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Rethinking DDT: The Misguided Goals of the Stockholm Convention on Persistent Organic Pollutants and a Plan to Fight Malaria Worldwide

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RETHINKING DDT: THE MISGUIDED GOALS OF THE STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS AND A PLAN TO FIGHT MALARIA WORLDWIDE

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INTRODUCTION

This Note argues that the adoption of the Stockholm Convention on Persistent Organic Pollutants, while well intentioned, has harmfully discouraged the use of DDT in targeted indoor sprayings. Increased sprayings would decrease the impact of malaria in sub-Saharan Africa, leading to an increased standard of living for millions, while causing minimal environmental impact. Thus, this Note argues that the signatories of the Stockholm Convention on Persistent Organic Pollutants should exempt DDT from their list of "restricted" chemicals in order to encourage increased funding and use of DDT.

In Part I, this Note will discuss the disease of malaria and detail some of the effects it has had on impoverished global regions. Part II will discuss the history of DDT usage, both in the United States and abroad. That section will include an exploration of the anti-DDT movement and the subsequent reduction in worldwide DDT usage. Part III will discuss the Stockholm Convention on Persistent Organic Pollutants, detailing its history and relevant provisions, as well as its effect on global DDT usage. Next, Part IV will discuss the environmental and health effects of DDT when it is used only in targeted indoor sprayings, and Part V will address some of the shortcomings of some of the alternative methods most commonly cited by anti-DDT activists to treat and prevent malaria. Finally, the Conclusion explains the limitations of this Note and clarifies the points that this Note is not attempting to address.

This Note will then conclude with a discussion of why, all factors considered, the Stockholm Convention on Persistent Organic Pollutant's inclusion of DDT is misguided as it increases the incidence of malaria and DDT when used properly does not pose serious health or environmental effects.

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I. MALARIA AND ITS EFFECTS: HEALTH, ECONOMIC, SOCIAL, AND DEVELOPMENT

Malaria is a vector-borne disease spread through the bite of the *Anopheles* mosquito.[1] In order to properly grow the parasite that causes malaria, the mosquito requires both high temperatures and high humidity.[2] As a result, malaria is found primarily in tropical and subtropical regions.[3] About 3.4 billion people in 106 countries are at risk of contracting malaria, and each year about 207 million of them do.[4] This leads to over 627,000 deaths per year, with 91% occurring in Africa.[5] Like many destructive diseases, children bear the majority of the malaria burden—about 86% of malaria deaths worldwide occur in children under the age of five.[6]

The symptoms of uncomplicated malaria include fever, chills, headaches, and general malaise.[7] Malaria also leads to disastrous economic effects—direct effects of the illness (in terms of hospitalizations, medical treatment, and premature death) are estimated to cost at least $12 billion per year.[8]

While the direct costs are high, the indirect costs of malaria are far more destructive. Those suffering the effects of malaria, for example, often find it difficult to work, leading to catastrophic economic effects for those states where malaria is endemic.[9] In fact, economists have observed that on average, countries that do not suffer from high levels of malaria have a GDP that is over five times higher than their malarial counterparts.[10] Similarly, countries with high levels of malaria experience far less growth

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[1] *Biology*, CTRS. FOR DISEASE CONTROL & PREVENTION, http://www.cdc.gov/malaria/about/biology/index.html (last updated Nov. 9, 2012), *archived at* http://perma.cc/7BY2-YHW4.
[2] *See Where Malaria Occurs*, CTRS. FOR DISEASE CONTROL & PREVENTION, http://www.cdc.gov/malaria/about/distribution.html (last updated Feb. 8, 2010), *archived at* http://perma.cc/LRT3-EAXZ.
[3] *Impact of Malaria*, CTRS. FOR DISEASE CONTROL & PREVENTION, http://www.cdc.gov/malaria/malaria_worldwide/impact.html (last updated Mar. 26, 2014), *archived at* http://perma.cc/WFM7-JUQK.
[4] *Id.*
[5] *Id.*
[6] *Malaria in Children Under Five*, WORLD HEALTH ORG., http://www.who.int/malaria/areas/high_risk_groups/children/en/ (last updated Mar. 6, 2013), *archived at* http://perma.cc/N82B-7TPM.
[7] *Disease*, CTRS. FOR DISEASE CONTROL & PREVENTION, http://www.cdc.gov/malaria/about/disease.html (last updated Feb. 8, 2010), *archived at* http://perma.cc/9J3L-UG7M.
[8] *Impact of Malaria*, *supra* note 3.
[9] *DDT: A Useful Poison*, ECONOMIST, Dec. 14, 2000, at 116.
[10] Jeffrey Sachs, *The Economic and Social Burden of Malaria*, 415 NATURE 680, 681 (Feb. 2002) [hereinafter Sachs, *Economic and Social Burden*].

and development per year, even when controlling for other possible causal factors.[11] It is clear that malaria is a major factor in determining which countries remain entrenched in poverty.

This disparity will likely persist for as long as malaria is so prevalent, as the effects of the disease conspire to keep poor countries poor. Since malaria kills so many children, for example, people living in areas with high levels of malaria are likely to have additional children to "replace" the ones they expect to lose.[12] Families that have many children are less likely to invest resources in each child's education, especially when those children are female, since female children will likely grow up to have many children of their own and will thus be unable to capitalize economically on any education they have received.[13] Even women who do receive an education will see their employment options limited, as they will likely be expected to care for either their children or the children of relatives.[14] Tragically, even some of the resources used on child rearing are likely to be wasted as children succumb to malaria.[15] This cycle of having many children and failing to educate them perpetuates poverty in countries with high rates of malaria.[16]

Similarly, even parents who actively try to educate their children may be thwarted by malaria. In Kenya, for example, researchers found that young children missed on average 11% of the total school year due to malaria.[17] Even when they are able to attend school, malarial children are generally not able to learn as much as their healthy peers.[18] Besides causing general lethargy and pain, malaria is known to cause permanent brain damage in its survivors.[19] In fact, each year about 575,000 people become infected with a strain of malaria that causes brain damage.[20] The majority of these people are children, and their brain damage will make it even less likely that they will one day receive an education.[21] This lack of education,

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[11] *Id.*
[12] *Id.* at 682.
[13] *Id.* at 682–83.
[14] *Id.* at 683.
[15] *Id.*
[16] Sachs, *Economic and Social Burden*, *supra* note 10, at 683.
[17] *Id.*
[18] *Id.*
[19] Tina Rosenberg, *What the World Needs Now is DDT*, N.Y. TIMES (Apr. 11, 2004), http://www.nytimes.com/2004/04/11/magazine/what-the-world-needs-now-is-ddt.html?pagewanted=all&src=pm, *archived at* http://perma.cc/W5CD-R2U3.
[20] Richard Idro et al., *Cerebral Malaria; Mechanisms Of Brain Injury And Strategies For Improved Neuro-Cognitive Outcome* 68 PEDIATRIC RES. 267, 268 (2010).
[21] *Id.* at 269.

as well as the brain damage malaria can cause, directly contributes to the poverty in which many nations of Africa find themselves entrenched.[22]

Malaria also has the effect of decreasing tourism and foreign direct investment.[23] Western investors are hesitant to invest in infrastructure in malarial regions, as doing so presents the cost that their laborers will contract the illness.[24] This fear limits not only the new infrastructure being built but also the employment available to citizens living in malarial regions.[25] Tourists are similarly dissuaded from visiting malarial regions for the same reason.[26]

This Note will discuss the fight against malaria and one of mankind's greatest weapons in this fight, DDT. It will argue that the environmental effects of DDT have been overblown, and this has led to a gross under-utilization of the chemical. This under-utilization has led to untold death, misery, and a lack of development among the nation-states of sub-Saharan Africa.

II. HISTORY OF DDT USAGE

A. DDT Use Worldwide Before the Anti-DDT Movement

Although it was first synthesized in 1874, DDT's insecticide properties were first discovered by scientist Paul Muller in the 1930s.[27] Against the backdrop of World War II, the United States and Western Europe quickly began using DDT to cure their soldiers of vector-borne diseases such as typhus and malaria.[28]

By the end of the war, DDT was being used in Guyana, Cyprus, Sardinia, and Venezuela to protect civilians from these diseases.[29] As

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[22] Julius Agbor, *Poverty, Inequality and Africa's Education Crisis*, THE BROOKINGS INS. (Sept. 26, 2012), http://www.brookings.edu/research/opinions/2012/09/26-inequality-education-africa-agbor, *archived at* http://perma.cc/MV33-E4P8.
[23] Sachs, *Economic and Social Burden*, *supra* note 10, at 682.
[24] *Id.* at 684.
[25] *Id.* at 683–84.
[26] *Id.* at 684.
[27] Roger Bate, *The Rise, Fall, Rise, and Imminent Fall of DDT*, 14 HEALTH POL'Y OUTLOOK 1, 1 (Nov. 2007), *available at* http://www.aei.org/outlook/energy-and-the-environment/the-rise-fall-rise-and-imminent-fall-of-ddt, *archived at* http://perma.cc/R7S6-8UWQ.
[28] *Id.*
[29] Shobha Sadasivaiah et al., *Dichlorodiphenyltrichloroethane (DDT) for Indoor Residual Spraying in Africa: How Can It Be Used for Malaria Control?*, 77 AM. J. TROPICAL MED. HYGIENE 249, 249 (2007).

both agricultural and health uses of DDT increased, the scientific community began to see DDT's world-changing value; in 1948, Paul Muller was awarded the Nobel Prize for his discovery of the insecticide.[30]

The United States moved quickly to take advantage of DDT. Shortly after the war, the public health infrastructure of the United States began earnestly funding the use of DDT to fight malaria domestically.[31] So-called "mosquito control officers" began spraying DDT in the walls of at-risk residences, leading to the eradication of malaria in the United States by 1952.[32] Although millions of cases had been reported just a few years earlier, by 1952 only a handful of malaria cases remained, and most originated overseas.[33]

Other nations were enjoying similar experiences with DDT. Malaria was essentially eradicated in Europe and the former Soviet Union and was severely curtailed in Latin America and the Middle East.[34] In India, DDT spraying throughout the 1950s decreased yearly cases of malaria from seventy-five million to 100,000.[35] Other countries such as Taiwan, Cuba, and Sri Lanka saw similar dramatic results, leading the World Health Organization to endorse a wide-scale DDT spraying program for the first time in 1955.[36]

As the health benefits of DDT began to be realized, those in the agriculture community began to turn to DDT as a way to preserve crops from predatory insects.[37] This was accomplished not through the relatively benign indoor residential spraying, but through a tactic called aerial spraying, wherein low-flying planes would fly over fields, liberally spraying DDT throughout them.[38]

This tactic was used to reduce populations of, among other insects, the gypsy moth.[39] It was eventually revealed through court testimony that the United States had aerially sprayed DDT over three million hectares, and because pilots were paid by the gallons they managed to spray, the amount of DDT that had been released was astronomical.[40] While it is

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[30] Robert L. Metcalf, *A Century of DDT*, 21 J. AGRIC. FOOD CHEM. 511, 511 (1973).
[31] Bate, *supra* note 27, at 2.
[32] *Id.* at 3.
[33] *Id.*
[34] Sadasivaiah et al., *supra* note 29, at 250.
[35] *Id.*
[36] Bate, *supra* note 27, at 3.
[37] Metcalf, *supra* note 30, at 512.
[38] John Paull, *The Rachel Carson Letters and the Making of Silent Spring*, 3 SAGE OPEN 1, 2 (July 2013), *available at* http://orgprints.org/22934/7/22934.pdf.
[39] *Id.*
[40] *Id.*

still unclear whether the gypsy moth was actually harmed by this DDT, it is unquestionable that any adverse impact of the DDT was due to its sheer amount—an amount that there is no need to replicate in modern indoor residential sprayings.[41]

Similarly, in 1957, Massachusetts aerially sprayed DDT to kill mosquitoes living in marshes.[42] An unintentional byproduct of this large-scale spraying was the killing of birds, grasshoppers, and bees, whose habitats unfortunately lay in the path of the DDT planes.[43] These sprayings, done in the early stage of widespread DDT use, lacked the care and expertise of sprayings in later years.[44] It would be these types of clumsy aerial sprayings that sparked the anti-DDT movement.

B. The Anti-DDT Movement, Environmentalism, and Resulting Changes in DDT Use

In 1957, *The New York Times* reported on the dedicated yet unsuccessful struggle of a group of citizens in Nassau County, New York, to restrict the aerial spraying of DDT in their community.[45] The struggle caught the attention of a young environmentalist, Rachel Carson, who spent several years assisting the citizens in their fight.[46] During this time, Carson gathered information about the use and effects of DDT and also made several contacts who would be key in the anti-DDT movement.[47]

Carson continued to research the environmental and health effects of pesticides, especially DDT.[48] This research culminated in Carson publishing her famous 1962 book, *Silent Spring*.[49] The book, which is widely credited for sparking the modern environmentalist movement, held out DDT as a representation of the new impulse for humans to alter their

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[41] Sadasivaiah et al., *supra* note 29, at 259.
[42] H. Patricia Hynes, *Perspective on the Environment: Unfinished Business: 'Silent Spring' : On the 30th Anniversary of Rachel Carson's Indictment of DDT, Pesticides Still Threaten Human Life*, L.A. TIMES (Sept. 10, 1992), http://articles.latimes.com/1992-09-10/local/me-38_1_silent-spring, *archived at* http://perma.cc/UYR9-UN8B.
[43] *Id.*
[44] Malcolm Gladwell, *The Mosquito Killer*, GLADWELL.COM (July 2, 2001), http://gladwell.com/the-mosquito-killer, *archived at* http://perma.cc/D66A-HUAQ.
[45] Paull, *supra* note 38, at 2.
[46] *Id.* at 5.
[47] *Id.* at 5–6.
[48] *Id.* at 6–7.
[49] *The Story of Silent Spring*, NAT'L RES. DEF. COUNCIL (Dec. 5, 2013), http://www.nrdc.org/health/pesticides/hcarson.asp, *archived at* http://perma.cc/4JM9-MDYD.

natural environment despite the problems these alterations caused them.[50] For DDT specifically, Carson argued that the pesticide, once sprayed, enters the biosphere threatening the ecosystems and health of both animals and humans.[51]

Although Carson was not the first to make the case that DDT had negative environmental effects, she was among the first to verbalize the concern about manipulating the environment through chemicals that the public had begun to feel.[52] This verbalization would prove crucial as citizens began pushing their governments to address what they saw as a major problem.

Based in part on this movement, the Environmental Protection Agency ("EPA") banned the non-emergency use of DDT within the United States in 1972.[53] Despite the well-organized and passionate anti-DDT movement, the chemical was not universally accepted as dangerous even at that time.[54] In fact, the judge who ran EPA hearings on DDT independently concluded that the chemical was not dangerous when used properly.[55] This and similar opinions remained outside the norm, however, as legislation in both the United States and abroad increasingly began to address what many perceived to be a DDT problem. One recent piece of such legislation—the Stockholm Convention on Persistent Organic Pollutants—is addressed in detail below.

C. The Debates

Debates on the safety and efficacy of DDT began as early as the 1960s, when Professors Wurster and Jukes famously squared off in the public sphere over whether DDT should continue to be sprayed.[56] The debates centered around the often-discussed environmental effects of DDT, but eventually came to address DDT's health effects as well.[57] These

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[50] *See id.*
[51] Eliza Griswold, *How 'Silent Spring' Ignited the Environmental Movement*, N.Y. TIMES (Sept. 21, 2012), http://www.nytimes.com/2012/09/23/magazine/how-silent-spring-ignited-the-environmental-movement.html?pagewanted=all&_r=0, *archived at* http://perma.cc/T5GT-76AN.
[52] *Id.*
[53] Rosenberg, *supra* note 19.
[54] *See id.*
[55] *Id.*
[56] Elena Conis, *Debating the Health Effects of DDT: Thomas Jukes, Charles Wurster, and the Fate of an Environmental Pollutant*, 125 PUB. HEALTH REP. 337, 337 (2010).
[57] *Id.*

debates marked one of the first times that health concerns infiltrated a debate on environmental policy; in the debates between Professor Wurster and Professor Jukes it was clear that human health was inextricably linked with the environment, which was a departure from previous rhetoric that focused exclusively on the environmental effects of environmental policies.[58]

What made the debates even more groundbreaking was that they framed public health concerns not in a scientific way, but against a framework that included a discussion of morals and social interests.[59] That is, the debates quickly evolved from a discussion on the effects and benefits of DDT to one regarding which goals policymakers should necessarily prioritize over others; Jukes focused on the huge life-saving potential of DDT as diseases that threaten human health disappear, while Wurster focused on DDT's supposed effect on the ecosystem, and what this would mean for humankind.[60] Besides sparking the modern environmental movement, DDT had sparked a larger debate about public health and the goals that the government should pursue in that area.

While the development of these types of debates did much to heighten the level of discourse regarding public health policies, they occurred at a time when the American public was especially susceptible to the view of Professor Wurster.[61] With scares involving radioactive fallout and other pesticides in recent memory, Americans in the 1960s had lost a good amount of trust in government to protect them from harmful chemicals.[62] Adding to that fear was the reality that cancer had recently overtaken infectious diseases as the top killer of Americans.[63] Even though this change had come about due to the development of such treatments of DDT, the fact that DDT was purported to be a carcinogen was especially resonant with people of the time.[64] Many did not support this change in discourse; as Professor Wurster himself explained, ". . . if the environmentalists win on DDT, they will achieve a level of authority they have never had before. In a sense, much more is at stake than DDT."[65]

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[58] *See id.* at 338.
[59] *Id.* at 337.
[60] *Id.*
[61] *See id.* at 338–39.
[62] Conis, *supra* note 56, at 338–39.
[63] *Id.* at 339.
[64] *See id.*
[65] Steven Milloy, *Bald Eagle—DDT Myth Still Flying High*, FOX NEWS (July 6, 2006), http://www.foxnews.com/story/2006/07/06/bald-eagle-ddt-myth-still-flying-high/, *archived at* http://perma.cc/4E7P-9YQF.

III. THE STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS

A. Legislative History

While concern over DDT waned a bit after the anti-DDT movement hit its peak in the 1970s, the movement sparked a realization that chemical overuse can be harmful. National and world leaders began to address the problem of the reliance on many of these harmful chemicals. In 1995, the Governing Council for the United Nations Environment Programme renewed the fight against chemicals by calling for immediate action against persistent organic pollutants.[66] It defined these as "chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment."[67]

In response, the International Programme for Chemical Safety compiled a list of what it considered to be the worst persistent organic pollutants, the so-called "dirty dozen."[68] Unsurprisingly, DDT was featured prominently on this list.[69] In May of 2001, interested nations gathered to compose a treaty that would address these ostensibly harmful pollutants.[70] The treaty became effective in 2004 when, as required by international law, it was ratified by at least fifty nation-states.[71]

B. The Relevant Provisions of the Stockholm Convention on Persistent Organic Pollutants

Currently, 162 nations and the European Union have signed on to the treaty.[72] The aim of the treaty is, broadly speaking, to protect both the environment and the health of its inhabitants from persistent organic

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[66] *Non Combustible Persistent Organic Pollutants*, UNITED NATIONS INDUS. DEV. ORG., http://emb.gov.ph/UNIDO-NonCom%20Web%201/h-intro.html (last visited Oct. 27, 2014), *archived at* http://perma.cc/WT9T-UG6J.
[67] *Id.*
[68] *Legislation*, SUSTAINABLE PERSISTENT ORGANIC STOCKPILES MGMT. PROJECT IN THE REP. OF MOLD., http://www.moldovapops.md/legislation/?lang=english (last visited Oct. 27, 2014), *archived at* http://perma.cc/4QTG-LKXL.
[69] *Id.*
[70] *The POPs Treaty*, US POPS WATCH, http://www.uspopswatch.org/ (last visited Oct. 27, 2014), *archived at* http://perma.cc/GDC4-LX6J.
[71] *Id.*
[72] *Id.*

pollutants.[73] It attempts to accomplish this goal by requiring signatories of the treaty to develop a plan in order to ensure that it does not release a high amount of persistent organic pollutants.[74] From a pragmatic standpoint, this often means that the production and importation of such pollutants will be prohibited by national governments.[75]

The treaty divides persistent organic pollutants into two categories: Annex A, which includes those persistent organic pollutants that the treaty aims to completely abolish, and Annex B, which includes persistent organic pollutants that the treaty aims to severely restrict.[76] DDT is on the restricted list, with the caveat that it may be used for the limited purpose of vector control.[77] The inclusion of DDT on the restricted, rather than the abolish list, is the product of lengthy debate and discussion; it is clear that many signatories would have preferred to see DDT banned entirely.[78] Nations wishing to use DDT to control malaria must, every three years, submit a lengthy and detailed report to the Secretariat of the Stockholm Convention and to the World Health Organization.[79] While this exception would seemingly allow DDT to be used to combat malaria, other provisions of the treaty make this extremely difficult.[80]

C. Effects of the Treaty

Robert Gwadz of the National Institutes of Health once remarked, "the ban on DDT may have killed twenty million children."[81] While Gwadz

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[73] *Id.* at 1.
[74] *Stockholm Convention on Persistent Organic Pollutants (POPs)*, AUSTL. GOV'T: DEP'T OF THE ENV'T, http://www.environment.gov.au/topics/environment-protection/chemicals-management/pops (last visited Oct. 27, 2014), *archived at* http://perma.cc/MF3M-VZYX.
[75] *Id.*
[76] The Stockholm Treaty on Persistent Organic Pollutants art. 3, May 22, 2001, 2256 U.N.T.S. 119, *available at* http://www.pops.int/documents/convtext/convtext_en.pdf (entered into force May 17, 2004).
[77] *Id.*
[78] *Stockholm Convention Continues to Allow DDT Use for Disease Vector Control*, STOCKHOLM CONVENTION (Dec. 3, 2012), http://chm.pops.int/Implementation/DDT/DDTRelatedArticles/SCallowsDDTusefordiseasevectorcontrol/tabid/2998/Default.aspx, *archived at* http://perma.cc/9X4K-J6TJ.
[79] *Frequently Asked Questions on DDT Use for Disease Vector Control*, WORLD HEALTH ORG. 4 (2005), *available at* http://www.chem.unep.ch/DDT/documents/WHO_FAQonDDT.pdf.
[80] *See generally Stockholm Convention on Persistent Organic Pollutants (POPs)*, *supra* note 74.
[81] Michael Finkel, *Malaria*, NAT'L GEOGRAPHIC MAG. 4 (July 2007), *available at* http://ngm.nationalgeographic.com/print/2007/07/malaria/finkel-text, *archived at* http://perma.cc/M6AA-WW3C.

was perhaps utilizing hyperbole to prove his point, the Stockholm Convention on Persistent Organic Pollutants and other legislation aimed at controlling or eliminating DDT have had the unintentional consequence of increasing the prevalence of malaria.

In Mozambique, for example, where malaria is endemic, there was recently a particularly brutal malaria epidemic.[82] While DDT had previously been used to control malaria there, sprayings of DDT had stopped completely a few decades earlier.[83] The lack of DDT was attributed to the fact that donors, who made up an estimated 80% of Mozambique's public health budget, had responded to the anti-DDT legislation by ordering that their donations not be used to fund DDT.[84] There are many other similar cases—as Richard Tren, Director of Africa Fighting Malaria explains,

> [C]ountries like Tanzania, and Kenya are very reliant on donors. That means they basically have to do what the donors say they must do. Donors shy away from interventions like indoor residual spraying. They really force them to use insecticide-treated nets. That on its own is not going to control malaria.[85]

D. Diverting Funding from DDT

While DDT is the most cost-effective method to fight malaria, it still requires funding in order to be used by malarial regions.[86] Unfortunately, the major funder of global health programs—the U.S. Agency for International Development ("USAID")—refuses to fund DDT, based on the same concerns expressed by the signatories of the Stockholm Convention on Persistent Organic Pollutants.[87] The World Health Organization not only refuses to fund projects involving DDT but also actively discourages DDT use.[88] While Eritrea does receive funding for DDT from a global

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[82] Jose Tembe, *Mozambique's Malaria Emergency*, BBC NEWS (Jan. 7, 2002), http://news.bbc.co.uk/2/hi/africa/1766711.stm, *archived at* http://perma.cc/XM96-37UU.
[83] Pat Sidley, *Malaria Epidemic Expected in Mozambique*, 320 BRIT. MED. J. 669, 669 (Mar. 2000).
[84] *Id.*
[85] *Fighting Malaria with DDT in South Africa*, BBC NEWS (Sept. 21, 2005), http://news.bbc.co.uk/2/hi/africa/4264374.stm, *archived at* http://perma.cc/5Z2E-7L24.
[86] *Id.*
[87] Rosenberg, *supra* note 19.
[88] *Id.*

organization—the World Bank—this funding comes with the condition that Eritrea attempt to phase out its DDT use under a specific time frame (that may or may not be appropriate for its malaria-fighting needs).[89] This limitation proves problematic for many attempting to eradicate malaria, including former Pan American Health Organization head, Renato Gusmäo, who once commented, "I cannot envision the possibility of rolling back malaria without the power of DDT . . . in tropical Africa, if you don't use DDT, forget it."[90]

E. DDT Use Post-Treaty

Currently, only a few nation-states persist in using DDT to fight malaria.[91] Production is limited mainly to two nation-states: India and China.[92] Use is similarly limited—besides the two producer states, only about sixteen nation-states use DDT.[93] Of these sixteen, the majority are located in sub-Saharan Africa and Southeast Asia.[94] There is no reported use of DDT to control malaria in the Americas, but other, less-effective insecticides are often used instead.[95] India, the biggest consumer of DDT, saw its use drastically decrease after the Stockholm Convention on Persistent Organic Pollutants went into effect; from 2005 to 2007, India's use of the chemical decreased by over one-fourth.[96]

Compounding the drop in funding and therefore usage of DDT, the Stockholm Treaty on Persistent Organic Pollutants includes a so-called "precautionary principle," which ensures that no equally effective pesticide will be developed.[97] The precautionary principle holds that a pesticide must undergo a far more rigorous process than in the past in order to enter the market.[98] That is, instead of assuming a pesticide is

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[89] *Id.*
[90] *Id.*
[91] Henk van den Berg, G*lobal Status of DDT and its Alternatives for Use in Vector Control to Prevent Disease*, 118 ENVTL. HEALTH PERSP. 575, 580 (2009).
[92] *Id.* at 577.
[93] *Id.*
[94] *Id.*
[95] *Id.*
[96] *Id.* at 577.
[97] *Stockholm Convention on Persistent Organic Pollutants (POPs)*, EUROPA: SUMMARIES OF EU LEGISLATION (July 7, 2011), http://europa.eu/legislation_summaries/environment/air_pollution/l21279_en.htm, *archived at* http://perma.cc/8BHU-UT8M.
[98] WORLD HEALTH ORG., THE PRECAUTIONARY PRINCIPLE: PROTECTING PUBLIC HEALTH, THE ENVIRONMENT AND THE FUTURE OF OUR CHILDREN 4 (2004), *available at* http://www.euro.who.int/data/assets/pdf_file/0003/91173/E83079.pdf.

safe before it may be introduced in the market, the pesticide will be subject to a number of extra tests and trials before it may be made available for public use.[99] While this process may help to uncover possible effects of pesticides, it makes it far less likely that companies will invest in the development of these pesticides.[100] The costly process dissuades businesses from even entering the development stage, as they are extra fearful that, after spending millions of dollars to develop a product, it may never enter the market and thus the company will lose all of its investment capital.[101] This precautionary principle makes it even more important that DDT be used in residential sprayings—there is little to no chance that an equally effective pesticide will be developed due to the lack of incentives.[102]

F. Solution

Although well intentioned, the Stockholm Convention on Persistent Organic Pollutant's inclusion of DDT on the "restricted" list has led to an increase in malaria as the treaty restricts even accepted DDT use.[103] Instead of discouraging or outright forbidding DDT use, the global health infrastructure should focus on ensuring that DDT is used in a safe and effective way to control malaria. One of the most common safe and effective ways to use DDT, targeted indoor sprayings, is discussed in detail below.

IV. THE ENVIRONMENTAL AND HEALTH EFFECTS OF DDT WHEN USED FOR TARGETED INDOOR RESIDENTIAL SPRAYINGS

A. Aerial Spraying versus Targeted Indoor Spraying

As previously discussed, much of the anti-DDT movement has focused on the negative environmental and health effects associated with aerial spraying of DDT. What the anti-DDT movement has largely ignored, however, is an alternative use of DDT-targeted sprayings of indoor

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[99] *Id.* at 58.
[100] *See* Jonathan H. Adler, *The Problems with Precaution: A Principle Without Principle*, THE AM. (May 25, 2011), http://www.american.com/archive/2011/may/the-problems-with-precaution-a-principle-without-principle, *archived at* http://perma.cc/B6WR-RVAV.
[101] *See id.*
[102] *See id.*
[103] *Stockholm Convention—DDT Restrictions*, DDT INFORMATION SYSTEM, http://www.chem.unep.ch/ddt/DDTRestrictions.html (last updated Apr. 10, 2007), *archived at* http://perma.cc/7V8P-VMN3.

residential dwellings.[104] Such sprayings, instead of being done by planes over large fields, are conducted by individuals in homes.[105] These individuals use a diluted solution of DDT combined with other, non-active ingredients in order to accomplish the sprayings.[106] The DDT then kills any mosquitoes on or near the walls of the houses, and ensures that others are repelled from entering.[107]

In tropical areas of Asia where targeted spraying has been used to fight malaria, malaria has been reduced by as much as 90%, and child mortality has drastically decreased.[108] Although sub-Saharan Africa has not yet been exposed to a similar large-scale, targeted spraying campaign, pilot programs suggest that the sprayings would be just as effective there.[109]

While targeted sprayings can be accomplished with several different insecticides, DDT is the most effective.[110] Unlike other insecticides, DDT is not used for agricultural purposes, and thus does not pose the risk that mosquitoes will become resistant to it.[111] Resistance has been shown to be a problem especially for sub-Saharan Africa, where resistance to other insecticides is already building.[112] It is for this reason that the World Health Organization has recommended that DDT be used over other insecticides for targeted sprayings.[113]

Environmental concerns associated with DDT in the United States mainly centered around a powerful symbol for the nation, the Bald Eagle.[114] Concerns in the 1960s and 1970s that DDT was leading to the extinction of the bald eagle by killing the birds and weakening their eggs drove many to join the crusade against DDT.[115] The truth, however, was that the bald eagle population had been threatened by overhunting and human destruction of habitat long before DDT was used in the United

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[104] WORLD HEALTH ORG., WORLD MALARIA REPORT 2013, x (2013), *available at* http://www.who.int/iris/bitstream/10665/97008/1/9789241564694_eng.pdf.
[105] *Id.* at 4.
[106] *DDT Guidelines for IRS*, USAID 11 (June 2009), http://pdf.usaid.gov/pdf_docs/PNADR935.pdf.
[107] *Indoor Residual Spraying*, WORLD HEALTH ORG. 1 (2006), http://whqlibdoc.who.int/hq/2006/WHO_HTM_MAL_2006.1112_eng.pdf.
[108] *Id.* at 2–3.
[109] *Id.* at 3.
[110] *Id.* at 4, 6.
[111] *Id.* at 5, 7.
[112] *Id.* at 5.
[113] *Indoor Residual Spraying*, *supra* note 107.
[114] Milloy, *supra* note 65.
[115] *Id.*

States.[116] As the decades passed, new causes, none of which were DDT, were added to the list; a 1984 National Wildlife Federation study found that besides illegal hunting and habitat destruction, causes such as electrocution from power lines, collisions with other eagles, and poisoning from ingesting ducks containing lead were the main killers of bald eagles.[117] Also, despite a 1966 study—conducted when DDT use in the United States was still common—that found that DDT did not actually harm bald eagles, the idea that DDT was poisoning the national symbol remained.[118] This powerful image—the strong bald eagle being destroyed by the careless spraying of DDT—is likely a factor in why opposition to residential indoor sprayings in malarial regions persists in the United States.[119]

Besides being more effective for use in residential sprayings, DDT is cheaper, as well.[120] DDT is effective after being sprayed for up to one year, while other insecticides must be sprayed again after only six months.[121] Combined with the facts that DDT is cheaper than its competitors and also more efficient, meaning less must be sprayed in order to achieve the desired effect, it is clear that DDT is by far the most cost-effective insecticide available in the fight against malaria.[122]

B. Environmental Effects

While its detractors claim spraying small amounts can harm the environment, DDT has not been shown to harm the environment when it is used for targeted sprayings only.[123] The environmental effects of DDT observed in the 1960s and 1970s arose due to aerial sprayings of fields not targeted sprayings of residences.[124] Even USAID—a well-known opponent of DDT—published a fact sheet explaining that "[t]he negative environmental effects of DDT use that led to its banning were due to massive, widespread agricultural use . . . . Spraying limited amounts of DDT inside houses is considered unlikely to have major negative environmental impact."[125] It is clear that targeted indoor sprayings of DDT do not produce

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[116] *Id.*
[117] *Id.*
[118] *Id.*
[119] *Id.*
[120] *Indoor Residual Spraying*, *supra* note 107, at 6.
[121] *Id.*
[122] *Id.*
[123] *Id.* at 5; Sadasivaiah et al., *supra* note 29, at 252.
[124] Sadasivaiah et al., *supra* note 29, at 251–52.
[125] Rosenberg, *supra* note 19.

the catastrophic environmental consequences that Rachel Carson addressed in the seminal *Silent Spring*.

C. Health Effects

Similar to its environmental effects, the health effects of DDT are minimal when it is used in targeted indoor sprayings.[126] Despite the fact that health effects on humans were never explicitly connected to DDT, the anti-DDT movement has suggested that aerial sprayings led to breast cancer and premature births.[127] Also, while DDT has not been conclusively linked to cancer, many persist in the false belief that the former may cause the latter. This belief most likely stems from the 1972 DDT ban in the United States by EPA Administrator William Ruckelshaus who at the time claimed that DDT had a carcinogenic effect in humans.[128] This statement was later shown to have been based on two studies that have been disproved and disregarded by the scientific community.[129]

While early studies seemed to find a weak connection between indoor sprayings of DDT and certain reproductive effects, these studies focused on the sprayings that were conducted in the 1940s and 1950s.[130] Later studies that have focused on the spraying techniques currently employed have found no such connection.[131] No studies have conclusively linked targeted indoor sprayings of DDT to these health effects.[132]

Study after study attempts to link DDT to a heightened risk of developing cancer, and yet all are unable to do so.[133] There is no evidence, not even weak anecdotal evidence, that targeted indoor sprayings of DDT may cause these health effects in humans.[134] In fact, a 1997 study found that breast cancer rates were slightly *lower* in postmenopausal women who had been exposed to DDT than in those who had not.[135] While this outcome does not go so far as to suggest that DDT can lower cancer rates, it certainly confirms the conclusions of hundreds of other studies that have

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[126] *Id.*
[127] *Id.*
[128] J. Gordon Edwards, *DDT: A Case Study in Scientific Fraud*, 9 J. OF AM. PHYSICIANS & SURGEONS 83, 84 (2004).
[129] *Id.* at 84.
[130] Sadasivaiah et al., *supra* note 29, at 252.
[131] *Id.* at 251–52.
[132] *See, e.g.*, *id.*
[133] Rosenberg, *supra* note 19.
[134] Sadasivaiah et al., *supra* note 29, at 2521–52.
[135] Pieter van't Veer et al., *DDT (Dicophane) and Postmenopausal Breast Cancer in Europe: Case-Control Study*, 315 BRIT. MED. J. 81, 81 (July 1997).

found no connection between DDT and health problems in humans.[136] Similarly, a 1998 study that focused on people commonly exposed to DDT found that DDT did not increase the risk of developing non-Hodgkin's lymphoma.[137] In fact, the study went on to conclude that other, more dangerous pesticides that are sometimes used in agricultural settings might actually pose a risk to humans.[138] These pesticides are used commonly alongside DDT, which may in part explain why DDT continues to be seen as dangerous in the eyes of the public.[139]

Even if negligible health effects can be detected, these health effects are likely to be outweighed by the huge toll that malaria takes on both the health and the economies of the places where it is endemic. As Yok Yorn, a Cambodian father who had already lost two of his five children to malaria explained, "I'm so afraid that my other children will die of malaria as well."[140]

V. COMMONLY CITED ALTERNATIVES TO FIGHT MALARIA ARE LESS PRACTICAL AND EFFECTIVE THAN DDT

While many in the international community argue that the malaria epidemic can be better controlled by alternatives to DDT,[141] these alternatives cannot address malaria nearly as effectively as can DDT. These alternatives, which include insecticide-treated bed nets, antimalarial drugs to prevent and treat malaria, and the spraying of insecticides other than DDT, are addressed below.

A. Insecticide-Treated Bed Nets

Insecticide-treated bed nets are a commonly proposed solution to the DDT epidemic. Such bed nets have been created and distributed by key players in global health and environmental issues such as the World

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[136] *See, e.g.*, *id.*

[137] Dalsu Baris et al., *Agricultural Use of DDT and Risk of Non-Hodgkin's Lymphoma: Pooled Analysis of Three Case-Control Studies in the United States*, 55 OCCUPATIONAL ENVTL. MED., 522, 526 (1998).

[138] *Id.*

[139] *Id.*

[140] Nicholas D. Kristof, *Malaria Makes a Comeback, Deadlier Than Ever*, N.Y. TIMES (Jan. 8, 1997), http://www.nytimes.com/1997/01/08/world/malaria-makes-a-comeback-and-is-more-deadly-than-ever.html, *archived at* http://perma.cc/8JKG-DN9S.

[141] *Safer Alternatives to Malaria-Controlling DDT Focus of UN-Backed Meeting*, UN NEWS CENTRE (Nov. 3, 2008), http://www.un.org/apps/news/story.asp?NewsID=28793&Cr=Chemical&Cr1#.UmXDWxAlUhU, *archived at* http://perma.cc/9SMJ-8F32.

Health Organization, the Bill and Melinda Gates Foundation, and the Carter Foundation.[142] An insecticide-treated bed net prevents malaria by forming a physical barrier between the person sleeping beneath it and any mosquitoes that might bite that person.

Besides physically preventing mosquitoes from accessing the individual protected by the bed net, bed nets treated with insecticides presumably both repel and kill mosquitoes, thus preventing them from even entering individual homes.[143] This is supposedly able to prevent those at risk for malaria from being bitten by the virus-carrying mosquito, and thus ensure that they do not become infected.

While the nets have helped to prevent malaria,[144] they have also caused several unforeseen problems. The insecticide on these nets wears off after about six to twelve months, or even sooner if the nets have been washed.[145] As the insecticide wears off, the nets begin to present dangers for fellow occupants of the residence who have no nets.[146]

While those with nets still receive some protection through the physical barrier, the lack of insecticide means that the same number of mosquitoes is present in the residence as would be the case if the nets did not exist. Because some people are protected, however, those without nets absorb a disproportionate amount of mosquito bites, and thus suffer a far higher chance of developing malaria than they would if no nets were present.[147] Because most households with access to nets are not able to obtain enough nets for every household member,[148] bed nets may have actually increased the incidence of malaria for many individuals living in malaria prone regions.

Even when the nets work perfectly, however, logistical problems prevent them from being fully utilized by the people who need them most.

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[142] Christian G. Meyer & Stephan Ehrhardt, *Are Insecticide Treated Bednets Failing?*, 12 THE LANCET INFECTIOUS DISEASES 513, 513 (2012).

[143] *Insecticide-Treated Bed Nets*, CTRS. FOR DISEASE CONTROL AND PREVENTION, http://www.cdc.gov/malaria/malaria_worldwide/reduction/itn.html (last updated Mar. 26, 2014), *archived at* http://perma.cc/QQ9F-6NTM.

[144] *Id.*

[145] *Id.*

[146] Laith Yakob & Guiyun Yan, *Modeling the Effects of Integrating Larval Habitat Source Reduction and Insecticide Treated Nets for Malaria Control*, 4 PLOS ONE 1, 5 (2009), http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0006921, *archived at* http://perma.cc/UQ8V-W7N6.

[147] *Id.* at 2–3.

[148] Sibhatu Biadgilign, et al., *Determinants of Ownership and Utilization of Insecticide-Treated Bed Nets for Malaria Control in Eastern Ethiopia*, 2012 J. OF TROPICAL MED. 1, 3 (2012).

Cost of the nets is a huge barrier to many who might benefit from them. The World Health Organization has estimated that over thirty-two million nets are needed in Africa each year, at a cost of $100 million per year.[149] Unlike the cost of targeted sprayings of DDT, this cost must be paid each year; $100 million will provide bed nets only for one year, at which time the cost will have to be repeated.[150]

This cost is far too high to be met each year by African governments and international donors.[151] Even after the nets are purchased, they must be retreated often, which is an additional expense of time and money.[152] Also, nets are often destroyed, adding to the considerable expense as they must then be replaced, and possibly retreated.[153] If the cost of replacing nets is not met, as it often cannot be, the original cost associated with purchasing, treating, and transporting the net will have essentially been wasted.[154]

Besides cost, distribution difficulties keep nets away from those who need them. Experts are divided on whether it is more effective to distribute the nets free of cost, or to subsidize them and charge a nominal fee so that purchasers value them more highly.[155] This presumably leads to less waste, as well as encouraging the development of small, local businesses as Africans begin to sell nets themselves.[156] While international consensus currently seems to favor free distribution, it is unclear whether this method of distribution will be effective.[157]

Those living in remote rural regions may find that distribution efforts fail to reach them. It is notoriously difficult to reach such regions with medical supplies, and the fact that bed nets must be replenished yearly makes distribution especially difficult.[158] Because they wear out

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[149] Allison Tarmann, *Public Health Goes Private in Africa: Mosquito Nets Could Become Big Business*, POPULATION REF. BUREAU (Mar. 2000), http://www.prb.org/Publications/Articles/2000/PublicHealthGoesPrivateinAfricaMosquitoNetsCouldBecomeBigBusiness.aspx, *archived at* http://perma.cc/T2CC-LLCK.

[150] *Id.*

[151] *Id.*

[152] *Insecticide-Treated Mosquito Nets: A WHO Position Statement*, WORLD HEALTH ORG. 5, http://www.who.int/malaria/publications/atoz/itnspospaperfinal.pdf?ua=1 (last visited Oct. 27, 2014).

[153] *Id.*

[154] *Id.*

[155] Reuben Kyama & Donald G. McNeil Jr., *Distribution of Nets Splits Malaria Fighters*, N.Y. TIMES (Oct. 9, 2007), http://www.nytimes.com/2007/10/09/health/09nets.html, *archived at* http://perma.cc/VT3H-APU3.

[156] *Id.*

[157] *Id.*

[158] *UNICEF Supports Wider Distribution of Mosquito Nets in Cunene Province*, UNICEF

quickly and are not always effective, many note the lack of will of the international community to ensure that the proper number of bed nets is delivered to rural homes.[159]

Exacerbating these difficulties is the fact that many rural individuals need to be educated in order to get the benefit of the bed nets.[160] When they were not told the purpose of the bed nets, some rural villagers (quite reasonably) believed that they were made to catch fish; besides the fact that using a bed net for fishing means that it will likely not be used for its intended purpose, this will in all likelihood cause the insecticide on the bed net to become defective at a much faster rate.[161] Bed nets thus pose the problem of requiring aid workers to expand resources ensuring that the nets are properly used and maintained.[162]

Furthermore, even those with access to bed nets may decline to use them. Bed nets block ventilation, thus increasing temperatures in already hot, uncomfortable tropical climates.[163] Those living in regions where malaria is especially common often decide that the benefit of possibly avoiding a very common disease is outweighed by the cost of being extremely physically uncomfortable.[164]

Although DDT's detractors point to the fact that Mexico and parts of Central America have had success using bed nets, these bed nets do not work equally in every region.[165] As South African Professor Hindrik Bouwman explained, "we have a whole host of mosquito species and more than one parasite. The biology of the vectors is different and there is therefore no one-method-fits-all strategy. . . ."[166] While bed nets may be sufficient for some regions, they cannot contain malaria everywhere it is endemic.[167] As such, the problems associated with bed nets, including cost, logistics, effectiveness, and insecticide breakdown means that bed nets

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(Nov. 25, 2010), http://www.unicef.org/esaro/5440_Angola_UNICEF_distributes_mosquito_nets.html, *archived at* http://perma.cc/HVH6-NSSD.

[159] *Id.*

[160] *Id.*

[161] *Id.*

[162] *Id.*

[163] Sonia Shah, *In Africa, Anti-malaria Mosquito Nets Go Unused by Recipients*, L.A. TIMES (May 2, 2010), http://articles.latimes.com/2010/may/02/opinion/la-oe-shah-20100502, *archived at* http://perma.cc/GP76-A5TR.

[164] *Id.*

[165] Marla Cone, *Should DDT Be Used to Combat Malaria?*, SCI. AM. (May 4, 2009), http://www.scientificamerican.com/article/ddt-use-to-combat-malaria/, *archived at* http://perma.cc/YD5S-776E.

[166] *Id.*

[167] *Id.*

are not an effective long-term substitute for DDT in the ongoing battle against malaria.

B. Anti-malarial Drugs

Another commonly cited anti-malarial tool is medication taken to prevent the illness. Travel literature aimed at outsiders visiting tropical regions advises them to take preventive medication throughout their entire stay and to continue this medication for a certain period upon returning.[168] These drugs, however, are not a solution for permanent residents of Africa; they are intended for short-term use, and are far too toxic to be taken long-term.[169] These preventive drugs thus have minimal effect in preventing malaria in the vast majority of people who are at risk of developing it.

While drugs to treat malaria do exist, these drugs are unobtainable by those who need them most. Besides carrying a prohibitive cost, these drugs are generally dispensed at clinics, meaning that most rural villagers must walk miles and miles in order to have a chance of purchasing them.[170] Often, by the time a villager is able to reach a clinic, the person for whom that villager was seeking medicine is already dead or has progressed so far along in the illness that he or she is beyond medical help.[171] Furthermore, there does not seem to be an attempt by governments to implement a plan that would allow rural residents continuous access to these anti-malarial medications.[172]

C. Insecticides Other Than DDT

While DDT itself is not widely used, other insecticides have been employed to kill the mosquitoes that spread the deadly virus. Indoor Residual Spraying ("IRS") can be conducted with a range of insecticides other than DDT.[173] These insecticides by themselves, however, are not

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[168] *Malaria Prevention*, WEBMD, http://www.webmd.com/a-to-z-guides/malaria-prevention (last updated Apr. 11, 2013), *archived at* http://perma.cc/CX2L-APQY.
[169] *See* Rosenberg, *supra* note 19.
[170] *See* Jeffrey D. Sachs, *Getting Practical in Controlling Malaria*, PROJECT SYNDICATE (Dec. 20, 2006), http://www.project-syndicate.org/commentary/getting-practical-in-controlling-malaria, *archived at* http://perma.cc/Z4SD-JZ9H.
[171] *Id.*
[172] *Id.*
[173] *Malaria Prevention and Control*, E. AFRICAN COMMUNITY, http://www.eac.int/health

nearly as effective as DDT.[174] Besides the fact that they are far less effective than DDT, they are also more expensive; these alternative insecticides cost about four times more than DDT.[175]

There are twelve insecticides that can be used in targeted indoor sprayings, and these insecticides fall into four general classes.[176] One of these categories, pyrethroids, are the most cost-effective alternative to DDT.[177] Pyrethroid resistance in malarial regions, however, means that they cannot be as effective in fighting malaria as is DDT.[178] While some new pyrethroids are currently in development, they are not expected to be ready for use anytime soon, and their effectiveness at that time remains unknown.[179] While some countries attempt to switch to pyrethroids, they find that the positive effects of DDT cannot be ignored; for example, South Africa eventually had to reintroduce DDT in 2000 after a 1996 switch to pyrethroids failed due to widespread pyrethroid resistance, causing several malaria outbreaks throughout the country.[180]

Although South Africans were at first wary of participating in the targeted indoor spraying programs, in some provinces South Africa eventually was able to spray about 90% of the homes that contained individuals at risk for malaria.[181] In 2000, malaria affected over 65,000 South Africans, killing almost 500.[182] Realizing that the pyrethroid spraying the country had been doing was not very effective, South Africa made the switch to DDT the same year.[183] As health minister Seaparo Sekwati explained, "[w]e have decided that . . . we cannot go for expensive things which we cannot afford as a country. We are going to continue using DDT as it has worked and has worked for those developed countries in the past."[184] Only four years after South Africa began to spray DDT, its annual malaria death rate fell from 458 to 89, and has continued to drop ever since.[185] With the introduction of DDT to its malaria-fighting tools, South

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/index.php?option=com_content&id=95%3Aclassification-system&Itemid=32 (last visited Oct. 27, 2014), *archived at* http://perma.cc/NHG6-9QTV.

[174] Rosenberg, *supra* note 19.

[175] *Id.*

[176] van den Berg, *supra* note 91, at 1659.

[177] *Id.*

[178] *See id.* at 1660.

[179] *See id.* at 1659, 1661.

[180] *See id.* at 1660; Rosenberg, *supra* note 19.

[181] *Fighting Malaria with DDT in South Africa*, *supra* note 85.

[182] *Id.*

[183] *Id.*

[184] *Id.*

[185] *Id.*

Africa seems poised to meet its goal of completely eradicating malaria within its borders by 2018.[186] It should be noted here that non-pyrethroid alternatives to DDT remain even less cost-effective and less potent in the battle against malaria.[187] As such, DDT remains the only effective, sufficiently cheap pesticide to treat malaria.

VI. LIMITATIONS

As previously discussed, targeted indoor sprayings of DDT have been shown to be safe and effective in combating the disastrous effects of malaria. It should be noted, however, that this Note does not assume that targeted indoor sprayings are a sort of magical solution; indoor sprayings of DDT are just one of the many tools used to combat malaria, and should not be seen as an instant and total fix. In fact, the World Health Organization currently recommends that targeted indoor sprayings be used in conjunction with bed nets and, when possible, anti-malarial drugs for maximum effectiveness in the ongoing struggle against malaria.[188]

This Note also recognizes that targeted indoor sprayings are not an effective anti-malaria tool in every instance. Sprayings must be done in residences with a high number of surfaces that are conducive to spraying.[189] Also, mosquitoes that spread malaria must spend at least part of their time feeding or resting indoors in order for the insecticide to reach them.[190] Finally, for DDT to be effective, it must be sprayed in an area in which the mosquitoes are not resistant to it.[191] Overuse of DDT for agricultural purposes,(such as in the previously discussed aerial sprayings), have made mosquitoes in some areas resistant to DDT.[192] For this reason, the World Health Organization requires that epidemiological studies establish that DDT will be effective before it is sprayed.[193]

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[186] Agence France-Presse, *DDT Helping South Africa Drastically Reduce Deaths From Malaria*, THE RAW STORY (Oct. 9, 2013), http://www.rawstory.com/rs/2013/10/09/ddt-helping-south-africa-drastically-reduce-deaths-from-malaria/, *archived at* http://perma.cc/V5LT-TPHS.

[187] *See* van den Berg, *supra* note 91, at 1657–60.

[188] *Vector Control and Insecticide Resistance*, THE WORLD HEALTH ORG., http://www.who.int/malaria/areas/vector_control/en/index.html (last visited Oct. 27, 2014), *archived at* http://perma.cc/4NMQ-AMH9.

[189] *See Indoor Residual Spraying*, *supra* note 107.

[190] *Id.*

[191] *See id.* at 4–5.

[192] *See Malaria Prevention and Control*, *supra* note 173.

[193] WORLD HEALTH ORG., THE USE OF DDT IN MALARIA VECTOR CONTROL: WHO POSITION

Finally, for DDT to help fight malaria, the local population must be willing to have their homes sprayed; about 80% of homeowners must agree to participate in the program in order for it to be successful.[194] This Note recognizes these shortcomings of DDT and has taken into account the problems they pose during the discussion of the relative cost and effectiveness of DDT and of targeted indoor sprayings.

CONCLUSION

Although much concern has been raised by activists about the environmental and health effects of DDT, these concerns have been overblown. The disastrous health, social, and economic effects of malaria, as well as its role in entrenching nation-states in poverty, makes it imperative that any available means to fight it be used by the worldwide community.

One of these available means, DDT, is far more practical as a tool against malaria than other commonly cited methods; it is more effective, cheaper, and lasts longer than most methods being employed currently. Commonly cited alternatives to DDT, including bed nets and other insecticides, are thus not adequate substitutes. Although these methods can be used along with DDT to increase its effectiveness, they are not adequate on their own to address the widespread malaria epidemic.

Despite the fact that DDT was instrumental in eradicating malaria throughout much of the developed world, anti-DDT activists in the 1960s and 1970s protested DDT's environmental and health effects, leading to a significant scale back in use of the chemical. Although the activists were correct about DDT's harmful effects when the chemical is used in aerial sprayings, DDT use for targeted indoor sprayings has far fewer health and environmental effects. Targeted indoor sprayings, in fact, have minimal consequences for both human health and the environment—and any consequences they may have are vastly outweighed by DDT's unique ability to address the malaria problem.

Despite DDT's positive uses and minimal negative impacts, the publicity surrounding it continues to inform global policy. The 2001 Stockholm Treaty on Persistent Organic Pollutants, for example, citing the commonly repeated environmental and health concerns, placed DDT on a list of chemicals it aimed to severely restrict. The inclusion on this list caused DDT use

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STATEMENT, 5 (2011), *available at* http://whqlibdoc.who.int/hq/2011/WHO_HTM_GMP_2011_eng.pdf?ua=1.

[194] WORLD MALARIA REPORT 2013, *supra* note 104, at 4.

to drop even more dramatically than before; funding for DDT was curtailed, and developing countries were urged not to spray it. Faced with a lack of support as well as express encouragement to refrain from using DDT, many nation-states decreased or even halted their use of the chemical.

This under-use of DDT will in the long run prove very harmful to developing nations struggling against malaria, and malaria will continue to cause serious problems and stall development. The Stockholm Convention on Persistent Organic Pollutants, therefore, should remove DDT from the restricted list so that the chemical can be used responsibly for targeted indoor sprayings.