How Environmentalism Kills the Poor – Malaria and the DDT Story

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Most of our pre-occupations arise from the modern paradox: while our longevity, health and environment has never been better we spend more time than ever before worrying about all three. Classic examples in Europe have been the various scares – nitrates, pesticides residues, breast implants, passive smoking, nuclear power; more recently, mobile phones; and GM foods. In some of these, the concern was completely invalid, in others the scare was blown out of all proportion.

This paper is not aimed at exposing such scares, misinformation or exaggeration but to say, even if some of the scares contain truth, it may be inappropriate for poor countries to be worried too much about them. Indeed, it may be sensible for other countries to allow things to happen which we would sensibly discourage or even prohibit.

You might think that the poorest less developed countries (LDCs) in the world would not share our preoccupations, such as a cancer risk from overhead power-lines (when lack of electricity for refrigeration of food and medicines, and lighting for education… is the real problem). But often this isn't the case. For example, it is instructive to see analysis of risk issues in France and the francophone African State of Burkina Faso. The medical, environmental, geographical and political realities of Burkina Faso are radically different from France, yet a study of attitudes towards risk showed that Burkina Faso intellectuals had approximately the same preoccupations as the French respondents and to the same degree. In fact intellectual responses reflected media coverage in Burkina Faso, indicating that reality plays a secondary role to the media's representations of reality (Craven and Johnson 1999).

Why this is the case is not properly established, but it appears that media coverage in LDCs is likely to follow press coverage from powerful trading partners (such as USA), or former colonial powers (such as France or Britain). It is also probable that poor country intellectuals and political elites have been educated at Western universities, and share western concerns. Furthermore, given that in LDCs tertiary educated people are rare, it is likely that the educated are the ones writing the news.

But even where local media addresses local problems, the solutions proposed will often be driven by western concerns, which may be inappropriate to local conditions. Sometimes countries take an individual line, but in doing so they often go up against an unwritten consensus, a tacit international agreement about the 'correct' way to deal with an issue, in what is known in the jargon as a 'status marker' of opinion. Recent examples include: South African President Thabo Mbeki's stance on AIDS; Chinese official's refusal to sanction a UN Convention on tobacco; similarly OPEC states' refusal to go along with the climate change consensus. In all three examples they have felt the opprobrium of the English-speaking media – conservative and socialist alike.

But on the whole poor country politicians do not go up against the international community and problems often arise because of this. There are many examples of this from policy on

irrigation and agricultural development (where I have some knowledge) to education of women and rights of the child (where I have none), but analysis is limited in the literature, not because they are not plentiful but because research costs are high, not so much in discovering anecdotal examples but in following them through into a detailed study.

I am lucky enough to have lived in South Africa on and off since 1994, and became aware of one key example. And I want to track through this example to detail the unintended consequences of policy. We hear that phrase, 'unintended consequences' often but we don't always appreciate the extent or depth (in terms of human lives) of the consequences. Therefore, this paper concentrates on one main example to show the problem. But also to show how necessary it is to dig to get the details, because the type of problem I discuss are almost certainly increasing in number and severity, especially as our rich societies becomes more risk averse, but poor countries still have problems we long said good bye to.

First, three short examples:

1.Concerns about trihalomethanes (compounds created in water chlorination, which are carcinogenic in rats) in drinking water contributed to the Peruvian Government's decision to reduce the chlorination of drinking water. This decision was made simpler by the fact that they simply didn't have the money to fully implement the chlorination programme and this gave them the perfect excuse: 'the richest country in the world (the US EPA) thinks chlorine poses a health problem so we are justified in not imposing this risk on our people') This led to the first outbreak of cholera in Peru in 1991, killing thousands. It then spread across South America with nearly a million cases. As far as known trihalomethane compounds have never killed anyone – but they are nasty for rats when drowned in the stuff (see Ghersi 1999).

2. A ban on trade in certain secondary metals (cadmium, zinc, nickel) has seriously harmed the market and hence jobs for very poor traders in Asia. Metals pollution is an environmental problem, but batteries we in the west throw away are scavenged by many Asian traders for reuse and recycling. For them the risk of a bit of metal pollution is easily outweighed by the benefit of jobs and income (albeit those benefiting from the jobs may not be harmed by pollution even though occupational exposure says they're first in line for any risk). But the point is that such traders had no voice in a ban established by western interests for western interests (See Evans 1996)

3. Another contentious example is from the development of nuclear power in LDCs. In many poor African states there are no electricity grid systems (or they are very limited highly-dispersed, sparse populations make the infrastructure unfeasibly expensive, plus the equipment is often dismantled and used to build houses or burnt for firewood). Some large industrial plants in remote locations use significant amounts of energy (an aluminium smelter in Mozambique for example). Two technologies with potential here are nuclear and solar. South African efforts to bring on line a new technology, the Pebble Bed Modular Reactor, which could be used at the aluminium smelter, are being hampered by international rejection of older nuclear technologies. Furthermore, although the Reactor would benefit Southern Africa it is a home-grown technology, which arouses suspicion and mistrust from the countries of the North – we forget that South Africa has many capable nuclear physicists (see Kemm 1999).

There are, of course, other examples of this phenomenon, but now I will concentrate on the main example, which is of the disease malaria and the use of the pesticide dichlorodiphenyltrichloroethane, commonly know as DDT.

Malaria

Most people consider malaria to be a tropical disease, and indeed today it is. But this has not always been the case. In the period called the Little Ice Age (over 300 years ago) Malaria was common in England. At the time it was called the ague.

William Harvey (who discovered the circulation of blood) wrote: "When insects do swarm extraordinarily and when… agues (especially quartans) appear early as about midsummer, then autumn proves very sickly."

The diarist Samuel Pepys – suffered from chronic ague. Oliver Cromwell died of the Ague in a cool September 1658.

William Shakespeare wrote about it in eight of his plays. Most notably in *The Tempest* (Act II, Scene II), the slave Caliban curses his master Prospero and hopes that he will be struck down by the disease: "All the infections that the sun sucks up/ From bogs, fens, flats, on my master fall and make him/ By inch-meal a disease!"

The disease is caused by a parasitic single-cell protozoa – plasmodium (such as *vivax* and *falciparum*) carried by the female *Anopheles* mosquito (such as *atroparvus* or *funestus*). Depending on the type of plasmodia it either causes periodic fevers or in some people death.

The cure, quinine powder, was used for the first time in 1660 (this is why we know Ague was malaria, since the symptoms were the same, as was the cure). It became known as Jesuit's Powder, and helped cure French King Louis XIV's son. Interestingly Protestants didn't like to use the powder as it was seen as a Catholic cure (See Reiter 2000 for a fuller discussion).

Even though the cure was known, and the disease declined due to better drainage (removal of mosquito habitat, often through planting eucalyptus trees) there were still major epidemics in all of Europe up to the early part of the 1920s. There were even Russian epidemics as far north as Archangel on the Arctic Circle, and also in Holland and Britain, as well as many US States. Malaria was endemic to Southern US States and in Italy andGreece.

These countries completely eradicated malaria after the second world war when widespread vector control (insecticidal spraying to kill the mosquito (which is the disease carrier or vector) was undertaken – especially with DDT.

History of DDT

DDT was first synthesised in the 1880s by mistake and its insecticidal properties were not rediscovered until the Swiss chemist Paul Müller was looking for a new agricultural pesticide. Müller won the Nobel Prize in 1948 for this discovery. DDT was introduced to control malaria, typhus and other insect-carried diseases by the US Military by 1944. After the end of the Second World War DDT was in widespread use around the world for vector control and in agriculture. The use of the pesticide led to enormous optimism and the belief that malaria could be eradicated from the entire globe. The reasons for this optimism were not hard to see. DDT was, and still is, highly effective in killing the malaria vector and so interrupting the transfer of the malaria parasite. It is also safe, cheap and easy to use which put it within reach of even the poorest countries' health budgets. Shortly after the end of the Second World War there was also a conviction that vector control, and in particular pesticide spraying, was the only way in which the disease could be tackled.

The early successes of DDT were nothing short of spectacular. Scientists 'thought that the whole literature of agricultural and medical entomology would have to be re-written… because of the use of DDT' (Mellanby 1992:37). Mellanby even withdrew a book he had written on medical entomology because he believed it would be overtaken by events. In Europe and North America, DDT was widely used and within a few years, the disease had been eradicated from both continents. It is thought that in one year alone, the transmission of malaria in Greece came to a halt (Harrison, p. 231). One historian (Mack-Smith, 1959:494) even suggested that malaria eradication 'was the most important single fact in the whole of modern Italian history'.

In South Africa, the malaria control programme adopted DDT in 1946 and shortly afterwards, the number of cases in the then Transvaal declined to about one tenth of the

number of cases reported in 1942/3. In some areas of South Africa, DDT spraying stopped altogether because of the success it had achieved and was only reintroduced after periods of heavy rains, when malaria cases tended to rise.

Perhaps the most remarkable success story however was to be found in Sri Lanka (then Ceylon). DDT spraying began in 1946 and, as with South Africa, was an instant success with the island's death rate from malaria falling dramatically. Within ten years, DDT use had cut the incidence of malaria down from around three million cases to 7,300 and had eliminated all malaria deaths (Harrison 1978: 230) By 1964, the number of malaria cases had been reduced to just 29 and at the time it was assumed that the war against malaria in Sri Lanka had been won.

India also used the pesticide to great effect. India at the time had a particularly bad malaria problem, where every year around 75 million people contracted the disease and about 800,000 died. Almost the entire country was malarial, except for the mountainous areas and there were, and still are, six *Anopheline* mosquito vectors. By using DDT, India managed to bring the number of cases down from the estimated 75 million in 1951 to around 50,000 in 1961 (Harrison:1978: 247) The achievement of reducing the number of infections to this degree cannot be overstated, however the success in India as in many other countries was to be short-lived.

Success but no eradication

Complete eradication of malaria was achieved in only ten countries, four of which were in Europe, and the other six in the Americas and the Caribbean. The international strategy of eliminating malaria from the globe was led by WHO and largely funded by The United States Agency for International Development (USAID). USAID contributed $1.2 billion to the programme between 1950 and 1972. The WHO contributed far less, with $20.3 million between 1956 and 1963, of which $17.5 million was contributed by the United States. All other countries combined contributed only $2.8 million. (Baird 1999:14)

These efforts did not stretch to much of Africa, where the vast majority of cases occurred and indeed still occur. It had been hoped that the swift and decisive use of DDT through well planned and funded malaria control programmes throughout the world would achieve success. For some countries, particularly those in Europe and the Americas it did. For others the plans were not appropriate. While vector control using DDT certainly proved effective, many countries (especially in Africa) did not have the infrastructure and capacity to ensure that the spraying programmes were carried out systematically and effectively.

One of the reasons that the WHO pushed for rapid implementation of DDT spraying for an intensive and limited time period was because of fears of resistance to the pesticide. The problems of resistance to DDT first emerged in Greece in the early 1950s where it was observed that the main Greek vector, *Anopheles sacharovi* showed physiological resistance to the pesticide. Resistance to DDT was later observed in the Middle East, parts of Indonesia and also in northern Nigeria in 1956.

Fears about the increase in resistance to DDT (and also another pesticide - Dieldrin) led the WHO expert committee in 1956 to call once again for the swift and overwhelming vector control programmes that would eliminate the pool of parasites before resistance could develop. But for a variety of reasons, complacency, poor-training, poor DDT formulation[1], poor medical detection of cases, and lack of political will led to the demise by the mid 1960s of the Global Malaria Eradication Campaign which had been adopted by the World Health Assembly in May 1955.

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[1] DDT is insoluble in water and hence has to be suspended in a solution with inert matter (such as clay) to stop it sinking. Poor formulation is a key problem especially from DDT sources in developing countries.

DDT was remarkably successful in almost all the countries in which it was used, however it was never likely to work as a magic bullet. Malaria is a disease that is influenced by a number of factors, such as climate and migration of people. Developing a malaria control strategy that is solely reliant on vector control and in particular on the use of one pesticide was optimistic at best and foolish at worst. The greater folly however was in the unilateral way in which the policy was developed which failed to take into account the conditions under which the policy would be implemented.

So to summarise in the early 1970s the WHO dropped DDT-based mosquito eradication programme because of the following reasons:

1. DDT resistance;

2. Eradication of malaria from donor countries;

3. Lack of infrastructure in Sub-Saharan countries to support eradication programmes;

4. Environmental and health concerns about DDT (many of which have been later been shown to be exaggerated).

Green backlash and its impact today

I will dwell on this last reason. While DDT was being used in malaria control campaigns and also in agriculture, concerns were raised about the environmental impacts of the pesticide[2]. Perhaps the most well known attack on DDT was Rachel Carson's book *Silent Spring*, which was published in 1962[3]. The book popularised the scare associated with DDT and claimed that it would have devastating impacts on birdlife, particularly those higher up the food chain. The fears were based on the fact that DDT and its metabolites, DDE and DDD accumulate in the body fat of animals. Despite the fact that many of the fears surrounding DDT were unfounded and the studies upon which they were based were unscientific, DDT was banned by the US Environmental Protection Agency in 1972

The EPA administrator, William Ruckelshaus overturned scientific reports and evidence given by numerous expert witnesses, the conclusions of which were firmly against a ban of DDT and argued in favour of its continued use. The US National Academy of Sciences claimed that it had saved "500 million lives from malaria". Whereas, Ruckelshaus argued that the pesticide was "…a warning that man may be exposing himself to a substance that may ultimately have a serious effect on his health". Ruckelshaus's preoccupations with potentially negative environmental and health impacts (despite all the evidence to the contrary) and refusal to accept the scientific advice offered most certainly condemned millions to death in malarial countries by denying them access to this life saving pesticide[4].

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[2] Before WWII it was generally argued that malaria control could only be afforded if it contributed to agricultural development. For two decades from 1945 this link was dissolved (Litsios 1997). But in recent decades a new parallel has emerged with the pre-war phase, in that although much medical control of malaria is done for humanitarian reasons, the only insecticides used in vector control are those that were developed for agriculture. DDT remains the exception, that was developed for disease control, although the original research was into agricultural pesticides.

[3] Entomologists and other scientists in Britain and US were aware of the potential environmental dangers of DDT in 1945. But at the time the acute toxicity problems from other pesticides, including organophosphate pesticides dominated concerns of various governmental scientific committees (Mellanby 1992:83).

[4] Others had Neo-Malthusian objections. For example, the argument was made that it would be unkind to keep people from "dying from malaria so that they could die more slowly of starvation", and even saw malaria as "a blessing in disguise, since a large proportion of the malaria belt is not suited to agriculture, and the disease has helped to keep

DDT is banned

Most developed countries soon imposed outright bans on the chemical for all uses. Some developing countries also imposed a complete ban of the pesticide – for agricultural use and (and some for all uses). For example South Africa banned it for agricultural use in 1974. Sri Lankan officials had stopped using DDT in 1964 believing the malaria problem was solved, but by 1969 the number of cases had risen from the low of 17 (achieved when DDT was used) to over half a million (Silva 1997). It is alleged that DDT was not widely re-introduced because of mosquito resistance to it, and DDT use was finally abandoned in favour of Malathion[5] in 1977 (Spielman 1980). But pressure not to use DDT was applied by western donors, and arguments of resistance were used as a political convenience. But recent evidence shows that even where resistance to DDT has emerged the 'excito-repellancy' of DDT causes mosquitoes not to enter buildings which have been sprayed (Roberts et al. 2000), in other words mosquitoes don't like settling on areas sprayed with DDT. Hence it is unlikely that malaria rates would have increased (significantly) even if resistance was found.

Malaria Recovery

The failure to eradicate malaria led to calls for stabilisation, but without the use of DDT in many countries (banned because of environmental concerns), malaria rates have bounced back. The countries discussed before Sri Lanka, South Africa, India have all seen cases and deaths rise significantly by many fold.

N.B. Some have claimed that the resurgence in the disease in the past 20 years has been because of changes in climate due to man's activities. But according to world expert Dr Paul Reiter, head of Vector Control at CDC in US:

"Increase has been attributed to population increase, forest clearance, irrigation and other agricultural activities, ecologic change, movement of people, urbanization, deterioration of public health services, resistance to insecticides and antimalarial drugs, deterioration of vector control operations, and disruptions from war, civil strife, and natural disasters. Claims that malaria resurgence is due to climate change ignore these realities and disregard history" (Reiter 2000).

Economic Costs

Other than obvious humanitarian reasons, controlling malaria is vital because the economic costs are significant. Professor Jeffrey Sachs at the Harvard University Center for International Development has analyzed the effects of malaria on 27 African economies from 1965 to 1990. The study found that the disease cut 1 percentage point a year from the annual growth rates of those economies. If malaria had been eliminated in 1965, Africa's annual gross domestic product would be $400 billion now, rather than $300 billion, the

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man from destroying it – and from wasting his substance upon it" (Vogt 1949:13;28). The modern day green version of this is stated by Gell-Man: "Some day anti-malarial vaccines will probably be developed, which may even wipe out the various forms of the disease entirely, but then another difficulty will arise: important wild areas that had been protected by the dangers of malaria will be exposed to unwise development (1994:353).

[5] The introduction of alternative pesticides had disastrous results for those doing the spraying, with many deaths caused by poisoning from replacements. It should be recognised that there are many examples of individuals eating DDT everyday for decades with no harm. The DDT expert Kenneth Mellanby used to eat a pinch of DDT at every lecture he gave on DDT over a period of 40 years (Mellanby 1992:75).

study estimated. The models did more than just assess the costs of treatment and losses associated with death. They also estimated the losses to tourism and foreign investment from malaria-prone countries; the damage done by large numbers of sick children missing school; and the increase in population and impoverishment that ensues when parents decide to have extra children because they know some will die (Gallup and Sachs 1998). Sachs' study confirms research done by Richard Tren of the NGO Africa Fighting Malaria which shows that the cost to Southern Africa is several billion dollars a year, and this figure was far higher in the past (see www.iea.org.uk for Tren paper).

What is important for our discussion is that some countries have defied international opinion and continued to use DDT. These countries have benefited from a lower death rate due to malaria and hence a better economy.

Indeed, DDT has quietly been used in developing countries, such as South Africa, Botswana, Equador, Indonesia and India for the past three decades, almost without comment. In 1995, however, the United Nations Environment Programme (UNEP) decided to promote a legal instrument that would ban or heavily restrict the use of 12 persistent organic pollutants (POPs), including DDT (see http://irtpc.unep.ch/pops).

Rise of Conventions – the international community has its way

Legal conventions set the ground rules and tone of whole treaty process. It usually establishes conditions that are easy to agree among the parties. In the POPs treaty process (as in all UNEP treaties), the developed world, mainly European and American interests, are promoting the agenda and draft text. Since these countries neither produce nor use any of the 12 chemicals to be targeted, it is simple for them to promote a total ban. Western industry is not fighting to retain any of the chemicals, and the green pressure groups want a total ban. The only reason the language is not completely prohibitionist is because of three factors:

1. Western industry concern about what might be next. Once the initial 12 chemicals are banned, the green pressure groups and the treaty secretariat will probably target other chemicals which are produced and used in the west;
2. Official protests from developing countries that do produce and or use some of the 12 chemicals listed;
3. Pressure from two or three anti-malaria groups who are concerned about the fate of malaria vector control without DDT.

The Status of the POPs instrument

A negotiating text for the treaty document is established, but certain textual changes can and will be made prior to December when the final negotiating meeting will take place in South Africa. Complete agreement on the treaty is held up on two issues: will DDT be reprieved? And how will the rich countries pay for the developing countries to abandon the 12 POPs (possibly including DDT).

It is possible, given pressure from the pro-DDT groups (including AFM, Malaria Foundation International and the Malaria Project, as well as some University medic staff), that DDT will be reprieved for use in malaria control. However, this is far from certain as several important country delegates (from Scandinavia, some other European countries, Argentina, Canada and possibly USA) still want a ban. And behind the scenes the pressure groups are working on delegates for this forthcoming meeting. A special concern is financial transfers to Francophone malarial African countries from green groups, and possibly

international agencies, to vote in favour of a DDT ban (but there is no data on this, just speculation from various off the record sources)[6].

However, at least a reprieve is possible. Prior to INC 3, it looked most unlikely. At the first two meetings a straw poll showed that about 80% did not know that DDT was still used in malaria control. At that time the Malaria Project put forward a letter signed by 400 malaria experts including 3 Nobel Laureates to demand the right to use DDT. I watched in Geneva as the letter was presented to the UN conference, and was astonished to see the WHO not support the initiative – the representative looked embarrassed but obviously had his instructions.

Indeed, medical leaders seem to want to pursue only two modes of attack: drugs and bednets. Now there is nothing wrong with these two approaches, but to combat malaria every weapon in the arsenal is required, which includes insecticides (and DDT). The people on the ground know it, but it either hadn't filtered through to the people in Geneva, or more likely they overruled pesticide use, the head of the WHO is after all green apostle, Gro Harlem Brundtland.

Furthermore, far from learning from past errors, such as ignoring local concerns and adopting a one-weapon approach, the WHO and donor agencies, including USAID continue to promote policies on political grounds.

However, after the letter presented at Geneva, and good media coverage (such as in the NYT, Guardian, Economist) the WHO has now finally come out in favour of DDT. Even the WWF has backtracked from calling for a ban, just yet. But aid agencies (including USAID[7], NORAD, SIDA.…), as well as EU country delegates still want a ban.

One way they may achieve this is by switching pressure from proposing an outright ban (INC1-INC3) to proposing restricted trade (INC4). This is strategically sensible on their part. Most people who bother to listen are convinced that DDT should still be used to control malaria (today a child dies every 15 seconds from the disease), but they can also be persuaded that we do not need international trade in the product (anti-globalisation arguments about local production for local use, with concern about transporting toxic chemicals, is the usual rhetoric). If they can persuade the delegates to ban trade in DDT then this would be close to banning its use. Only China and India (and probably Russia) produce DDT, and the quality is not the best (potentially leading to resistance in mosquitoes, increased spray time – hence higher cost) (see Baird 1999). The impact of having production in only a few countries is already problematic. For example, Botswana claims it cannot get enough DDT for its malaria control programme, and is having to buy less of the more expensive alternatives. Compliance with import restrictions, delays and uncertainties have already forced Tanzania to reduce its DDT intake, because of bureaucratic cost.

Related Problems

Western chemical companies have become concerned by the possibility of a reprieve for DDT. While overtly supportive of DDT, some may be funding the work of the green

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[6] What is certain is that the Francophone countries are angry at English-speaking African nations. The English speaking nations dominated the Africa working group session at INC3 – because there was no French-English translator. The French speakers did not feel that they were able to put there arguments across, and while UNEP were to blame, they unfortunately decided to attack one bit of policy that was discussed at the meeting – support for DDT use. Consequently the francophone countries are taken an anti-DDT stand on political grounds (see Bate 2000).

[7] A worrying example of USAID pressure is in Belize where officials, having imported seven tonnes of DDT, decided not to use it all under pressure from USAID. Two tonnes was found close to a water course in a poorly maintained state.

pressure groups to argue against DDT. The reason is financial – vector control is roughly 25% of the market for replacement pesticides for DDT. Re-introduction or expansion of DDT-use in developing countries would cost certain companies tens of millions of dollars.

Furthermore, green pressure groups have moved from discussing the carcinogenic effects of DDT to alarm over its possible endocrine disruption effects. Once again the evidence is flimsy at best and there is no choice for the people exposed to malaria. But nevertheless, it is once again gaining coverage in European press, and encouraging the prohibitionists within the EU to push for an outright ban in December.

Related Advantages

While unfortunate for those contracting the disease, it is to our advantage that the final POPs meeting is in South Africa, because SA has 500% more malaria cases this year than in 1997, and 30 times the cases in 1994 (incidentally, DDT use was dropped in 1996). INC 1-4 occurred in non-malarial countries (Vancouver, Geneva (twice), Bonn), where local politicians knew and cared little about malaria issues. SA politicians are aware and have to be seen to care about the issue. Furthermore in SA the media are interested in development issues and especially the DDT/malaria issue, since they perceive correctly that western attitudes are dictating policies for the poor.

Western media are beginning to wake up to the problems of mosquito-borne diseases such as the West-Nile virus in New York State. There are also problems with mosquito control in Florida. Here we have another example of unintended consequences. Regulations designed by EPA to make Floridians and other Americans safe from pesticides are making it prohibitively expensive (even in America) to develop new, or even re-test old products. Every year there are fewer products (with notably different molecular structures) reaching the market – which means faster mosquito resistance transferral. In a weird twist of fate, mosquito abatement societies are trying to get the EPA to re-introduce pesticides that its own regulations have made non-viable.

It remains to be seen what the outcome will be in December at the most important meeting on DDT's fate since the EPA hearings 30 years ago. But the real medical concerns of Africa are seriously threatened by relatively trivial concerns from rich countries. The unintended consequences of our policies are not just measured in billions of dollars, but in thousands, maybe millions of lives.

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