Kenya. *Malaria journal.* 2015; 14:41.
4. Afrane YA, Zhou G, Githeko AK, Yan G. Clinical malaria case definition and malaria attributable fraction in the highlands of western Kenya. *Malaria journal.* 2014; 13:405.
5. Gilbreath TM 3rd, Kweka EJ, Afrane YA, Githeko AK, Yan G. Evaluating larval mosquito resource partitioning in western Kenya using stable isotopes of carbon and nitrogen. *Parasites & vectors.* 2013; 6:353.
6. Zhou G, Afrane YA, Dixit A, Atieli HE, Lee MC, Wanjala CL, Beilhe LB, Githeko AK, Yan G. Modest additive effects of integrated vector control measures on malaria prevalence and transmission in western Kenya. *Malaria journal.* 2013; 12:256.

7. Vardo-Zalik AM, Zhou G, Zhong D, Afrane YA, Githeko AK, Yan G. Alterations in *Plasmodium falciparum* genetic structure two years after increased malaria control efforts in western Kenya. *The American journal of tropical medicine and hygiene*. 2013; 88(1):29-36. PubMed [journal] PMID: 23166196, PMCID: PMC3541741
8. Afrane YA, Lawson BW, Brenya R, Kruppa T, Yan G. The ecology of mosquitoes in an irrigated vegetable farm in Kumasi, Ghana: abundance, productivity and survivorship. *Parasites & vectors*. 2012; 5:233.
9. Bonizzoni M, Afrane Y, Dunn WA, Atieli FK, Zhou G, Zhong D, Li J, Githeko A, Yan G. Comparative transcriptome analyses of deltamethrin-resistant and -susceptible *Anopheles gambiae* mosquitoes from Kenya by RNA-Seq. *PloS one*. 2012; 7(9):e44607.
10. Badu K, Siangla J, Larbi J, Lawson BW, Afrane Y, Ong'echa J, Remoue F, Zhou G, Githeko AK, Yan G. Variation in exposure to *Anopheles gambiae* salivary gland peptide (gSG6-P1) across different malaria transmission settings in the western Kenya highlands. *Malaria journal*. 2012; 11:318.
11. Badu K, Afrane YA, Larbi J, Stewart VA, Waitumbi J, Angov E, Ong'echa JM, Perkins DJ, Zhou G, Githeko A, Yan G. Marked variation in MSP-119 antibody responses to malaria in western Kenyan highlands. *BMC infectious diseases*. 2012; 12:50.
12. Kweka EJ, Zhou G, Beilhe LB, Dixit A, Afrane Y, Gilbreath TM 3rd, Munga S, Nyindo M, Githeko AK, Yan G. Effects of co-habitation between *Anopheles gambiae* s.s. and *Culex quinquefasciatus* aquatic stages on life history traits. *Parasites & vectors*. 2012; 5:33.
13. Afrane YA, Githeko AK, Yan G. The ecology of Anopheles mosquitoes under climate change: case studies from the effects of deforestation in East African highlands. *Annals of the New York Academy of Sciences*. 2012; 1249:204-10.
14. Atieli HE, Zhou G, Lee MC, Kweka EJ, Afrane Y, Mwanzo I, Githeko AK, Yan G. Topography as a modifier of breeding habitats and concurrent vulnerability to malaria risk in the western Kenya highlands. *Parasites & vectors*. 2011; 4:241.
15. Bonizzoni M, Afrane Y, Yan G. Loop-mediated isothermal amplification (LAMP) for rapid identification of *Anopheles gambiae* and *Anopheles arabiensis* mosquitoes. *The American journal of tropical medicine and hygiene*. 2009; 81(6):1030-4.
16. Baliraine FN, Afrane YA, Ameyia DA, Bonizzoni M, Vardo-Zalik AM, Menge DM, Githeko AK, Yan G. A cohort study of *Plasmodium falciparum* infection dynamics in Western Kenya Highlands. *BMC infectious diseases*. 2010; 10:283.
17. Zhou G, Afrane YA, Vardo-Zalik AM, Atieli H, Zhong D, Wamae P, Himeidan YE, Minakawa N, Githeko AK, Yan G. Changing patterns of malaria epidemiology between 2002 and 2010 in Western Kenya: the fall and rise of malaria. *PloS one*. 2011; 6(5):e20318.
18. Smith PH, Mwangi JM, Afrane YA, Yan G, Obbard DJ, Ranford-Cartwright LC, Little TJ. Alternative splicing of the *Anopheles gambiae* Dscam gene in diverse *Plasmodium falciparum* infections. *Malaria journal*. 2011; 10:156.
19. Atieli HE, Zhou G, Afrane Y, Lee MC, Mwanzo I, Githeko AK, Yan G. Insecticide-treated net (ITN) ownership, usage, and malaria transmission in the highlands of western Kenya. *Parasites & vectors*. 2011; 4:113.

20. Kweka EJ, Zhou G, Gilbreath TM 3rd, Afrane Y, Nyindo M, Githeko AK, Yan G. Predation efficiency of *Anopheles gambiae* larvae by aquatic predators in western Kenya highlands. *Parasites & vectors*. 2011; 4:128.
21. Himeidan YE, Zhou G, Yakob L, Afrane Y, Munga S, Atieli H, El-Rayah el-A, Githeko AK, Yan G. Habitat stability and occurrences of malaria vector larvae in western Kenya highlands. *Malaria journal*. 2009; 8:234.
22. Baliraine FN, Afrane YA, Amenyaa DA, Bonizzoni M, Menge DM, Zhou G, Zhong D, Vardo-Zalik AM, Githeko AK, Yan G. High prevalence of asymptomatic *Plasmodium falciparum* infections in a highland area of western Kenya: a cohort study. *The Journal of infectious diseases*. 2009; 200(1):66-74.
23. Bonizzoni M, Afrane Y, Baliraine FN, Amenyaa DA, Githeko AK, Yan G. Genetic structure of *Plasmodium falciparum* populations between lowland and highland sites and antimalarial drug resistance in Western Kenya. *Infection, genetics and evolution: journal of molecular epidemiology and evolutionary genetics in infectious diseases*. 2009; 9(5):806-12.
24. Afrane YA, Little TJ, Lawson BW, Githeko AK, Yan G. Deforestation and vectorial capacity of *Anopheles gambiae* Giles mosquitoes in malaria transmission, Kenya. *Emerging infectious diseases*. 2008; 14(10):1533-8.
25. Zhong D, Afrane Y, Githeko A, Cui L, Menge DM, Yan G. Molecular epidemiology of drug-resistant malaria in western Kenya highlands. *BMC infectious diseases*. 2008; 8:105.
26. Zhong D, Afrane Y, Githeko A, Yang Z, Cui L, Menge DM, Temu EA, Yan G. *Plasmodium falciparum* genetic diversity in western Kenya highlands. *The American journal of tropical medicine and hygiene*. 2007; 77(6):1043-50.
27. Afrane YA, Zhou G, Lawson BW, Githeko AK, Yan G. Life-table analysis of *Anopheles arabiensis* in western Kenya highlands: effects of land covers on larval and adult survivorship. *The American journal of tropical medicine and hygiene*. 2007; 77(4):660-6.
28. Afrane YA, Zhou G, Lawson BW, Githeko AK, Yan G. Effects of microclimatic changes caused by deforestation on the survivorship and reproductive fitness of *Anopheles gambiae* in western Kenya highlands. *The American journal of tropical medicine and hygiene*. 2006; 74(5):772-8.
29. Afrane YA, Lawson BW, Githeko AK, Yan G. Effects of microclimatic changes caused by land use and land cover on duration of gonotrophic cycles of *Anopheles gambiae* (Diptera: Culicidae) in western Kenya highlands. *Journal of medical entomology*. 2005; 42(6):974-80.
30. Afrane YA, Klinkenberg E, Drechsel P, Owusu-Daaku K, Garms R, Kruppa T. Does irrigated urban agriculture influence the transmission of malaria in the city of Kumasi, Ghana? *Acta tropica*. 2004; 89(2):125-34.
31. Wanjala CL, Mbugi JP, Ototo E, Gesuge M, Afrane YA, Atieli HE, Zhou G, Githeko AK, Yan G. Pyrethroid and DDT Resistance and Organophosphate Susceptibility among *Anopheles* spp. Mosquitoes, Western Kenya. *Emerging infectious diseases*. 2015; 21(12):2178-81.
32. Wanjala CL, Zhou G, Mbugi J, Simbauni J, Afrane YA, Ototo E, Gesuge M, Atieli H, Githeko AK, Yan G. Insecticidal decay effects of long-lasting insecticide nets and indoor residual spraying on *Anopheles gambiae* and *Anopheles arabiensis* in Western Kenya. *Parasites & vectors*. 2015; 8:588.
33. Wang X, Afrane YA, Yan G, Li J. Constructing a Genome-Wide LD Map of Wild *A. gambiae* Using Next-Generation Sequencing. *BioMed research international*. 2015; 2015:238139.

34. Bonizzoni M, Ochomo E, Dunn WA, Britton M, Afrane Y, Zhou G, Hartsel J, Lee MC, Xu J, Githeko A, Fass J, Yan G. RNA-seq analyses of changes in the *Anopheles gambiae* transcriptome associated with resistance to pyrethroids in Kenya: identification of candidate-resistance genes and candidate-resistance SNPs. *Parasites & vectors*. 2015; 8:474.
35. Dixit A, Lee MC, Goettsch B, Afrane Y, Githeko AK, Yan G. Discovering the cost of care: consumer, provider, and retailer surveys shed light on the determinants of malaria health-seeking behaviours. *Malaria journal*. 2016; 15:179.
36. Global Warming Impacts – Case Studies on the Economy, Human Health, and on Urban and Natural Environments Afrane YA, Githeko AK, Yan G. Casalegno S, editor. Rijeka, Croatia: INTECH; 2011. Chapter 4, Malaria Transmission in the African Highlands in a Changing Climate Situation: Perspective from Kenyan Highlands; p.53-66. 290p.
37. Afrane YA, Mweresa NG, Wanjala CL, Gilbreath Iii TM, Zhou G, Lee MC, Githeko AK, Yan G. Evaluation of long-lasting microbial larvicide for malaria vector control in Kenya. *Malaria journal*. 2016; 15(1):577.
38. Sam-Agudu NA, Paintsil E, Aliyu MH, Kwara A, Ogunsola F, Afrane YA, Onoka C, Awandare GA, Amponsah G, Cornelius LJ, Mendy G, Sturke R, Ghansah A, Siberry GK, Ezeanolue EE. Building Sustainable Local Capacity for Global Health Research in West Africa. *Annals of global health*. 2016; 82(6):1010-1025.
39. Owek CJ, Oluoch E, Wachira J, Estambale B, Afrane YA. Community perceptions and attitudes on malaria case management and the role of community health workers. *Malaria journal*. 2017; 16(1):272.
40. Afrane YA, Bonizzoni M, Yan G. Rodriguez-Morales AJ, editor. Czech Republic: In Tech; 2016. Chapter 20, Secondary Malaria Vectors of Sub-Saharan Africa: Threat to Malaria Elimination on the Continent? p.473-490.
41. Niu G, Zhang G, Franca C, Cui Y, Munga S, Afrane Y, Li J. FBN30 in wild *Anopheles gambiae* functions as a pathogen recognition molecule against clinically circulating *Plasmodium falciparum* in malaria endemic areas in Kenya. *Scientific reports*. 2017; 7(1):8577.
42. Zhong D, Lo E, Wang X, Yewhalaw D, Zhou G, Atieli HE, Githeko A, Hemming-Schroeder E, Lee MC, Afrane Y, Yan G. Multiplicity and molecular epidemiology of *Plasmodium vivax* and *Plasmodium falciparum* infections in East Africa. *Malaria journal*. 2018; 17(1):185.
43. Aidoo EK, Afrane YA, Machani MG, Chebore W, Lawson BW, Atieli H, Kariuki S, Lee MC, Koepfli C, Zhou G, Githeko AK, Yan G. Reactive case detection of *Plasmodium falciparum* in western Kenya highlands: effective in identifying additional cases, yet limited effect on transmission. *Malaria journal*. 2018; 17(1):111