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Phasing in Alternatives to DDT

Reasons, experiences and links

Pesticides constitute an important element in the current global strategy for the control of major vector-borne diseases such as malaria. But in parts of the developing world pesticide poisoning causes more deaths than infectious diseases.[1] Many of the pesticides are highly toxic and have immediate adverse affects on human health and wildlife or contaminate local food, water, soil and air. Others produce chronic consequences including neurotoxic, carcinogenic, immunotoxic, hormonal and reproductive effects. Harm may result from direct exposure among people living in sprayed houses or using impregnated material, during handling, from spray drift, through washing contaminated work clothes or impregnated material, and from storing pesticides in the home. Harm can also result indirectly via pesticide dumps and persistence in the environment. One of these highly problematic pesticides is the insecticide dichlorodiphenyltrichloroethane, better known as **DDT**.

Joint Paper of the PAN International Working Group Alternatives to Synthetic Pesticides

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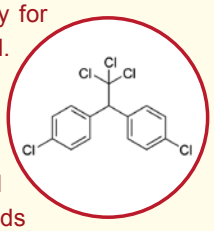
DDT – negative impacts on health, wildlife and the environment

DDT is an organochlorine insecticide. It is currently being produced in India, China and the Democratic People's Republic of Korea. Its annual production is estimated to be 9,000 tonnes. An estimated 5,000 tonnes is used each year for the control of vector-borne diseases, mainly for malaria and visceral leishmaniasis control. The remainder is used as an intermediate for the production of the acaricide dicofol, as an additive in anti-fouling paints and in agriculture. For malaria control the World Health Organisation (WHO) recommends the application of DDT on all surfaces inside habitations, referred to as indoor residual spraying (IRS). An estimated 26 countries are using DDT or intend to use it in the future. Since the WHO promoted the use of DDT in 2006 for malaria control even more countries are considering the reintroduction of DDT. Hence, its use may be increasing. In addition it is known that large quantities of old DDT stocks are stored under high-risk circumstances, threatening human health and the environment and potentially being used illegally.[4,5]



DDT is considered a persistent organic pollutant (POP). It accumulates in the fatty tissue of animals and humans, accumulating up the food chain and being found in high concentrations in human breast milk (biomagnification). Populations in regions adjacent to countries which apply DDT, and in temperate regions may be indirectly affected by long-range atmospheric transport so that DDT may contaminate environments far from where it is used. DDT has a relatively low acute toxicity. Ingestion of DDT, even when repeated, by volunteers or people attempting suicide, has indicated low lethality. Large acute exposures can lead to vomiting and ejection of the chemical. The earliest symptoms are hyperaesthesia of the mouth, followed by paraesthesia of the tongue, dizziness, tremors, and vomiting.[2] The chronic exposure of humans to DDT has been of great concern. Until now, the results of the accumulating studies have not been consistent but there are indications of impaired semen quality, early pregnancy loss, preterm birth, decreased lactation, fertility loss, leukaemia, neuro-developmental deficits, diabetes, breast cancer and urogenital birth defects due to exposure to DDT and its main metabolic product DDE (dichlorodiphenyldichloroethylene). Experimental studies on animals have demonstrated neurotoxic, carcinogenic, immunotoxic and reproductive effects of DDT and DDE. DDT is highly toxic to insects, shrimps and fish and adversely affects the reproduction of wild birds through thinning of egg shells. Due to high contamination resulting from the agricultural use of DDT, the peregrine falcon became almost extinct in the USA, Great Britain and Scandinavia at the beginning of the 1970s.[2,4,5,6]

Adverse health and environmental effects versus the health gains in terms of malaria prevention require more attention. The WHO is conducting a re-evaluation of the health risks of DDT, but progress has been slow.[5]

DDT legislation

In the 1970s, environmental concern arose as a result of the general use of DDT for the control of many different pests. Since then, most industrialised countries have completely banned the use of DDT. In 2001, the international community of states drew up an agreement known as the Stockholm Convention, to ban the use of twelve persistent organic pollutants. DDT is one of these chemicals. But its use and production is still allowed under the convention for the acceptable purpose of disease vector control because of concern that a sudden ban could adversely affect the malaria burden. The Convention entered into force in 2004. As of December 2009, there are 168 parties to the Convention.[3]

The Stockholm Convention calls for reduced reliance on DDT for vector control with the goal of reducing and ultimately eliminating its use. However, many countries are using DDT for disease vector control and DDT use in Africa has even increased since the Stockholm Convention came into force. Therefore, in 2009 a 'Global Alliance for the Development and Deployment of Products, Methods and Strategies as Alternatives to DDT for Disease Vector Control' was established by the Secretariat of the Stockholm Convention. But its effectiveness has been viewed critically, calling into question the Secretariat's original goal of putting an end to the story of DDT by 2020.[4]

The Stockholm Convention is an international treaty that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs) in order to protect human health and the environment. Under the Stockholm Convention DDT is banned for agricultural use, but its limited use in disease vector control continues and remains controversial.

The study 'DDT and the Stockholm Convention – States on the Edge of Non-compliance' states that DDT is still being produced and used in several countries and that many players and financiers of malaria control programs do not comply with the requirements of the Stockholm Convention.[4]

DDT and the Stockholm Convention

How is DDT used?

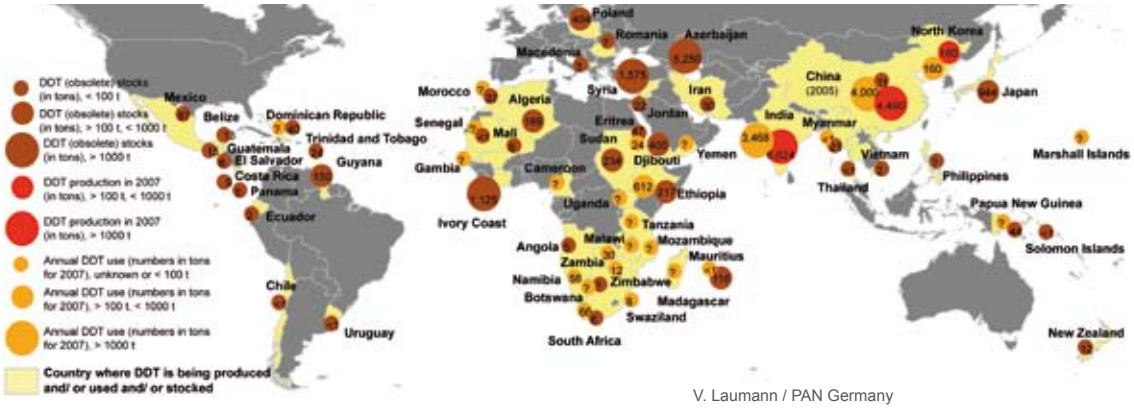
DDT was first synthesized in 1874; its effectiveness as an insecticide was discovered in 1939. Since then, it has been used extensively to control vermin and vector-borne diseases such as typhus and malaria. Many people were dusted or wore clothes impregnated with DDT. After 1945, agricultural and domestic usage of DDT became widespread. In the 1950s and 1960s, the WHO integrated the use of DDT into its programme to eradicate malaria. In some parts of the world it was sprayed aerially, while in others spraying of houses led to striking reductions in mosquito counts indoors and subsequently in cases of malaria. But resistance of mosquitoes to DDT, financial and technical problems, and concerns about toxicological effects led to the strategy being abandoned. Today, DDT is still recommended by the WHO for malaria control. According the WHO guidelines and recommendations, DDT can be used on all surfaces inside habitations at rates of several hundred grams per dwelling, twice a year. There is an ongoing controversy about whether this use is in accordance with the Stockholm Convention.

An Ethiopean man spraying an insecticide.

Bad practice: countries where DDT is still in use

India is the biggest user of DDT with about 4,000 tonnes annually for vector control. China and India also produce large amounts of DDT for use as an intermediate in the production of the acaricide dicofol. In China, small quantities of DDT are added as a biocide to paints. North Korea's production of DDT (160 tonnes p.a.) is mainly used for agriculture. Several states are using DDT against malaria including Ethiopia, South Africa, Namibia, Zambia, Eritrea, Zimbabwe, Swaziland, Gambia, Myanmar, North Korea, Papua New Guinea and Yemen. Others are using it in emergencies to combat malaria (Morocco and Botswana) or are considering re-introducing it for malaria control. These include Cameroon, Madagascar, Malawi, Mauritius, Mozambique, Senegal, Tanzania, Uganda and the Marshall Islands. In various countries there are obsolete DDT stocks. Information is not available on where and how many tonnes of DDT are stored, but an estimated 10,000 tonnes are believed to be located in 41 countries. In these countries, illegal use is suspected.[4,5]

DDT production, use and stocks.



V. Laumann / PAN Germany

Controlling malaria without DDT: experiences and case studies

Controlling malaria without DDT is possible.

As immediate alternatives to DDT, other chemical methods for vector control are available including, for example, indoor residual spraying with pyrethroids or impregnated mosquito nets. But the arsenal of insecticides is limited and in certain areas the development of resistance is undermining the efficacy of insecticidal tools. New insecticides for vector control are not expected in the short term. Nevertheless, chemical methods pose established and suspected risks for human health, the environment and international trade. All but one of the pesticides recommended by WHO for malaria control, are on the PAN International List of Highly Hazardous Pesticides.[5,8,9]

Historically, anti-malarial programmes in the US, Europe, the Middle East and some other previously endemic locations, had largely succeeded in eliminating malaria even before the use of chemical pesticides. Successful strategies relied primarily on environmental management interventions to reduce vector-breeding habitats, as well as advances in socioeconomic development, health care services and education. In Africa (Zambia) environmental management strategies proved to be successful.[7] But environmental management interventions almost disappeared with the advent of DDT, which offered a standardised single attack during the Global Malaria Eradication Campaign. [7,10] Today, many programmes have reduced the use of pesticides for disease vector control. Several countries have eliminated the use of DDT, and in pilot projects, environmental management strategies and biological control are being applied for malaria vector control.

Controlling malaria without DDT: experiences from ASIA

Sri Lanka. In Sri Lanka, Farmer Field Schools were established in 2002 to educate rice farmers about environmental management options for malaria control in connection with the improvement of agricultural pest management. Participants voluntarily conduct ecosystem management activities in their paddy fields including levelling land to reduce the number of puddles, cleaning and water management of irrigation systems to encourage faster flow and so avoid mosquito breeding, draining fields to prevent mosquito larvae reaching the adult stage, clearing coconut shells and containers, covering water containers at regular intervals, and minimising pesticide use to conserve natural enemies of pests and mosquito vectors. In addition, participants eliminate breeding sites, use oil, salt or fish in wells and water storage tanks, and improve environmental sanitation in residential areas. The active participation of the community resulted in reduced populations of anophelines and reduced insecticide use in agriculture which has the potential to interrupt malaria transmission.[11,12]

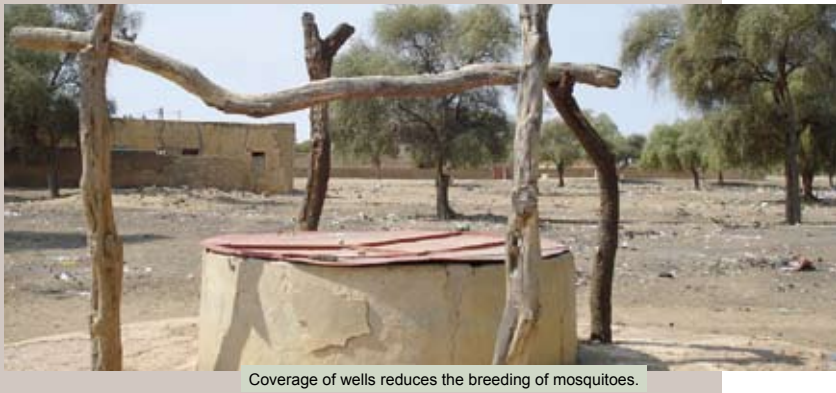
Faster flow of water prevents mosquito larvae reaching the adult stage in rice fields. Information campaigns involving rice farmers have shown success in DDT use reduction.

Vietnam. Since a devastating malaria epidemic struck Vietnam in 1991, the government decided to launch a new National Malaria Control Programme. DDT-spraying was abandoned and insecticide-treated nets became the key intervention method. Indoor residual spraying became more targeted using pyrethroids. Mefloquine and later artemisinin-based drugs replaced the chloroquine, quinine and sulfadoxin/pyrimethamin treatments to which mosquitoes had become resistant. The programme also included extensive communication campaigns, public education about malaria, and promotion of prevention strategies. The strategy established active leadership at all levels of government, mobilised and trained communities in malarial areas, provided technical support and ensured sufficient funding. Drug resistance has been monitored and epidemiological surveillance has been strengthened through mobile teams. As a result, the interventions became more targeted with decision-making based on data gathered. Today, commune and village health workers, motivated by government incentives, detect and treat 65 per cent of all malaria cases. By 2006, the number of reported malaria cases was less than 100,000 – a spectacular decrease compared to the 1991 figures when over one million malaria cases were detected.[13,14]

Controlling malaria without DDT: experiences from AFRICA

Kenya. In Kenya, two pilot projects were initiated in 2004 and 2005 by the Swiss Biovision Foundation in urban Malindi and rural Nyabondo to demonstrate how malaria can be controlled in an ecological and cost-effective way. Scientific assistance comes from two local research institutions, the International Centre of Insect Physiology and Ecology (ICIPE) and the Kenyan Medical Research Institute (KEMRI). Local civil society organisations support the initiative. The project areas offer malaria mosquitoes numerous man-made breeding sites. To inform people about the danger presented by stagnant water pools, local people are trained to become 'mosquito scouts'. Public awareness campaigns provide malaria information. 'Mosquito days' are initiated to motivate the local community in environmental management through, for example, draining pools and canals and filling in pools of stagnant water. Personal protection is encouraged. Malaria awareness is incorporated into education in schools. Biological agents like Bacillus thuringiensis israelensis and neem are used to kill mosquitoes in their larval stage. Impregnated mosquito nets have been distributed to improve personal protection. Monitoring and evaluation is essential, and the results are assessed to help adapt malaria interventions to the local situation. The interventions resulted in larval and mosquito reductions and reduced malaria cases among children. From Malindi it is reported that malaria cases have halved from 10,000 at the beginning of the project (2005) to 5,000 in 2008.[15,16,17,18]

Distribution of mosquito bed nets for the improvement of personal protection.



Coverage of wells reduces the breeding of mosquitoes.

Controlling malaria without DDT: experiences from LATIN AMERICA

Mexico. The Mexican model provides a unique example of an overarching approach to fighting malaria. The adoption of environmental management practices by the local population and improvement of personal hygiene, combined with the effective treatment of malaria cases, has led to dramatic reductions in malaria transmission and discontinued use of DDT. A detailed analysis of the local situation taking into account the parasite, the vector and the environmental and social characteristics of the transmission – was conducted in order to observe focal points of malaria transmission and identify the breeding and hiding places of the malaria transmitting mosquitoes. Based on this analysis a 'focalised treatment' was carried out: First, all individuals living in households where malaria had been detected received, over a period of three years, intensive treatment with antimalarials to eliminate the sources of infection. Secondly, to reduce and physically eliminate the mosquito breeding sites, communities were involved in environmental management measures (monthly cleanup of filamentous, green algae and trash from rivers and streams). Lastly, given that malaria generally reoccurs in those families with poorer hygiene, housing conditions were improved (collection and disposal of trash and excrement, care in water use, trimming of the vegetation growing within ten metres of the housing structure and housing modifications). The 'focalised treatment' strategy was first implemented in 1999 in Oaxaca and later extended to the entire country. Since 2000, DDT has been eliminated for malaria control and localised spraying of alternative insecticides has been carried out only during outbreaks. The number of malaria cases fell from 17,855 in 1998 to only 289 cases in 2001. Following this success, the Pan American Health Organisation (PAHO) led the implementation of a 'Regional Programme of Action and Demonstration of Sustainable Alternatives to DDT for Malaria Vector Control in Mexico and Central America' in partnership with UNEP and with funding from the Global Environment Facility (GEF). The PAHO pilot programme successfully demonstrated that pesticide-free techniques and management regimes could cut cases of malaria in many Latin American countries.

Keeping the house surroundings free from vegetation reduces mosquito breeding sites close to households.

As a result, UNEP and WHO, in partnership with the GEF, announced the launch of ten new projects in 2009 under the global programme 'Demonstrating and Scaling-up of Sustainable Alternatives to DDT in Vector Management'. The project will involve some 40 countries in Africa, the Eastern Mediterranean and Central Asia.[19,20,21]

Mexico: People cleaning up the streams to prevent mosquito's from breeding.

Mexico: Malaria control without DDT needs the help of all people involved.

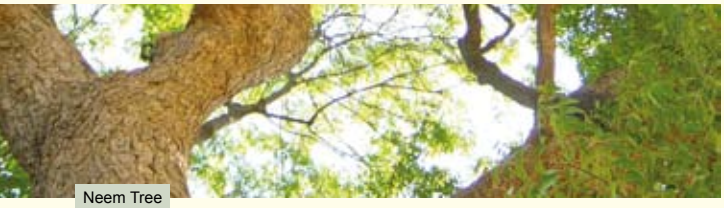
Mexico: People from Oaxaca are cleaning up a close by river stream to prevent the breeding of mosquitoes.

Alternative Malaria Control Methods

Biological control agents like neem are used in vector control.

No use of chemical pesticides

A number of non-chemical methods including environmental management, non-chemical personal protection, and biological control have proved their value for malaria control in certain settings. Environmental management is the collective term for manipulating and modifying environmental factors or their interaction with humans to reduce mosquito breeding and mosquito-human contact. Water management through land levelling, filling depressions, covering water pools, irrigation management and vegetation management has the potential to prevent, eliminate or reduce the mosquito habitat. Polystyrene beads have been used to prevent mosquito breeding in small confined water collections. Non-pesticidal personal protection strategies like house improvement contribute significantly to transmission control. Screens prevent mosquitoes from entering houses. Mosquito nets reduce the human vector contact. Biological methods of malaria control use natural enemies of mosquitoes and biological toxins to suppress the mosquito population. The principal biological control agents are predators, especially fish and the bacterial pathogens Bacillus thuringiensis israelensis and Bacillus sphaericus. Some plants like neem, citronella or pyrethrum can be used as repellents or larvicides, whereas others are used as medicinal herbs to control the parasite. Further promising organisms include fungal pathogens, nematodes and the aquatic plant Azolla.
Data on the cost effectiveness of non-chemical methods are scarce. There is need for a detailed economic analysis of programmes to combat malaria so that the costs and benefits of alternative approaches may be compared.



Neem Tree

Restricted use of chemicals

To reduce the reliance on DDT and alternative chemical tools for malaria control, integrated strategies have to be developed based on social and ecological approaches and using local resources. These strategies should not reject the use of synthetic insecticides in general but should have the potential to restrict the use of certain insecticides and thereby avoid the adverse health and environmental impacts of pesticides. The analysis of the specific local situation is important in order to develop a holistic strategy combining multiple interventions which will be appropriate for the vectors and local conditions. This will enable the effective application of non-pesticidal interventions instead of just blanket spraying with pesticides. Alternative tools to complement and replace insecticide-based malaria-control strategies must be developed, strengthened and implemented. Health education and surveillance, improvement of public health systems, decentralisation of malaria control implementation, income generation, legislation and local capacity-building are all important components of an effective malaria control strategy. New programmes need to set out strategies for involving local communities, relevant sectors, research institutions and civil society organisations to share information and to implement cost-effective and ecologically sound interventions, adapted to local conditions. In this way, the living conditions and the general health of the people will be improved, while at the same time protecting the environment, enabling sustainable development and contributing to rural development.

Phasing in alternatives to DDT – for our Children's future.

Notes

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Obsolete Stockpiles. B. Davis, Prevention and Disposal of Obsolete Pesticides (FAO): cover
An Ethiopean man spraying an insecticide. Bonnie Gillespie, Voices for a Malaria Free´Future. Cover, page 3
Women and child. Pierre Holtz for UNICEF, hdptcar.net (server): page 2
Afrika: Covered well. Wiki commons (public domain) http://commons.wikimedia.org/wiki/File:Woyndou_mawndu.JPG: page 4
Neem Tree. © Sarah Bandukwala - Fotolia.com: page 6, back
Africa: People with bed net. PAN North America: Cover, page 4
Vietnam: Woman in rice field. Chilombiano_morguefile.com: page 4
Mexico: Communities involved in environmental management measures. Dr Jorge Mendez: page 5 right above
Mexico: Surrounding of a House is cleared from vegetation. Dr Jorge Mendez: Cover, page 5 left
Mexico: Information campaign on Malaria control. Dr Jorge Mendez: page 5
Mexico: Women cleaning up a stream. Dr Jorge Mendez: page 5 below
Children in Senegal. Britta Pichler: page 6

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Pesticide Action Network (PAN) is a network of over 600 participating nongovernmental organizations, institutions and individuals in over 90 countries working to replace the use of hazardous pesticides with ecologically sound and socially just alternatives. PAN was founded in 1982 and has five independent, collaborating Regional Centers that implement its projects and campaigns. www.pan-international.org