Position Paper of

Pesticide Action Network (PAN) Asia and the Pacific

on Endosulfan

Statement of Concerns

The organochlorine insecticide endosulfan is a highly toxic, ubiquitous environmental pollutant, causing long-term harm to humans and wildlife. It is widely considered to be a Persistent Organic Pollutant (POP), and was included in the initially proposed list of POPs. It is recognised by UNEP to be a Persistent Toxic Substance.

We believe that endosulfan should be the next pesticide added to the POPs schedule for elimination because:

- it is acutely toxic and has poisoned numerous people, livestock and wildlife
- it is an endocrine disruptor and threatens reproductive capacity
- it is volatile and contaminates environments far from where it is used
- it is persistent in the environment, and its main metabolite is even more persistent and bio accumulative and exhibits long range transport across national boundaries.
- effective alternatives are available
- it is already deregistered or banned in many countries.

Considerable damage to human health, wildlife and the environment can be avoided by the world- wide elimination of this outdated and unnecessary chemical.

Endosulfan's Threat to Human Health and the Environment

■ *Acute Toxicity to Humans*

The Intergovernmental Forum on Chemical Safety has identified endosulfan as an acutely toxic pesticide that poses significant public health problems for developing countries/ economies in transition. The U.S. EPA has classified it as Category 1b - highly hazardous. It is readily absorbed by the stomach, lungs and through the skin, and all routes of exposure pose a hazard.

Endosulfan acts primarily on the nervous system, and many cases of poisoning, including fatalities, have been reported - in Benin, Columbia, Costa Rica, Cuba, Guatemala, India, Indonesia, Malaysia, Philippines, South Africa, Sri Lanka, Sudan, Turkey, and USA.

■ *Acute Toxicity to the Environment*

Endosulfan is acutely toxic to wildlife, cats, dogs, honeybees, birds, amphibia, fish and aquatic insects, crustacea, molluscs, alligators, crocodiles, turtles, plankton, soil microorganisms, and arthropods.

It has caused massive fish kills in numerous countries, including Germany, Canada, USA, Sudan, and is implicated in the worldwide decline of amphibians.

■ *Endocrine Disruption*

Endosulfan is known to interfere with hormonal mechanisms at low concentrations, and existing levels of environmental contamination pose a threat to the long-term viability of animal populations, and of chronic illness and death in humans.

Endosulfan exhibits oestrogenic properties, increasing the risk of breast cancer. It also inhibits testicular synthesis of androgens, and alters sex ratios. Impacts on male reproductive health include reduce sperm quality and count, testicular damage, delayed sexual maturity.

■ *Other chronic effects*

In laboratory studies, endosulfan damages red blood cells, thyroid, kidneys and the developing foetus. It is hepatotoxic, genotoxic, mutagenic, clastogenic, a tumour promoter, and inhibits immune function. It has produced malignant neoplasms and lymphosarcomas in rats. Behaviour and neurological changes have been observed.

Endosulfan has resulted in congenital birth defects, reproductive health problems, cancers, loss of immunity, neurological and neurobehavioural problems amongst exposed villagers in Kerala, India.

Limb deformities have been seen in salamander larvae.

■ *Persistence*

Endosulfan is volatile and persistent and there is evidence of widespread environmental and food chain contamination around the world.

The half-life of endosulfan in soil varies from 60 days (alpha-endosulfan) to 800 days (beta-endosulfan), with persistence increased by acidic conditions.

The half-life in water varies from 35-150 days.

Endosulfan sulphate is the main degradation product. It is as toxic as the parent compound but of greater persistence.

Residues of endosulfan have been detected in the environment in areas far distant from where it has been used: in Arctic air, lichen, snow-water and lake-waters, rainfall and snow samples in Californian mountains, and remote European mountain lakes.

Residues have also been found in air, rain, lakes, rivers, stream sediments, groundwater, well water, spring water, municipal water supplies, marine water and sediment, lagoons, estuarine and river sediment, soil, tree bark, aquatic plants and other biota. It has been found in Argentina, Australia, Azerbaijan**,** Benin, Chile, China, Columbia, Costa Rica, Europe, Ghana, Greenland, Guatemala, Honduras, Hong Kong, India, Israel, Jamaica, Madagascar, Malawi, Malaysia, Mexico, Nigeria, North America, Pakistan, South Africa, Spain, Sudan, and Zambia.

Residues have also been found in food around the world, including Australia, Benin, Brazil, Colombia, Côte d'Ivoire, Croatia, Cyprus, Canada, Finland, India, Italy, Kenya, Kuwait, Madagascar, New Zealand, Nigeria, South Africa, Tanzania, Uganda, USA. They were found in dairy foods, meat, chicken, vegetable oil, peanuts, seeds and many different vegetables.

■ *Bioaccumulation*

The U.S. EPA considers endosulfan as having a high potential to bioaccumulate in fish, and hence may affect animals higher up the food chain. It has been found in trout from lakes in North America; and the European Union has banned importation of fish from Tanzania, Uganda and Kenya due to high levels of endosulfan.

Residues have been detected in human umbilical cord blood, placental tissue, breast milk, fat, blood and urine - in Colombia, Croatia, Egypt, India, Indonesia, Japan, Nicaragua, Pakistan, Spain, and Sub Saharan Africa.

■ ***Regulatory status***

Many countries have already banned or restricted the use of endosulfan because of human health and environmental impacts.

Endosulfan is banned in Bahrain, Belize, Cambodia, Columbia, Germany, Kuwait, Netherlands, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, St Lucia, Sri Lanka, Sweden, Syria, Tonga, United Arab Emirates.

It is restricted in Australia, Bangladesh, Canada, Denmark, Dominican Republic, Finland, Honduras, Iceland, Indonesia, Iran, Japan, Korea, Kazakhstan, Lithuania, Norway, Panama, Russia, Serbia & Montenegro, Thailand, Taiwan, USA, UK, Venezuela.

In the UNEP-GEF Regional-based Assessment of Persistent Toxic Substances (PTS), it is rated as follows:

- Indian Ocean region - "regional concern"
- North American region - "regionally specific PTS"
- Mediterranean region - "local concern"
- Sub Saharan Africa - PTS of highest concern after DDT
- E&W South American - emerging concern
- European region - proposed possible priority hazardous substance
- SE Asia and S Pacific region - regional concern, with long-term effect on the structure of the aquatic ecosystem
- Central America and Caribbean - one of the most important PTS of emerging concern.

In summary, endosulfan is recognised as being unacceptably hazardous to human health and the environment in many regions of the world. Its continuing use in other regions jeopardises wildlife populations, environmental integrity and human health everywhere because of its volatility, which enables it to spread around the globe, and its persistence. It is a leading cause of poisonings from pesticides, and in some communities has left a legacy of deformity and malfunction. It is a pesticide that is no longer needed for there are acceptable alternatives for all current uses.

Endosulfan Poisoning in Kasargod, Kerala, India

More then twenty years of aerial spraying of endosulfan for cashew nut production, in the government owned Plantation Corporation of Kerala, has been linked to massive health problems—from horrendous birth defects to cancers and deaths—in the communities around Kasargod District, Kerala. People residing in the villages within the plantation have been afflicted with different kinds of illnesses which, according to the villagers, were not present before the cashew nut plantation started their operations. People also noticed the death of fishes, honeybees, frogs, birds, chicken and even cows. Through the commitment and tenacity of the villagers, local journalists, doctors and the support of THANAL (Thanal Conservation Action & Information Network) and the Delhi based Center for Science and Environment (CSE) the case gained greater notoriety.

Between January 18-22, 2002, PAN AP organised a fact-finding mission led by Dr. Romeo Quijano, Professor in the Department of Pharmacology and Toxicology, at the College of Medicine, University of the Philippines Manila. THANAL had requested PAN AP to provide technical expertise in order to obtain a more scientific validation of the poisoning cases in Kerala.

Summary findings from the Fact Finding Mission and Report undertaken by Dr. Romeo F. Quijano, facilitated by Pesticide Action Network Asia and the Pacific.

■ The illnesses observed are to be expected from the known intrinsic toxicologic properties of endosulfan. The preponderance of neurologic and mental illnesses among the reported health problems is compatible with the fact that endosulfan is a known neurotoxicant, belonging to a group of highly toxic organochlorine chemicals. Endosulfan blocks the inhibitory receptors of the central nervous system, disrupts the ionic channels, and destroys the integrity of the nerve cells. Acute toxic effects include dizziness and vomiting, hyperactivity, tremors, lack of coordination, and convulsions. Chronic exposure may result in permanent damage to the nervous system which may manifest in various kinds of neurologic diseases. Apart from its capacity to directly damage the nervous system, endosulfan is also an endocrine disruptor. Even low levels of exposure during pregnancy could result in various forms of endocrine disrupting effects in the offspring, including mental retardation, reproductive organ anomalies, developmental disorders, behavioral disorders later in life, and many others.

■ There is no evidence that other environmental toxicants that might possibly explain the observed health problems are present in the affected areas. There has been no other pesticide, not even household pesticides, that has been used except endosulfan. There are no industrial activities at or near the areas affected which might indicate possible contamination by industrial pollutants, like lead, mercury, cadmium, polyaromatic hydrocarbons, etc.; that might confound the causation of the health problems in the affected areas. Furthermore, the villages affected were too far away from the nearest city where pollution by other toxicants might possibly occur. Ionizing radiation is also an unlikely cause since there is no identifiable source.

■ There is clear time and geographic association between the occurrence of the health problems and the aerial spraying of endosulfan. The people's claim that the health problems occurred and gradually accumulated during the period of aerial spraying of endosulfan has not been disputed. Cases of cancer, developmental anomalies, reproductive disorders, neurologic diseases, and the other serious illnesses were practically non-existent before the advent of endosulfan aerial spraying.

■ There is corroborating evidence of adverse effects on animals and the environment which are attributable to endosulfan. The reports on fish kills and dwindling population of honeybees, frogs, birds, and other animals soon after the aerial spraying of endosulfan started have not been disputed. Cows and chicken were also observed to die of mysterious causes. People were also complaining that their domestic animals had suffered miscarriages, bleeding, infertility, stunting of growth and deformities. These effects can be expected as a result of exposure to endosulfan.

■ People's experiences and testimonies from the affected villages had indicated that endosulfan was causing health and environmental problems. The people in the affected villages had been seeing the increased incidence of diseases and environmental problems only since the plantation started its operations. Many other villages in Kasargod have also reported such health problems at various times during the years of endosulfan aerial spraying.

Stop Endosulfan!

On the occasion of the First Meeting of the Conference of the Parties of the Stockholm Convention Punta del Este, Uruguay, 2 - 6 May 2005, PAN Asia and the Pacific urgess:

- **The authorities in all countries ban the use of endosulfan**
- **Governments attending the Uruguay Conference of the Parties of the Stockholm Convention add endosulfan to the POPs schedule for worldwide elimination**
- **The Government of India stops all use of Endosulfan in the country, and take full responsibility and assume liability for the severe health effects on the Kasargod communities badly effected by endosulfan used in the government owned Plantation Corporation of Kerala (PCK).**

- **All producers of endosulfan stop production of this highly persistent and hazardous pesticide**
- **Endosulfan be replaced with safer and more sustainable pest control methods**

Pesticide Action Network (PAN) Asia and the Pacific
P.O. Box 1170,10850 Penang, Malaysia
Tel: 604-6570271/6560381 Fax: 604-6583960
Email: panap@panap.net
Web: www.panap.net

References and Sources of information:

Arumugam V. 1992. *Victims without voice: a study of women pesticide workers in Malaysia*. Kelang (Malaysia): Tenaganita, and Penang: Pesticide Action Network Asia and the Pacific.

Bhattacharya B, Sarkar SK, Mukherjee N. 2003. Organochlorine pesticide residues in sediments of a tropical mangrove estuary, India: implications for monitoring. *Environ Int* 29(5):587-92.

Botella B, Crespo J, Rivas A, Cerrillo I, Olea-Serrano MF, Olea N. 2004. Exposure of women to organochlorine pesticides in Southern Spain. *Environ Res* 96(1):34-40.

Broomhall S, Shine R. 2003. Effects of the insecticide endosulfan and presence of congeneric tadpoles on Australian treefrog (Litoria freycineti) tadpoles. *Arch Environ Contam Toxicol* 45(2):221-6.

Burke ER, Holden AJ, Shaw IC. 2003. A method to determine residue levels of persistent organochlorine pesticides in human milk from Indonesian women. *Chemosphere* 50(4):529-35.

Carlson DL, Basu I, Hites RA. 2004. Annual variations of pesticide concentrations in Great Lakes precipitation. *Environ Sci Technol* 38(20):5290-6.

Cerrillo I, Granada A, Lopez-Espinosa MJ, Olmos B, Jimenez M, Cano A, Olea N, Fatima Olea-Serrano M. 2005. Endosulfan and its metabolites in fertile women, placenta, cord blood, and human milk. *Environ Res* 98(2):233-9.

Choudhary N, Sharma M, Verma P, Joshi SC. 2003. Hepato and nephrotoxicity in rat exposed to endosulfan. *J Environ Biol* 24(3):305-8.

Dalvie MA, Cairncross E, Solomon A, London L. 2003. Contamination of rural surface and ground water by endosulfan in farming areas of the Western Cape, South Africa. *Environ Health* 2(1):1.

Dewan A, Bhatnagar VK, Mathur ML, Chakma T, Kashyap R, Sadhu HG, Sinha SN, Saiyed HN. 2004. Repeated episodes of endosulfan poisoning. *J Toxicol Clin Toxicol* 42(4):363-9.

ESR. 2004. 2003/4 New Zealand Total Diet Survey Analytical Results - Q1,2,3,4. Institute of Environmental Science & Research. Christchurch.

Fatoki OS, Awofolu OR. 2004. Levels of organochlorine pesticide residues in marine-, surface-, ground- and drinking waters from the Eastern Cape Province of South Africa. *J Environ Sci Health B* 39(1):101-14.

Fukata H, Omori M, Osada H, Todaka E, Mori C. 2005. Necessity to Measure PCBs and Organochlorine Pesticide Concentrations in Human Umbilical Cords for Fetal Exposure Assessment. *Environ Health Perspect* 113:297-303.

Garg UK, Pal AK, Jha GJ, Jadhao SB. 2004. Haemato-biochemical and immuno-pathophysiological effects of chronic toxicity with synthetic pyrethroid, organophosphate and chlorinated pesticides in broiler chicks. *Int Immunopharmacol* 4 (13):1709-22.

Golfinopoulos SK, Nikolaou AD, Kostopoulou MN, Xilourgidis NK, Vagi MC, Lekkas DT. 2003. Organochlorine pesticides in the surface waters of Northern Greece. *Chemosphere* 50(4):507-16.
Gonzalez M, Miglioranza KS, Aizpun De Moreno JE, Moreno VJ. 2003. Organochlorine pesticide residues in leek (Allium porrum) crops grown on untreated soils from an agricultural environment. *J Agric Food Chem* 51(17):5024-9.

Grunfeld HT, Bonefeld-Jorgensen EC. 2004. Effect of in vitro estrogenic pesticides on human oestrogen receptor alpha and beta mRNA levels. *Toxicol Lett* 1;151(3):467-80.

Harikrishnan V, Usha S. 2004. Endosulfan. Fact Sheet & Answers to common questions. Thanal, Thiruvananthapuram. http://thanaluser.web.aplus.net/sitebuildercontent/sitebuilderfiles/endosulfan_factsheet.pdf Accessed April 27, 2005.

Hernandez-Romero AH, Tovilla-Hernandez C, Malo EA, Bello-Mendoza R. 2004. Water quality and presence of pesticides in a tropical coastal wetland in southern Mexico. *Mar Pollut Bull* 48 (11-12):1130-41.

Hoh E, Hites RA. 2004. Sources of toxaphene and other organochlorine pesticides in North America as determined by air measurements and potential source contribution function analyses. *Environ Sci Technol* 38(15):4187-94.

Ibarluzea Jm J, Fernandez MF, Santa-Marina L, Olea-Serrano MF, Rivas AM, Aurrekoetxea JJ, Exposito J, Lorenzo M, Torne P, Villalobos M, Pedraza V, Sasco AJ, Olea N. 2004. Breast cancer risk and the combined effect of environmental estrogens. *Cancer Causes Control* 15(6):591-600.

IFCS Forum Standing Committee Working Group. 2003. Acutely Toxic Pesticides Initial Input on Extent of Problem and Guidance for Risk Management. Forum IV Fourth Session of the Intergovernmental Forum on Chemical Safety, Bangkok, Thailand
1 – 7 November 2003.

Jamil K, Shaik AP, Mahboob M, Krishna D. 2004. Effect of organophosphorus and organochlorine pesticides (monochrotophos, chlorpyriphos, dimethoate, and endosulfan) on human lymphocytes in-vitro. *Drug Chem Toxicol* 27 (2):133-44.

Je KH, Kim KN, Nam KW, Cho MH, Mar W. 2005. TERT mRNA expression is up-regulated in MCF-7 cells and a mouse mammary organ culture (MMOC) system by endosulfan treatment. *Arch Pharm Res* 28(3):351-7.

Jergentz S, Mugni H, Bonetto C, Schulz R. 2004. Runoff-related endosulfan contamination and aquatic macroinvertebrate response in rural basins near Buenos Aires, Argentina. *Arch Environ Contam Toxicol* 46(3):345-52.

Kishi M. 2002. Initial Summary of the Main Factors Contributing to Incidents of Acute Pesticide Poisoning. Report to IFCS Forum Standing Committee Working Group.

Kuang Z, McConnell LL, Torrents A, Meritt D, Tobash S. 2003. Atmospheric deposition of pesticides to an agricultural watershed of the Chesapeake Bay. *J Environ Qual* 32(5):1611-22.

Louie PK, Sin DW. 2003. A preliminary investigation of persistent organic pollutants in ambient air in Hong Kong. *Chemosphere* 52(9):1397-403.

Miglioranza KS, Aizpun de Moreno JE, Moreno VJ. 2004a. Land-based sources of marine pollution: organochlorine pesticides in stream systems. *Environ Sci Pollut Res Int* 11(4):227-32.

Miglioranza KS, de Moreno JE, Moreno VJ. 2004b. Organochlorine pesticides sequestered in the aquatic macrophyte Schoenoplectus californicus (C.A. Meyer) Sojak from a shallow lake in Argentina. *Water Res* 38(7):1765-72.

Muir DC, Teixeira C, Wania F. 2004. Empirical and modeling evidence of regional atmospheric transport of current-use pesticides. *Environ Toxicol Chem* 23(10):2421-32.

Oktay C, Goksu E, Bozdemir N, Soyuncu S. 2003. Unintentional toxicity due to endosulfan: a case report of two patients and characteristics of endosulfan toxicity. *Vet Hum Toxicol* 45(6):318-20.

PANAP. 1996. Endosulfan. Pesticide Action Network Asia and the Pacific, Penang.

Pfeuffer RJ, Rand GM. 2004. South Florida ambient pesticide monitoring program. *Ecotoxicology* 13(3):195-205.

Pistl J, Kovalkovicova N, Holovska V, Legath J, Mikula I. 2003. Determination of the immunotoxic potential of pesticides on functional activity of sheep leukocytes in vitro. *Toxicology* 188(1):73-81.

Pozo K, Harner T, Shoeib M, Urrutia R, Barra R, Parra O, Focardi S. 2004. Passive-sampler derived air concentrations of persistent organic pollutants on a north-south transect in Chile. *Environ Sci Technol* 38(24):6529-37.

Qiu X, Zhu T, Li J, Pan H, Li Q, Miao G, Gong J. 2004. Organochlorine pesticides in the air around the Taihu Lake, China. *Environ Sci Technol* 38(5):1368-74.

Quaghebeur D, De Smet B, De Wulf E, Steurbaut W. 2004. Pesticides in rainwater in Flanders, Belgium: results from the monitoring program 1997-2001. *J Environ Monit* 6(3):182-90.

Quijano RF. 2002. Endosulfan Poisoning in Kasargod, Kerala, India: Report on a Fact-Finding Mission. Pesticide Action Network Asia and the Pacific, Penang.

Roberts DM, Karunarathna A, Buckley NA, Manuweera G, Sheriff MH, Eddleston M. 2003. Influence of pesticide regulation on acute poisoning deaths in Sri Lanka. *Bull World Health Organ* 81(11):789-98.

Rohr JR, Elskus AA, Shepherd BS, Crowley PH, McCarthy TM, Niedzwiecki JH, Sager T, Sih A, Palmer BD. 2003. Lethal and sublethal effects of atrazine, carbaryl, endosulfan, and octylphenol on the streamside salamander (Ambystoma barbouri). *Environ Toxicol Chem* 22(10):2385-92.

Saiyed H, Dewan A, Bhatnagar V, Shenoy U, Shenoy R, Rajmohan H, Patel K, Kashyap R, Kulkarni P, Rajan B, Lakkad B. 2003. Effect of endosulfan on male reproductive development. *Environ Health Perspect* 111(16):1958-62.

Sanghi R, Pillai MK, Jayalekshmi TR, Nair A. 2003. Organochlorine and organophosphorus pesticide residues in breast milk from Bhopal, Madhya Pradesh, India. *Hum Exp Toxicol* 22(2):73-6.

Schulz R. 2004. Field studies on exposure, effects, and risk mitigation of aquatic nonpoint-source insecticide pollution: a review. *J Environ Qual* 33(2):419-48.

Shen L, Wania F, Lei YD, Teixeira C, Muir DC, Bidleman TF. 2005. Atmospheric distribution and long-range transport behavior of organochlorine pesticides in North America. Environ Sci Technol 39(2):409-20.

Sutherland TD, Home I, Weir KM, Russell RJ, Oakeshott JG. 2004. Toxicity and residues of endosulfan isomers. *Rev Environ Contam Toxicol* 183:99-113.

Swartz CD, Donnelly KC, Islamzadeh A, Rowe GT, Rogers WJ, Palatnikov GM, Mekhtiev AA, Kasimov R, McDonald TJ, Wickliffe JK, Presley BJ, Bickham JW. 2003. Chemical contaminants and their effects in fish and wildlife from the industrial zone of Sumgayit, Republic of Azerbaijan. *Ecotoxicology* 12(6):509-21.

Tariq MI, Afzal S, Hussain I. 2004. Pesticides in shallow groundwater of Bahawalnagar, Muzafargarh, D.G. Khan and Rajan Pur districts of Punjab, Pakistan. *Environ Int* (4):471-9.

Teather K, Jardine C, Gormley K. 2005. Behavioral and sex ratio modification of Japanese medaka (Oryzias latipes) in response to environmentally relevant mixtures of three pesticides. *Environ Toxicol* 20(1):110-7.

van Drooge BL, Grimalt JO, Camarero L, Catalan J, Stuchlik E, Torres Garcia CJ. 2004. Atmospheric semivolatile organochlorine compounds in European high-mountain areas (central Pyrenees and high Tatras). *Environ Sci Technol* 38 (13):3525-32.

Vorkamp K, Riget F, Glasius M, Pecseli M, Lebeuf M, Muir D. 2004. Chlorobenzenes, chlorinated pesticides, coplanar chlorobiphenyls and other organochlorine compounds in Greenland biota. *Sci Total Environ* 331(1-3):157-75.

Wozniak AL, Bulayeva NN, Watson CS. 2005. Xenoestrogens at picomolar to nanomolar concentrations trigger membrane estrogen receptor-alpha-mediated Ca2+ fluxes and prolactin release in GH3/B6 pituitary tumor cells. *Environ Health Perspect* 113(4):431-9.

Zhang ZL, Hong HS, Zhou JL, Huang J, Yu G. 2003a. Fate and assessment of persistent organic pollutants in water and sediment from Minjiang River Estuary, Southeast China. *Chemosphere* 52(9):1423-30.

Zhang Z, Hong H, Cheng W, Wang X, Lin J, Yu G. 2003b. Contents of organochlorine pesticides in water, pore water and sediment in Minjiang River Estuary of China. *Huan Jing Ke Xue* 24(1):117-20.

Zhang Z, Huang J, Yu G, Hong H. 2004. Occurrence of PAHs, PCBs and organochlorine pesticides in the Tonghui River of Beijing, China. *Environ Pollut* 130(2):249-61.