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# Colonialism: Analyzing DDT in India: Ethical Considerations

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**Abstract**

The application of Dichlorodiphenyltrichloroethane (DDT) is one of the most debated global issues in the 21st century. Developed in the 1940s, it was discovered that DDT could be used as an insecticide to prevent the spread of diseases such as malaria that transmit to humans through vectors like mosquitoes (Mulliken et al., 2005). In fact, DDT was publicly lauded during the twentieth century for eradicating malaria in many developed nations and is now widely perceived as the most effective deterrent of malaria, especially in developing countries such as India (Mulliken et al., 2005). However, concerns have now risen regarding the detrimental effects of the prolonged use of DDT. Critics exemplify the aforementioned impacts of DDT within several categories including environmental, economic, health, and continued effectiveness. A comprehensive review of current research indicates that the drawbacks associated with the extensive use of DDT on these fronts outweigh its perceived effectiveness in malaria control. Moreover, research suggests that alternatives to DDT such as pyrethroids and ITN distribution show potential in replacing DDT as the primary method of vector-control in India.

*Keywords: DDT, insecticide, Environment, Stockholm Convention, Health, India, ITNs, Malaria*

## 1. Introduction

Dichlorodiphenyltrichloroethane (DDT) is an organochlorine insecticide first synthesized in 1874 (NPIC, 2000). A unique quality of DDT is that it affects the nervous system in organisms by interfering with the normal firing of neurons. Prolonged exposure to it through contact or ingestion causes nerve cells to repeatedly generate an impulse, resulting in seizures, tremors, and eventually death in less complex organisms such as insects (NPIC, 2000). This makes it an effective deterrent to malaria, a vector-borne disease transmitted to humans through insects such as mosquitoes.

According to the National Institute of Malaria Research in India, malaria assumes close to 85% of global infectious disease burden, and India alone has nearly 15 million cases with approximately 20,000 deaths annually, accounting for the majority of cases in South Asia (Kumar et al., 2007). The severity of global outbreaks of vector-borne diseases including malaria necessitated the mass production and distribution of insecticides in order to combat ever-growing case numbers. Thus, in previous decades, DDT pesticides have saved millions of lives by preventing the spread of malaria, and India has since become the largest producer and consumer of DDT in the world (Berg, 2009). However, global concerns over India's heavy reliance on DDT has engendered uncertainty over the ethicality of its continued use. This research paper is intended to benefit global discussion on DDT by providing a holistic evaluation of the ethical implications of using DDT pesticides as the primary method of combating the malaria epidemic in India and evaluate possible alternatives to DDT such as pyrethroid and ITN

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distribution.

## 2. Overview

### 2.1. Environmental Impact of Current DDT Usage

In India, DDT is an essential component of the aerosol used in indoor residual spraying (IRS), which "involves applying long-acting insecticides to [houses] to kill insects" (Rehwagen, 2006). This method is commonly perceived to be humane and cost-effective, as Dr. Asamoa-Baah states that IRS has been "one of the quickest ways to reduce [malarial] infections" (Rehwagen, 2006). Despite the apparent value of using DDT in malaria control, it is important to note that it has been banned in various countries including the US due to concerns voiced by environmentalists. Specifically, DDT has had a severe harmful impact on ecosystems. Studies have shown that the bioaccumulation and biomagnification of DDT in aquatic organisms through contamination and runoff can reach "levels many thousands of times higher than in water," harming entire ecosystems and disrupting environmental homeostasis (ATSDR, 2015). Ecologist Vladimir Turosov with the Russian Cancer Research Centre acknowledges that this is especially concerning because DDT accumulates in tissues and remains highly toxic to non-target organisms such as fish and birds for prolonged periods of time (Turusov et al., 2002). In fact, Turusov also concludes that the persistence of DDT in water has severely damaged wildlife populations around the world. This can be seen in the significant population decline of bird species, such as the osprey in India and the bald eagle in the US (Hellou et al., 2013). In response to such information, twelve chemicals including DDT were banned in 2001 by the United Nations under the Stockholm Convention because of their contribution to ecological damage (Lallas, 2001).

### 2.2. Economic Influence of DDT

A cost comparison of malaria control methods by the World Health Organization (WHO) found that non-DDT pesticides cost 2 to 23 times more per house than DDT (Walker, 2000). Additionally, non-DDT substances require frequent application, while DDT is sprayed just once a year and costs approximately $1.44 per house (Williams, 2004).

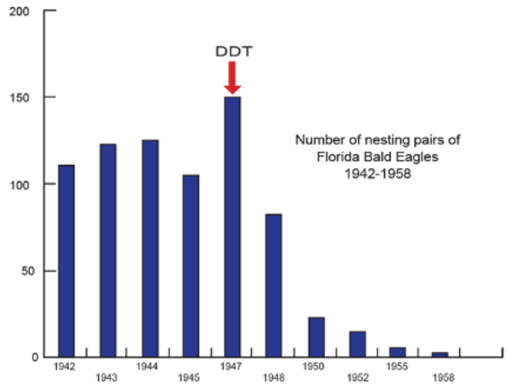


Figure 1a. Decline in the Bald Eagle population after initial mass exposure to DDT (American Eagle Foundation, n.d.)

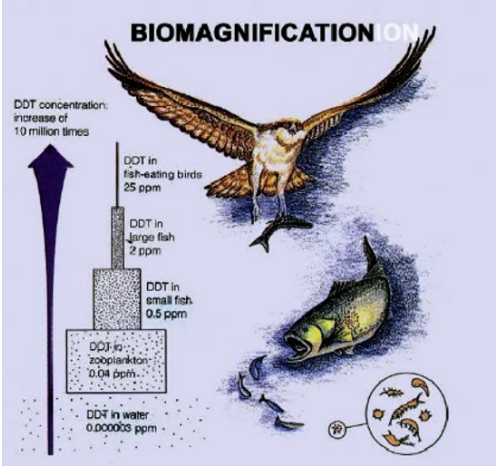


Figure 1b. How DDT accumulates in organisms through the food chain after environmental contamination (American Eagle Foundation, n.d.)

Thus, officials assume that countries with higher malaria incidence and related mortality rates receive larger net economic benefits from DDT because the potential cost of chronic conditions caused by the environmental effects of DDT may not be as significant of a concern as it is in low prevalence areas. As a result, governments in less-developed countries with high malaria prevalence are prompted to staunchly defend their use of DDT. For instance, when the global DDT ban was first proposed, at-risk populations and governments in Sub-Saharan Africa

and the Indian subcontinent defended DDT, arguing that prohibiting the use of such an effective "...anti-malaria weapon..." (Tren, n.d.) would result in an unprecedented amount of deaths and cost economies up to $480 million due to medical costs and loss of workforce members (Guimarães, 2007).

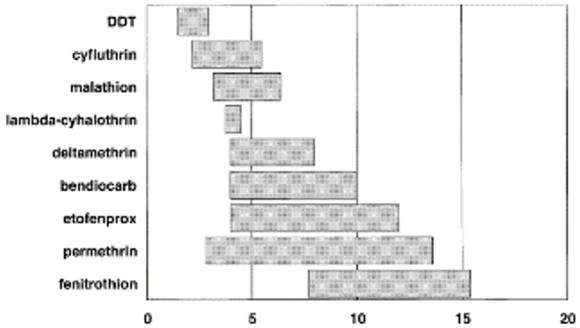


Figure 2. Average cost of insecticides in dollars per pound (Walker, 2000).

2.3. Economic Drawbacks to DDT

However, it is also important to note other studies indicate that DDT increases the economic burden on countries due to indirect costs. Although the complete eradication of malaria through DDT would "...result in a net economic benefit of 12 billion dollars…" (Mukose, 2015) annually, it would be improper to assume that IRS would result in full eradication. A study by Susmita Dasgupta analyzing the economic implications of DDT found that, "While...DDT can lead to a significant reduction in the estimated economic loss caused by malaria...it can also add more than...$28 billion a year in costs from the resulting inadvertent health effects" (Dasgupta, 2012). However, this economic loss can be reduced to $5 billion if spraying DDT is restricted to areas with the highest malaria prevalence, which would still target over 70% of the at-risk population (Dasgupta, 2012). Furthermore, although global price calculations show that DDT is currently the cheapest malaria control method, concerns over its safety have caused a decline in demand which has driven up its price.

2.4. Opposition to DDT Restriction

As stated earlier, various public health groups and governments including India oppose a complete ban on DDT because of its low cost and seemingly prominent usefulness in malaria control. For instance, despite the discouragement of DDT by the Stockholm Convention, governments in malaria-stricken countries like India have expressed outrage at the ban, and have obtained provisions from the UN to use DDT pesticides to combat malaria (Berg, 2009). The World Health Organization also supports DDT use, reasoning that the benefits of the pesticide outweigh any potential health risks (Harada et al., 2016). Other health officials disagree with this conclusion, expressing concerns over the side-effects of DDT on individuals living in highly concentrated areas. Although there is no conclusive evidence that low concentrations of DDT cause major illnesses in humans, medical experts assert that it is an endocrine inhibitor and possible carcinogen, and higher doses could harm the nervous system, liver, and reproductive organs ("DDT", 2017; Harada et al., 2016). Additionally, researcher Tom Børsen claims that despite risks of bioaccumulation, "public health agencies have incentives to use higher doses of DDT to achieve 'better' results," thereby exposing humans and wildlife to increasingly harmful concentrations (Børsen & Nielsen, 2017). Hence, the rising concentrations of DDT in the environment could potentially harm millions of Indians through food and water contamination. In fact, the Indian government even instituted a partial ban on DDT use in 2008 because of alarmingly high amounts of pesticide found in food samples (Toteja et al., 2003). However, because of the disunity between environmentalists, medical professionals, and global protocols on the morality of DDT, Indian officials have done little to enforce the ban and are able to hide behind overgeneralized regulations regarding DDT use, thus remaining disinclined to pursue a complete ban (Jayachandran).

2.5. The Decreasing Effectiveness of DDT

Regardless of ongoing global divisiveness, studies have indicated that the effectiveness of DDT in India is decreasing due to its extensive use, calling further into question the ethicality of India's continued reliance on DDT. Researchers note that "even

restricted use has led to...a dangerous rise in [resistant] mosquitoes," which will force India to use even higher concentrations of DDT, harming humans and wildlife alike (Kenney, 2013). Accredited malariologist V. P. Sharma notes several other reasons for the diminishing effectiveness of DDT in India, including inefficient administration. He reasons that because India lacks a proper oversight method and significantly undersupplies its distribution program, DDT pesticides are allocated to richer urban communities over rural areas with higher malaria prevalence, resulting in coverage rates that are too low to effectively control malaria transmission (Sharma, 2003). In other words, although DDT was previously regarded as a praiseworthy method of controlling vector-borne diseases in India, its lessening effectiveness indicates that the drawbacks of its use will soon outweigh the current benefits.

## 3. Discussion

### 3.1. A Potential Solution

One possible solution is to create evidence-based distribution systems that target malarious regions more efficiently. Although this would work temporarily, increasing insect resistance to DDT would unnecessarily expose individuals to higher amounts of pesticide and eventually render such distribution obsolete (Sharma, 2003). Instead, a cost-effective alternative to DDT pesticides are insecticide-treated nets (ITNs), which can be distributed to individuals in malaria-stricken regions. According to the WHO, ITNs have been "by far the largest contributor to the impressive drops seen in malaria incidence" since 2000 ("Malaria", n.d.). Most of these nets are treated with pyrethroids, compounds that, unlike DDT, "rapidly metabolize and do not accumulate in tissues," and are thus harmless to humans, while still retaining their effectiveness against mosquitoes (Chrustek et al., 2018).

### 3.2. Benefits of ITN Distribution over DDT

Initially, this solution seems costly to implement because it utilizes pyrethroids; however, this drawback would only be temporary because the price of DDT is expected to surpass the price of pyrethroids soon ("Facts", 2019). In fact, the IMARC Group, an accredited Market Research Firm, found that the global pyrethroids market is expected to grow at a compound annual growth rate of 4% in the next five years ("Pyrethroids", n.d.). This suggests that as demand increases, prices will go down, thus further narrowing the financial disparity between relying on pyrethroids and relying on DDT. While the ultimate goal of this approach would be to phase out DDT entirely, it would allow for a smooth transition towards alternative control methods while also gradually reducing malaria cases.

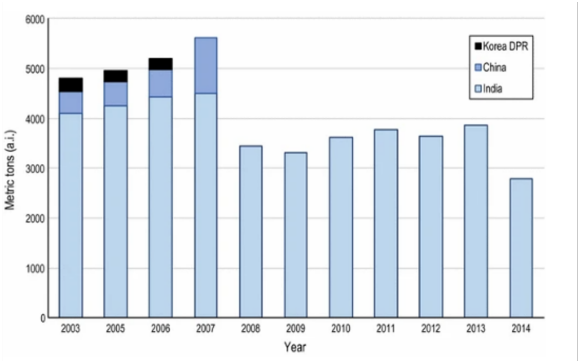


Figure 3a. shows the average use of DDT over a period of time in China, India, and DPR Korea, wherein DDT use is decreasing rapidly (Berg et al., 2017).

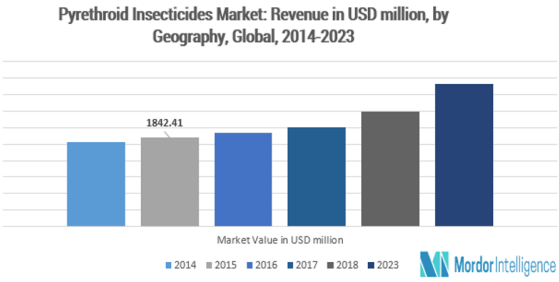


Figure 3b. shows the average global use of pyrethroids, wherein pyrethroid usage is rapidly increasing ("Pyrethroid Market", n.d.)

P. Jambulingam with the Vector-Control Research Center in India conducted a study to evaluate the effects of ITN distribution in comparison to DDT. He observed a "7.2-32.1% reduction of malaria

incidence" since using ITNs in a province where DDT pesticides were once implemented (Jambulingam et al., 2008). Jambulingam's results indicate that ITNs are becoming more effective than IRS and can be used without fear of harming human or wildlife populations. In fact, "China, the Solomon Islands, and Vietnam have begun replacing their IRS programs with ITN [distribution]" (Berg, 2009). Thus, it can be inferred that India could dramatically improve vector-control efforts by distributing ITNs to rural areas with high malaria incidence.

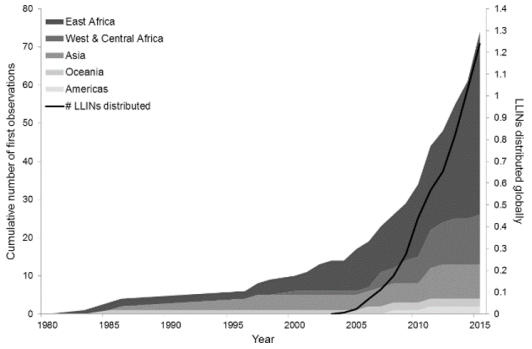


Figure 4. Global ITN distribution continues to increase rapidly (Short et al., 2018).

3.3. Limitations to Replacing DDT

There are limitations to completely replacing DDT pesticides with ITN distribution in India specifically. Since DDT is "produced by the government-controlled HIL and is [currently] cheaper than other pesticides," a total ban would be unrealistic, as officials would be unmotivated to encourage alternatives if their government would lose profit by undermining DDT production (Sharma, 2003). Additionally, without an efficient ITN distribution system, coverage may still be too low to significantly decrease malaria rates, making it necessary to have other methods of malaria control to reach as much of the Indian population as possible. To combat these limitations, researcher Kansinathan Gunasekaran suggests in his study that selling ITNs at "subsidized prices [to at-risk regions]...and ensuring the availability of nets" could improve coverage by encouraging more people to use ITNs (Gunasekaran et al., 2009). Disease experts also acknowledge that frequent insecticide rotations would help combat possible insect resistance to pyrethroids (Kranthi et al., 2001).

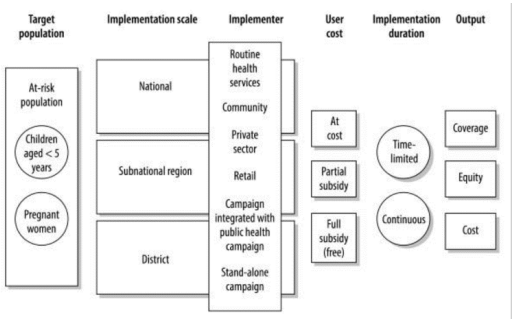


Figure 5. Diagram depicting the implementation of subsidies to improve coverage for at-risk populations (Wiley et al.)

## 4. Conclusion

Even globally, the controversial issue regarding DDT usage has raised "...questions about the balance between environmentalism and humanitarianism," (Querengesser, 2007) Ultimately, although there are differing conclusions on its effect on humans, data on the decreasing effectiveness of DDT coupled with overwhelming evidence regarding its ecological harm stipulate that its prolonged intensive use cannot be deemed ethical. Although further research should be conducted in order to definitively determine the physiological impacts on organisms and efficacy of DDT in comparison to ITNs, the most current studies have indicated that the best way to negate the detrimental impacts of DDT in India is to pursue less environmentally harmful alternatives of malaria control such as ITN distribution. Although limitations exist, finding another primary method of vector-control would help protect the diverse tropical ecosystems of India while effectively preserving the health of Indians for many generations.

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