END OF THE ROAD FOR ENDOSULFAN

A call for action against a dangerous pesticide

A summary report by the **Environmental Justice Foundation**

"This year the product is very effective. It kills everything – even snakes. Earthworms appeared from the soil in large numbers immediately after spraying, and subsequently died. Even the leaves of the cashew nut trees I planted next to my cotton field turned brown due to the product." — Cotton Farmer, Aklampa (Benin)[7].

© Mr Shree Padre

Above: Shruti, a young Indian girl whose village has long been exposed to aerial spraying of endosulfan, is one of many in her area to exhibit severe congenital deformities, which experts say are caused by endosulfan exposure.

introduction

In this short report, we present compelling evidence of the considerable threats the pesticide endosulfan poses to human health and environmental integrity. In light of the evidence presented, we make a number of key recommendations to the World Health Organisation, national governments, and the agrochemical industry. Implementation of these recommendations will represent a significant step towards protecting people and the natural environment from this hazardous chemical.

Endosulfan is an organochlorine pesticide used primarily to kill insects and mites on crops including tea, coffee, cotton, fruits, vegetables, rice and grains. The chemical is out of patent and is marketed by many different companies and under a variety of names including: Agrosulfan; Aginarosulfan; Banagesulfan; Cyclodan; Endocel; Endoson; Endonit; Endomil; Endosol; Endostar; Endodaf; Endosulfer; E-sulfan; Endorifan; Hildan; Redsun; Seosulfan; and Thiodan.

Pesticide safety is classified by the World Health Organisation (WHO) according to the results of LD_{50} tests, which document the amount of a chemical required to kill 50% of a population of laboratory rats. Under this system, endosulfan is currently classified as Class II – *moderately hazardous to human health*. However, the United States' Environmental Protection Agency (EPA) rates endosulfan as Category Ib – *highly hazardous*. LD_{50} data for endosulfan are equivocal, with some published results indicating that the chemical should be in the WHO's Class Ib, according to the organisation's own criteria. Evidence of the threats to human health posed by endosulfan are abundant, and the chemical has been banned outright or severely restricted in a number of countries as a result (see box). Independent of LD_{50} results, these threats warrant the immediate upgrading of endosulfan to WHO Class Ib.

WORLD-WIDE RESTRICTIONS ON ENDOSULFAN USE)[1,2]

Endosulfan is banned in:

Belize, Singapore, Tonga, Syria, Germany, the USA, the Brazilian state Rondonia, the UK, Sweden, Netherlands, Colombia, and the Indian state Kerala.

Endosulfan is severely restricted in:

Australia, Bangladesh, Indonesia, Cambodia, Japan, Korea, Khazakhstan, Kuwait, Philippines, Lithuania, Sri Lanka, Taiwan, Thailand, Denmark, Yugoslavia, Norway, Finland, Russia, Venezuela, Dominica, Canada.

Endosulfan has been identified as a pesticide of concern due to health and environmental problems associated with its use in Ecuador, Mauritius and Paraguay[3].

the danger to human health

ENDOSULFAN is acutely toxic and is readily absorbed by the stomach and lungs, and through the skin. Symptoms of acute endosulfan exposure include central nervous system disorders such as dizziness, vomiting, diarrhoea, breathing difficulties, convulsions, and loss of consciousness[4]. In extreme cases, death can result. Indeed, the chemical has been linked to dozens of accidental deaths in the USA, Colombia, Benin, India, Malaysia, Sudan, and the Philippines[5].

- In the USA, endosulfan exposure was linked to the death of one farmer and permanent neurological impairment of another[6].
- In Benin's Borgou province, endosulfan poisoning caused many deaths during the 1999/2000 cotton season. Official records state that at least 37 people died and a further 36 became seriously ill, although an independent report estimated that nearly 70 people actually lost their lives[7]. In 1999, a boy in Benin died after eating corn sprayed with endosulfan[8].
- In southern Sulawesi, Indonesia, endosulfan was the leading cause of pesticide poisoning between 1990 and 1993. Of 153 reported poisoning cases, 32 were due to endosulfan[5].
- In Sudan, in 1988, endosulfan barrels washed in irrigation canals caused fish mortalities and three people died after drinking water from the canal[9]. In 1991, also in Sudan, 31 people died after eating food containing seed sprayed with endosulfan[10].
- Colombia's Departmental Committee of Coffee Growers recorded 155 cases of poisoning due to pesticide exposure in 1994, most of which were due to endosulfan[11]. Pesticides Action Network North American reported that in 1993, 60 poisonings and one death occurred in Colombia due to endosulfan use on coffee[12].

Chronic, sub-lethal effects of endosulfan exposure manifested in experimental rats include liver enlargement, seizures and retarded growth[13]. The EPA states that "*available scientific literature suggests that endosulfan may act as a potential endocrine disruptor*." This means that the chemical has the potential to interfere with normal hormone production and activity. Implications of endocrine disruption may include disruption of development, and promotion of certain types of cancer. A major concern, especially in developing countries, is that low protein diets may increase people's sensitivity to the effects of this pesticide[5]. A further concern is evidence that endosulfan may cause mutagenic effects in humans if exposure is great enough; endosulfan has been shown to be genotoxic to human cells under experimental conditions[14].

In Kerala, India, endosulfan has been linked to hundreds of deaths and disorders among cashew nut plantation workers and villagers[15]. In Kasaragod province, where aerial spraying of endosulfan occurred for at least 15 years, alarmingly high levels of endosulfan residues have been detected in the blood and breast milk of villagers and cancers and disorders of the reproductive and central nervous systems are very common. A survey of only 123 houses found 49 cancer cases, 43 psychiatric cases, 23 epileptics, 9 with congenital abnormalities and 23 with mental retardation[16].

A case-controlled study comparing 170 children exposed to endosulfan with 92 unexposed children found, among the former, significantly poorer academic performance, elevated prevalence of congenital abnormalities and learning difficulties, delayed puberty in boys, and very high levels of menstrual disorders (see table below)[17].

Romeo Quijano, Professor of Pharmacology and Toxicology (University of Philippines), recently led an investigation of health defects in Kasaragod District and stated that, **"no other reasonable cause can explain the illnesses experienced by the people, except endosulfan."**[18]

Incidence of symptoms linked to endosulfan exposure[17]

Symptom	*Control %*	*Exposed %*
Learning disability	2.6	10.7
Retained in same class	13.5	20.4
Congenital abnormalities	1.09	5.8
Menstrual disorders	4	21.8

© CEDAC

© Mr Shree Padre

© Mr Shree Padre

Clockwise from top: Endosulfan bottle sold in Cambodia but labelled in Thai. **Avinash from Paleppady** in Kerala has cerebral palsy and cannot walk or talk. His village was exposed to aerial spraying of endosulfan for over 15 years. **Mamatha** (18) from Bellur Village in Kasaragod District died in 2001. She lived very close to cashew plantations sprayed with endosulfan and suffered from acute epilepsy and nervous systems problems which prevented her from walking.

threats to the environment

The effects of endosulfan on non-target species can be swift and devastating. Farmers in Benin have observed birds and frogs dying following consumption of insects sprayed with endosulfan[7]. According to one such farmer, "*Fields smell awful two or three days after spraying because virtually every living thing has been killed and starts to rot*"[8].

Endosulfan is also extremely toxic to aquatic life. Research has shown that exposure to endosulfan, even at sublethal doses (50% of LD_{50}), induces behavioural and biochemical changes in fish[19]. Endosulfan runoff from cotton fields killed over 240,000 fish in Alabama (USA) in 1995, despite the pesticide reportedly having been applied according to label instructions[20]. Similarly, mass fish deaths have been reported in India[21], Benin[7], Sudan[9], Germany[22] and Australia[23].

Dr Michael Berrill of Ontario's Trent University recently conducted research into the effects of endosulfan on amphibians[24]. Frogs and toads hatched from eggs exposed to low endosulfan concentrations exhibit a depressed "avoidance behaviour", increasing their likelihood of predation. Tadpoles exposed after hatching experienced elevated mortality, with death being considerably more likely for two-week old tadpoles than those just hatched. Symptoms of sub-lethal poisoning were also observed and included: exhibited hyperactivity, whip-like convulsions, temporary paralysis and slow growth rates. Berrill concluded that the hazard posed by endosulfan is "*sufficiently great to warrant its replacement by less toxic alternatives wherever possible*."[24] In a separate experiment with red-spotted newts, low-concentration exposure to endosulfan impaired the pheromonal system, thereby disrupting mate choice and reducing mating success[25].

© Mr Shree Padre

© LaDon Swann

Top: Deformed cow from area of heavy endosulfan use in Kerala, southern India. Endosulfan residues measured in cow milk and flesh in Kasaragod province were over 100 times the permissible level[26].
Above: Endosulfan has caused mass deaths of fish on five continents.

a persistent problem

Like the widely banned pesticides DDT and dieldrin, endosulfan is an organochlorine and, as such, is persistent in the environment. Endosulfan degrades relatively quickly in water (half life = 2-22 days)[5] but persists longer in soil (half life = 60-800 days)[5], and its major degradation product, endosulfan sulphate, is not only more persistent but is equally toxic[25]. Endosulfan bioaccumulates in humans and other animals (particularly in their liver, kidneys and fatty tissue). Experiments have shown endosulfan to accumulate to 600 times the ambient water concentration in mussels (*Mytilus edulis*)[5].

Such persistent organic pollutants (POPs) are of concern because of their long-term subtle effects on hormones, the immune system, and reproduction. Because of endosulfan's toxicity to fish, Canadian regulations discourage farmers from using endosulfan near open water. However, aerial drifting of the pesticide can leave residues up to three meters beyond the perimeter of sprayed agricultural fields[24]. Ultra low volume endosulfan products were banned in Australia, where spray drift had been resulting in residue problems for the beef industry[2]. Indeed, endosulfan residues led to South Korea's rejection of Australian beef in the past[28]. Similarly, in 1999, the European Union temporarily suspended imports of fish from Tanzania, Uganda and Kenya because of contamination with pesticides, including endosulfan[29].

Given the serious health concerns associated with endosulfan exposure, it is highly worrying that a report by the International Programme on Chemical Safety stated that endosulfan has been shown to persist on the hands of pest control operators for up to 31 days after exposure[22].

recommendations

THE INDICATIONS are that endosulfan poses serious risks to human health, especially under conditions of use in developing countries. Indeed, the chemical has been implicated in scores of cases of accidental death across the globe and long-term exposure has been linked to a range of serious disorders among villagers of southern India.

The pesticide kills indiscriminately, affecting not only pests, but also a range of other harmless or beneficial insects, with similar ramifications for species further up the food chain. Endosulfan's ability to harm is reflected in the death of vertebrate species following consumption of previously exposed insects or exposure to contaminated water. This document is a synthesis of evidence that endosulfan presents *considerable* risk to humans and the environment. In light of this, the Environmental Justice Foundation is making the following recommendations:

- Endosulfan is a highly dangerous, outdated chemical, the safe use of which cannot be guaranteed by many poor countries where it is still used. Governments should ban endosulfan use and Designated National Authorities in countries that are signatories of the Rotterdam Convention should propose the chemical for inclusion in the Convention's Prior Informed Consent procedure.
- Endosulfan is a persistent chemical that has been demonstrated to bio-accumulate in exposed organisms. As such, it should be included on the list of Persistent Organic Pollutants targeted for global elimination by the Stockholm Convention.
- To further promote better practice, the World Health Organisation should: upgrade endosulfan from Class II (moderately hazardous) to Class Ib (highly hazardous), in line with the USA's EPA classification. Such a move would assist countries like Cambodia, which has banned all Class Ia and Ib chemicals, to promote safer agrochemical practices.
- Ultimately, the action most ably protecting human and environmental health would be the withdrawal from sale of endosulfan. This requires the agrochemical industry to rapidly phase out production of endosulfan and to dispose of all stockpiles safely.
- Safe alternatives to endosulfan must be researched, identified and widely promoted. Pesticides Action Network Asia-Pacific lists a number of alternatives to endosulfan use in different agricultural contexts[5]. These include use of botanical pesticides (neem extracts) and parasitic wasps in rice production, and the use of baculoviruses, natural enemies and pheromone traps to control cotton pests.

References

1 www.indiatogether.org/petitions/endosulfan/worldwide.htm
2 Cattle Council of Australia. 2001. Cattle Council welcomes ULV endosulfan ban. Media Release #10/01 [30 March 2001].
3 PRC. 1994. Data sheet on Endosulfan. Philippine Resource Centre, London.
4 Chugh, S. et al. 1998. Endosulfan poisoning in Northern India: a report of 18 cases. *International Journal of Clinical Pharmacology & Therapeutics* 36: 474-477.
5 PANAP, 1996. Endosulfan datasheet. Pesticide Action Network – Asia and the Pacific, Penang, Malaysia.
6 Brandt, V. *et al.* 2001. Exposure to endosulfan in farmers: Two case studies. *American Journal Of Industrial Medicine* 39: 643-649.
7 Ton, P. *et al.* 2000. Endosulfan deaths and poisonings in Benin. *Pesticides News* 47: 12-14.
8 Myers, D. 2000. Cotton Tales. *New Internationalist* 323 [May 2000].
9 Dinham, B. 1993. The pesticide hazard. Zed books, London.
10 PAN-UK. 1991. 31 die from endosulfan poisoning in Sudan. *Pesticides News* 13: 7.
11 PAN-UK. 1995. On/off ban on endosulfan in Colombia. *Pesticides News* 28: 25.
12 Pesticide Action Network North America Updates Service. 1994. International Citizen's Campaign Targets Hoechst Pesticides. *PANUPS* (16 June 1994).
13 EXTOXNET. 1996. Extension Toxicology Network Pesticide Information Profiles: endosulfan [http://ace.orst.edu/cgi-bin/mfs/01/pips/endosulf.htm?8#mfs].
14 Lu, Y. *et al.* 2000. Genotoxic effects of α-endosulfan and β-endosulfan on human HepG2 cells. *Environmental Health Perspectives* 108: 559-561.
15 THANAL. 2001. *Preliminary Findings of the Survey on the Impacts of Aerial Spraying on the People and the Ecosystem.* Thanal Conservation and Information Network, Thiruvananthapuram, India.
16 Joshi, S. 2001. Children of Endosulfan. *Down to Earth* 19: 28 [28 February 2001].
17 Yadav, K. & Jeevan, S. 2002. Endosulfan Conspiracy. *Down to Earth* [15 July 2002] www.cseindia.org/html/endosulfan/endosulfan_index.htm.
18 THANAL. 2002. Experts Confirm Endosulfan Poisoning. Thanal Conservation Action and Information Network, Kerala, India. Press Release [22 January 2002].
19 Abu Zeid, I. et al. 2000. Behavioural and biochemical changes induced in a freshwater catfish, *Clarius garipinus.* Abstract – 4th International Symposium on Fish Endocrinology. Seattle, Washington, USA.
20 PAN-UPS. 1996. Endosulfan responsible for Alabama fish kill. *Pesticide Action Network North America Updates Service.* [23 February 1996].
21 Surendranath, C. 2001. Double trouble. *Down To Earth* 10 [31 October 2001].
22 International Programme on Chemical Safety. 1984. Environmental health criteria 40 – endosulfan. WHO/UNEP/ILO. Geneva, Switzerland.
23 www.mp.wa.gov.au/giz-watson/speeches/fitzroy.html.
24 Raloff, J. 1998. Common pesticide clobbers amphibians. *Science News* 154:150.
25 Park, D. *et al.* 2001. Endosulfan exposure disrupts pheromonal systems in the red-spotted newt: A mechanism for subtle effects of environmental chemicals. *Environmental Health Perspectives* 109: 669-673.
26 Vankar, P. *et al.* 2001. Analysis of samples from Padre village in Kasagarod district of Kerala for endosulfan residues. Pollution Monitoring Laboratory – Pesticide Residue Monitoring Study CSE/PRM-1/2001. Centre for Science and Environment, New Delhi, India.
27 ATSDR. 1993. Toxicological profile for endosulfan. United States Agency for Toxic Substances and Disease Registry, Atlanta, USA.
28 Myers, D. 1999. Endosulfan found in Australian beef. *Pesticides News* 44: 21.
29 European Commission, Directorate-General Health & Consumer Protection, Directorate D – Food And Veterinary Office. 1999. Final report of a mission carried out in Tanzania from the 23rd August to the 25th August 1999 for the objective of assessing the controls on pesticide residues in fish coming from Lake Victoria.

Acknowledgements

This report was written, edited and produced by the **Environmental Justice Foundation Ltd**. Printed on 100% post-consumer waste paper.

Design by **Dan Brown** (dan.brown@ukf.net).

We wish to thank the following individuals and organisations for providing information, ideas, literature and visual material, critical reviews of earlier drafts, or assisting in other ways.

Mr Jayakumar C, Mr Shree Padre, THANAL (India), OBEPAB (Benin), CEDAC (Cambodia), Dr Elizabeth Guillette, LaDon Swann, and Barbara Dinham / Pesticide Action Network UK

In thanking these individuals, we in no way imply that they or their organisations fully endorse the report's content.

More Information

Rotterdam Convention Homepage
www.pic.int

Stockholm Convention Homepage
www.chem.unep.ch/sc/

UNEP Chemicals
www.chem.unep.ch/

World Health Organisation Pesticide Evaluation Scheme
www.who.int/ctd/whopes/

Pesticides Action Network
www.pan-international.org

Environmental Justice Foundation
www.ejfoundation.org

Environmental Justice Foundation is a London-based non-governmental organisation. More information about EJF's work and pdf versions of this and other reports can be found at **www.ejfoundation.org**. Comments on the report, requests for further copies or specific queries about EJF should be directed to info@ejfoundation.org

This document should be cited as:

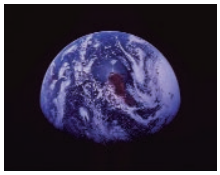
EJF. 2002. *End of the Road for Endosulfan: A Call for Action Against a Dangerous Pesticide.* Environmental Justice Foundation, London, UK.

RELATED EJF PUBLICATIONS

AVAILABLE FROM:
www.ejfoundation.org/reports.html

EJF. 2002. *Death in Small Doses: Cambodia's Pesticide Problems and Solutions.* Environmental Justice Foundation, London, UK.

EJF / CEDAC. 2002. *Bad Medicine: Health Threats Posed by Pesticide Misuse with Special Reference to Cambodia.* Environmental Justice Foundation, London, UK. [publication due Autumn 2002]



Environmental Justice Foundation Ltd
non-profit company no. 03853159

5 St Peter's St, London N1 8JD, UK
tel: 44 (0) 20 7359 0440
fax: 44 (0) 20 7359 7123
info@ejfoundation.org
www.ejfoundation.org